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REPORT

June 2019

Final Report – 2018 Municipal Vulnerability Preparedness (MVP) Action Grant

Prepared for:

CITY OF
Peabody
MASSACHUSETTS

Funded by:

MASSACHUSETTS EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS (MASSEEA)

MUNICIPAL VULNERABILITY
PREPAREDNESS (MVP) ACTION GRANT

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EXECUTIVE SUMMARY

In 2018, the City of Peabody (the City) was awarded a Municipal Vulnerability Preparedness (MVP) Action Grant by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA). The MVP grant allowed the City to explore options for improving the flood resiliency of Peabody Square and was awarded based on a comprehensive project proposal to specifically target a stretch of the North River Canal that will improve flood resilience, address site contamination from historic use as a tannery district and evaluate a park resource and Riverwalk that would enhance public access and vitality of the area.

The proposed Riverwalk will be approximately 1,600 feet in length, following along the canal in the urban industrial section of downtown Peabody from approximately Wallis Street to Howley Street. The existing wall on the south side of the canal over the length of the proposed Riverwalk varies drastically in condition from good to poor.

Weston & Sampson, on behalf of the City, performed engineering and design services to support the City of Peabody's grant award from the Commonwealth of Massachusetts under its MVP Action Grant Program. Activities included: 1) the preparation of a resiliency evaluation to determine how best to accommodate flood waters along the banks of the canal; 2) subsurface explorations immediately behind the Canal wall to obtain back of existing wall information, including wall type, dimensions, and subsurface conditions. Using that information, Weston & Sampson performed a preliminary geotechnical and structural analyses to evaluate replacement design alternatives. Investigation activities also included limited environmental sampling activities to better understand potential regulatory obligations under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000.

Weston & Sampson developed five (5) design replacement alternatives for the south canal wall to support the construction of a Riverwalk and improve flood resilience along the North River Canal. Wall alternatives included options for replacing the current wall with a new wall, as well as green options like providing protection with an earthen berm. Preliminary engineering cost estimates for each alternative were also provided. Weston & Sampson then conducted a preliminary analysis to evaluate the alternatives based on factors such as resiliency, anticipated durability, environmental impact, permitting, schedule, and costs. This was used to rank and prioritize alternatives for the wall.

Based upon the findings and comparative evaluations, Alternative C – Sheet Pile Option 2 with Sloped Bank ranked as the highest scoring alternative. This alternative would provide the most additional flood storage with relatively low total cost and minimal maintenance when compared to other alternatives, requires a reasonable easement width from private property owners, does not require any material to be dredged from the canal, and had the highest total permitting favorability. However, while this alternative works from a conceptual engineering and permitting evaluation perspective, it may not be feasible along the entire length of the wall due to existing structures and grade, and it may require a limited length of one of the other wall alternatives to be considered. The feasibility in such areas was further evaluated during the preliminary design process and may depend on other factors such as final property easements or acquisition potential.

A 25% preliminary design of the preferred wall alternative and a 25% preliminary design of the conceptual Riverwalk were generated as part of the project. A public meeting was held on May 30, 2019 to present the findings of the wall alternative evaluation and the 25% preliminary designs for the south wall and proposed Riverwalk. The project was received favorably by the public. The City has applied to EEA for additional grant assistance to further progress the project through 75% design and permitting.

1.0 INTRODUCTION

1.1 Project Overview

The City of Peabody suffers from recurring flooding which is expected to worsen from climate change, including sea level rise and increased precipitation frequency and intensity. In 2018, the City of Peabody (the City) was awarded a Municipal Vulnerability Preparedness (MVP) Action Grant by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA). The MVP grant allowed the City to explore options for improving flood resilience and evaluate a proposed Riverwalk and park resource that would enhance public access and vitality of the area. The North River Canal is a channeled and walled reach of the North River connecting Peabody Square to the tidal reach of the North River near the Salem-Peabody municipal boundary. The North River drainage basin discharges into Salem Sound

The proposed Riverwalk will be approximately 1,600 feet in length, following along the canal in the urban industrial section of downtown Peabody from approximately Wallis Street to Howley Street. The south side of the canal abuts six (6) privately owned properties (from west to east: 13 Wallis Street, 24 Caller Street, [Caller Street crossing], 21 Caller Street, 18 Howley Street, 166R Main Street, and Massachusetts Bay Transit Authority (MBTA) property). The existing wall on the south side of the canal over the length of the proposed Riverwalk varies drastically in condition from good to poor. In 2017, Weston & Sampson concluded that prior to the construction of the Riverwalk, the south canal wall would need to be repaired/replaced to support the construction of the proposed Riverwalk.

The following chapters of this report summarize the activities conducted as part of the City's 2018 MVP grant and the deliverables that were generated for each major engineering/design task. Copies of the complete reports and design plans are provided in the appendices. Each chapter also provides a summary section and future considerations associated with the major engineering and/or design service tasks:

- Resilience Evaluation
- Preliminary Engineering and Design Alternative Analysis
  - Geotechnical Evaluation
  - Environmental Evaluation
  - Structural Evaluation
  - Permitting Strategy
- 25% Preliminary Design – South Wall
- 25% Preliminary Design – Riverwalk
- Community Engagement
- Project Management of the Grant

The recommendations presented in this report are based on Weston & Sampson's understanding of the proposed project as described herein, subsurface conditions encountered at discrete exploration locations, and the provisions of the Limitations, provided in Section 9 of this report. Additional investigations, testing, and recommendations will be necessary for final design.

1.2 Project Understanding

The project site is in an urban industrial area of Peabody, between Wallis and Howley Streets, and crosses Caller Street, as shown in ***Figure 1 – Site Locus***. Refer to ***Figure 1*** and ***Figure 2 – Site Plan*** for the property limits, and ***Table 1 – Summary of Existing Conditions*** for a summary of existing conditions within the project area. Construction of the park and Riverwalk will require property acquisition or easements on these private properties.

The North River Canal has a history of flooding. The overall goal of the MVP grant project is to evaluate and incorporate resilient design measures to provide flood protection during storm events, which may include floodwater storage, increased canal wall height, and/or widening of the canal.

2.0 DESCRIPTION OF EXISTING SITE CONDITIONS

2.1 Existing Wall Structure

The south canal wall along the length of the project limits consists of multiple sections including earthen embankment (or possible buried wall), a stacked timber railroad tie structure behind an earth embankment, reinforced concrete, granite blocks, or stone or stone rubble sections. Wall heights range from about 4 to 6 feet above the canal bottom. The wall's condition varies over its length, ranging from good, in need of minor or no repairs, to poor, requiring full or partial reconstruction. A copy of Weston & Sampson's report titled "*Riverwalk along North River Corridor – South Wall Evaluation,*" dated June 2, 2017, is provided in *Appendix A* and provides a detailed description of the existing wall types and conditions along the project alignment.

In the report, Weston & Sampson recommended repair or replacement to sections of the wall for support of new loads associated with the proposed Riverwalk. The visual inspection performed on the south wall of the North River Corridor revealed that the wall's condition varies drastically over its length. Conditions range from "good," which need minor or no repairs, to "poor," which require full or partial reconstruction. Causes of deterioration include waterflow, overgrown vegetation (roots), and changes in the surrounding land conditions due to lack of maintenance. Materials used in construction of the wall vary along the wall's length and include earth embankment or buried wall, a timber tie structure behind earth embankment, reinforced concrete, granite blocks, and stone or stone rubble.

2.2 Existing Soil Contamination

There is known or suspected soil contamination along the proposed Riverwalk area that will need to be addressed as part of proposed wall repair activities and construction of the Riverwalk. Most of the area was formerly a tannery and it has known and potential environmental impacts. Weston & Sampson, on behalf of the City, conducted limited subsurface environmental assessments at several of the properties within the proposed Riverwalk area in 2017. Copies of the reports are provided in Appendix B - Engineering Evaluation & Design Alterative Analysis. Additional information regarding known, existing current environmental conditions and recommendations to comply with the requirements of the Massachusetts Contingency Plan (MCP) are also provided in Appendix B.

2.3 Existing Flood Issues

The City of Peabody has suffered from recurring flooding events since the 1950s, with the most significant flooding occurring downtown in Peabody Square. Significant floods occurred in 1954, 1968, 1979, 1987, 1996, and 2006. In the past, flooding was largely attributed to post-WWII development and decreased discharge capacity of watercourses in downtown Peabody. However, flooding events have become more frequent with climate change. As noted in the 2008 Preliminary Design of Flood Mitigation Facilities for Peabody Square Area Report, developed for the City, Peabody experienced flooding in October 1996, June 1998, March 2001, April 2004, and May 2006. Three of these events were declared Federal Disasters and caused significant impacts to public safety and public health, substantial property damage, and widespread economic losses. Major transportation arterials that connect to I-95 and MA Routes 128 and 114 as well as commercial rail service were closed for several days. The May 2006 event alone caused the following significant impacts:

- The City's main fire station and police department were isolated by floodwaters for several days. FEMA estimated the cost of this impact at $1.4 million.
- Emergency responses during the flooding cost the City approximately $360,000.
- FEMA estimated the loss of associated with road closures, delays, and detours cost $4.2 million.
- FEMA insurance claims were paid to home and business owners to a total of more than $4.6 million.

The City also experienced significant flooding in March 2010, October 2011, and December 2014 from short duration and intense rain events.

Flooding in the project area is largely due to high flows in the North River Canal caused by precipitation in the upgradient watersheds of Procter Brook, Goldthwaite Brook, and the North River (Metcalf & Eddy-AECOM, 2008). Precipitation events are projected to be more extreme due to climate change, which would exacerbate riverine flooding in the project area. Currently, tidal influences at Mean Higher High Water (MHHW) extend approximately 230 feet upstream of Howley Street (Metcalf & Eddy-AECOM, 2008). Sea level rise is expected to extend tidal influences further upstream into the project area. The flood events negatively impact area businesses and make it difficult for Fire and Police Department staff to respond to emergencies.

3.0 RESILIENCE EVALUATION

3.1 Introduction

To address the City's priority action of addressing flooding along the North River Canal and to enable the City to address climate change and continue its efforts to increase resilience against flooding in the watershed, Weston & Sampson conducted an evaluation of the floodplain along the proposed 1,600-foot-long park adjacent to the canal. The evaluation assessed the suitability and potential benefit of incorporating additional flood storage capacity in both the rehabilitation alternatives for the southern canal wall as well as on nearby public and private properties. This evaluation considered both existing and future potential climate conditions. In general, increasing flood storage has the potential to reduce peak flood levels, thereby decreasing potential damage downstream and, to a lesser degree, upstream of the storage site.

3.2 Resilience Evaluation

Weston & Sampson collaborated with both the City of Peabody and the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), the funding agency, to identify a suitable range of design events that considered both existing and potential future climate scenarios. The selection process also included significant research into regional and local evaluations of the potential impact of climate change, including but not limited to the following reports and datasets:

- Boston Research Advisory Group (BRAG), 2016. Climate Change and Sea Level Rise Projections for Boston – Boston Research Advisory Group Report, prepared for Climate Ready Boston, June 1, 2016.
- City of Cambridge, 2015. Climate Change Vulnerability Assessment (CCVA), Part 1 Appendix: Climate Projections & Scenario Development, November 2015.
- Massachusetts Coastal Zone Management, 2013. Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning.
- Northeast Climate Science Center (NECSC), 2018. Massachusetts Climate Change Projections, March 2018.

Based on our research, Weston & Sampson selected two (2) current climate scenarios and four (4) potential future climate scenarios to represent a likely range of flooding conditions. Weston & Sampson worked with the City of Peabody to select four (4) future climate scenarios that represent a likely range of potential future flooding conditions. Flood levels were defined for all six (6) scenarios by considering rainfall-driven runoff from the North River watershed as well as tidal influences and projected sea level rise. The extents of future tidal flooding were estimated by adding the predicted change to mean sea level under each scenario to the baseline Mean Higher High-Water elevation estimated for Beverly Harbor.

Weston & Sampson evaluated future increases in flood levels in the upper portions of the canal that are not tidally influenced by identifying the likely range of increased precipitation frequency and duration and relating that increased precipitation to changes in total discharge during large flood events. Weston & Sampson developed a rating curve from data within the FEMA Flood Insurance Study that relates

those increases in total discharge to estimated increases in flood stage. In this manner, Weston & Sampson developed estimated flood levels throughout the project site under future climate conditions.

Finally, based on our identification of existing and future flood levels, Weston & Sampson conducted a geographic information system (GIS) analyses to evaluate where potential flood storage areas exist. The GIS analyses were conducted on the latest LiDAR elevation data for the project site, which includes "2011 LiDAR for the Northeast" and "2013-2014 Sandy" datasets. Possible flood storage areas include the park along the canal located at 45 Walnut Street and large underutilized parcels such as 24 Caller Street, 13 Wallis Street, and 166R Main Street. Based on these LiDAR datasets and on the identified flood levels, Weston & Sampson produced a series of maps that highlight anticipated inundation extents throughout the project area under a variety of flooding and climate conditions. The location of available open spaces, such as 24 Caller Street, were also compared against the projected inundation extents to evaluate whether conditions exist for the creation of storage in the North River Canal system.

A copy of the Resilience Evaluation Report is provided in Appendix C.

3.3 Summary and Future Considerations

Based on our resilience evaluation, Weston & Sampson identified the following:

- Under existing climate conditions and under expected mid-century (2050) conditions, flooding in the North River Canal will largely be a function of runoff generated upstream (i.e., riverine flooding). However, by the end of the 21st century, tidal flooding due to sea level rise is expected to equal or exceed riverine flooding in the project area. The creation of additional flood storage may provide a modest benefit to the properties and infrastructure in the study area in the existing- and mid-century timeframe, but those benefits are significantly reduced over the long term by the end of the century (2100).

- The creation of additional flood storage in and/or near the North River Canal is only effective in areas of riverine flooding. Projects that create compensatory storage and projects that floodproof flood prone properties will have a greater and longer lasting benefit the further upstream they are.

In addition, the City may want to consider the following to further address climate change and continue its efforts to increase resilience against flooding in the watershed:

- An assessment of potential parcel-specific compensatory storage and flood control design options.

- A ost-benefit analysis of floodproofing individual buildings rather than eliminating flooding on a parcel scale.

- A more detailed evaluation of "retreat" alternatives and the potential benefit of a tide gate to limit tidal flooding under future climate conditions. While the potential benefits of a tide gate were not specifically considered as part of this project, a tide gate could be used to reduce flooding and improve resiliency in the North River area, but would likely need to be constructed at or near the North Street (Rte. 114) crossing in Salem, beyond Peabody's municipal boundary.

4.0 ENGINEERING EVALUATION & DESIGN ALTERATIVE ANALYSIS & PERMITTING STRATEGY

4.1 Introduction

This section of the report presents the results of Weston & Sampson's geotechnical and structural feasibility studies that were conducted in the target area along the North River Canal as part of MVP Grant activities. The purpose of the engineering evaluation was to preliminarily explore subsurface conditions and assess geotechnical, environmental, structural, and regulatory permitting considerations for repair/replacement alternatives for the North River Canal south wall to support the proposed Riverwalk.

The existing wall on the south side of the canal over the length of the proposed Riverwalk varies drastically in condition from good to poor. In 2017, Weston & Sampson concluded that prior to the construction of the Riverwalk, the south canal wall would need to be repaired/replaced to support the construction of the proposed Riverwalk.

Weston & Sampson, on behalf of the City, performed subsurface explorations immediately behind the Canal wall to obtain existing wall information, including wall type, dimensions, and subsurface conditions to support the City of Peabody's 2018 grant award from the Commonwealth of Massachusetts under its MVP Action Grant Program. Using the subsurface investigation information, Weston & Sampson was able to perform preliminary geotechnical and structural analyses to evaluate five (5) repair/replacement design alternatives for the wall. Additional activities also included limited environmental sampling activities to better understand potential regulatory obligations under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000 and developing a permitting strategy for each alternative.

4.2 Geotechnical Evaluation

4.2.1 Subsurface Explorations

Weston & Sampson oversaw the advancement of test borings and test pits in the proposed project area to fill in data gaps at the study area properties. The borings extended to depths of up to 22 feet below grade. The test pit excavations were terminated due to groundwater seepage at depths ranging from 5.6 to 6.8 feet. Weston & Sampson geotechnical engineering staff monitored drilling and test pit activities in the field and prepared logs for each boring. A Weston & Sampson structural engineer was also onsite to observe the structural characteristics of the back of the canal wall during test pit activities.

- 13 Wallis Street. Weston & Sampson reviewed existing data and made preliminary recommendations for allowable soil bearing capacity, lateral earth pressures, frictional resistance, and seismic design considerations. No borings or test pits were advance on this property.

- 24 Caller Street. Weston & Sampson oversaw the advancement of three (3) test borings and three (3) test pits at the property. Weston & Sampson made preliminary recommendations for allowable soil bearing capacity, lateral earth pressures, frictional resistance, and seismic design considerations based on the findings from the exploration program.

- 21 Caller Street. Weston & Sampson oversaw the advancement of one (1) test borings and three (3) test pits at the property. Weston & Sampson made preliminary recommendations for allowable soil bearing capacity, lateral earth pressures, frictional resistance, and seismic design

considerations based on the findings from the exploration program.

- 18 Howley Street. Weston & Sampson reviewed existing data and made preliminary recommendations for allowable soil bearing capacity, lateral earth pressures, frictional resistance, and seismic design considerations. No borings or test pits were advance on this property.

- 166 Main Street (R). Weston & Sampson oversaw the advancement of two (2) test borings at the property. Weston & Sampson made preliminary recommendations for allowable soil bearing capacity, lateral earth pressures, frictional resistance, and seismic design considerations based on the findings from the exploration program.

4.2.2 Subsurface Conditions

Subsurface conditions encountered in the explorations generally consisted of FILL overlying native SAND and SILT to the depths explored. ORGANIC SOILS were observed below the fill in six of the sixteen borings. The major soil groups encountered are described below, in general order of their occurrence with depth. Descriptions of the soils encountered are included in the exploration logs in ***Appendix B - Engineering Evaluation & Design Alterative Analysis Report.*** Variations may occur and should be expected outside of the exploration locations.

4.2.3 Groundwater

Logs for borings B-1(GSI) through B-6(GSI) report groundwater depths ranging from 8 feet to 10.5 feet at the completion of drilling. Groundwater depths were not measured in borings WS-1 through WS-4 or B-1 through B-6 due to the drilling method (drive and wash) which introduces water into the borehole during drilling. Groundwater seepage was observed at depths ranging from about 4.6 to 6.7 feet below grade in TP-1 through TP-6. Groundwater levels are expected to be influenced by the water level in the North River Canal and may fluctuate due to local and regional factors including, but not limited to, precipitation events, seasonal changes, and periods of wet or dry weather.

4.2.4 Geotechnical Laboratory Analysis

Select soil samples from the 2018 explorations were submitted to GeoTesting Express of Acton, Massachusetts for grain size analysis to confirm field classification and estimate engineering properties. Geotechnical Laboratory analytical results are included on the boring logs and in a copy is provided in ***Appendix B.***

4.2.5 Summary and Future Considerations

Weston & Sampson has provided the following preliminary geotechnical design considerations and recommendations for site design, and for evaluation and selection of preferred wall replacement alternative(s). Weston & Sampson should be contacted to provide specific geotechnical design and construction recommendations during final design. Additional information on the use of these geotechnical recommendations is provided in the document titled “Important Information about this Geotechnical Engineering Report” by Geoprofessional Business Association (GBA), Inc., also included in ***Appendix B***:

- Existing structures, pavements, curbing, vegetation, topsoil, tree roots greater than 1-inch in diameter, and surface debris should be removed from within the limits of construction during initial site preparation. The existing fill contains debris, cobbles, and boulders which may interfere with installation of driven wall elements. Pre-trenching may be required to remove these

obstructions if a driven wall type is selected (such as soldier pile or sheet pile wall). Any existing utilities within the proposed development areas should be identified and properly removed, re-routed, or evaluated and approved to remain.

- Excavations to remove and replace the existing canal walls will extend up to about 10 feet, or deeper where unsuitable soils are present at proposed structure bearing depths. Temporary excavation support will be required where excavations cannot feasibly be open cut, such as locations adjacent to structures and utilities, and where groundwater seepage is present. Groundwater is expected to be approximately equal with the water level in the canal and dewatering of excavations should be anticipated during construction.

- The existing fill at the site contains variable amounts of fines, organics, and debris. The existing fill is not suitable for use as Structural Fill (i.e., support of structures or other settlement sensitive features) but may be suitable for use as backfill in non-structural or landscape areas, provided it can be moisture conditioned and compacted to at least 92% maximum dry density as determined by ASTM D1557 (modified proctor).

- Structural Fill beneath foundations and other settlement sensitive improvements (or where on-site materials are not available or suitable for re-use) should consist of well graded imported sand and gravel with less than approximately 10% fines (such as MassDOT M1.03.0- type B Gravel Borrow or M2.01.7 Dense-graded Crushed Stone). Structural fill should have a maximum particle size of 3 inches and be compacted to at least 95% of maximum dry density as determined by ASTM D1557.

- Crushed stone should be wrapped in filter fabric, consisting of a woven geosynthetic with an AOS of #70 to #100 sieve, and a minimum puncture resistance of at least 120 pounds (such as Mirafi FW700 or equivalent).

4.3 Environmental Evaluation

There is known or suspected soil contamination along the proposed area of the Riverwalk and canal wall that will need to be addressed during construction. Most of the area was formerly a tannery and it has known or potential environmental impacts, including several previously identified Disposal Sites as defined by the Massachusetts Contingency Plan (MCP); 310 CMR 40.0000. As the City is evaluating property acquisition or easements on private property as part of the repair/replacement options for the southern canal wall and construction of the Riverwalk, is important for the City to develop a compliance strategy for the redevelopment of the properties in accordance with the MCP.

In 2017, in support of the City of Peabody's desire to construct the Riverwalk along the North River Corridor, limited subsurface investigations were performed as part of a multi-parcel limited environmental assessment on the 21 and 24 Caller Street, 18 and 20 Howley Street, and 13 Wallis Street properties. Each assessment evaluated the top 5 feet of soils in an approximate 10-foot wide strip of land abutting the south side of the North River in Peabody, Massachusetts. Analysis of soil samples identified concentrations of metals (i.e. antimony, arsenic, barium, trivalent chromium, unspeciated chromium (hexavalent), lead, and zinc) and polycyclic aromatic hydrocarbons (PAHs) (i.e. benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene and phenanthrene) above the applicable MCP Reportable Concentrations (RCS-1) thresholds and Method 1 S-1/GW-2 and S-1/GW-3 standards.

To support the potential excavation and off-site disposal of soil associated with future repairs to the canal wall and construction of the Riverwalk, Weston & Sampson collected one (1) composite soil sample (TP-5) from 5 to 6 feet below ground surface (bgs) from the test pit advanced on the 21 Caller Street property on November 6, 2018. The owners of 166R Main Street and 24 Caller Street would not allow Weston & Sampson to collect samples for environmental analyses (i.e. soil disposal characterization) as part of this study.

The sample from the 21 Caller Street property was submitted for disposal characterization parameters pursuant to the Massachusetts Department of Environmental Protection (DEP) Policy #COMM-97-001, *Reuse and Disposal of Contaminated Soil at Massachusetts Landfill*, including: total petroleum hydrocarbons (TPH); Resource Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver); semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); pH; ignitability; specific conductivity; and reactivity. The sample was later analyzed for speciated chromium and Toxicity Characteristic Leaching Procedure (TCLP) metals analysis. A grab soil sample was submitted for laboratory analysis for volatile organic compounds (VOCs) from the test pit.

The results of the disposal characterization analyses are presented in ***Appendix B - Engineering Evaluation & Design Alterative Analysis Report***. The results were compared to the COMM-97-001 requirements for reuse at Massachusetts lined and unlined landfills. Soil analytical results indicate concentrations do not exceed the RCS-1 thresholds or the COMM-97-001 Disposal/Reuse levels for In-State Lined and Unlined Landfills and were consistent with the analytical results for the soils collected in the 0-5 ft bgs interval in 2017. However, based on the history of the site and the contaminant concentrations detected, surplus soils generated at 21 Caller Street as part of the Riverwalk project will likely be required to be managed and disposed of appropriately in accordance with the MCP.

4.3.1 Summary and Future Considerations

In summary, the properties that will be impacted as part of the repair/replacement alternatives for the south wall of the North River Canal are known or suspected to be contaminated. Construction activities will require management of soils in accordance with the MCP and under a Release Abatement Measure (RAM) Plan. Excess soils will be required to be disposed of at a licensed disposal facility. Given the approximate quantities to be generated at each individual property locations for the repairs of the wall, Weston & Sampson has assumed that all soils will be managed similarly across all properties as the cost difference among in-state and out-of-state non-hazardous disposal facilities does not exceed the cost to manage the soils separately.

Additional MCP regulatory compliance requirements may also include: RAM Status Reports, additional sampling to support new risk characterization for Riverwalk area; Method 3 Risk Assessments for Riverwalk Area; Revised Permanent Solution Statements (PSSs) and Activity and Use Limitations (AULs) for Riverwalk Area (and associated land surveys); RAM Completion Reports; Soil Management & Bills of Lading (BOLs); and Construction Administration, Coordination, and Oversight.

4.4 Structural Evaluation

Weston & Sampson used the June 2017 existing wall evaluation report, the May 2018 survey (conducted by Weston & Sampson), and the geotechnical and structural field investigation data obtained along the study area as part of the 2018 MPV grant, to work with the City and identify five (5) potential wall repair alternative options.

The five (5) wall alternatives that were considered for the repair of the south wall of the North River Canal from Wallis Street to Howley Street included:

- Alternative A – Rip Rap Slope
  - Option 1, build out from Toe of existing wall
  - Option 2, build out from inside of existing wall
- Alternative B – Vegetative Berm Over Rip Rap Slope
  - Option 1, build out from Toe of existing wall
  - Option 2, build out from inside of existing wall
- Alternative C – Sheet Pile Wall
  - Option 1, Sheet Pile with Concrete Cap
  - Option 2, Sheet Pile with Sloped Bank (rip rap and/or vegetated berm)
- Alternative D – Cantilever Concrete Retaining Wall
- Alternative E – Stone Masonry Wall

Each alternative was analyzed for its resilience, durability, environmental impacts, constructability, construction schedule, and cost. The recommended alternative was decided by comparing these five aspects of each design alternative. A preliminary engineer's cost estimate for each alternative was also provided.

The resilience of each wall alternative was evaluated based on the six design flood-climate change projection scenarios presented in Weston & Sampson's report entitled, *MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park – Resilience Evaluation (Resilience Evaluation)*, dated February 2019, and the estimate of the potential benefit in terms of volume of storage and the number of parcels that may be removed from the floodplain without increasing downstream flooding impacts. Fifty-eight parcels or portions of parcels were identified in the study area. The maximum percent of parcels protected for all wall alternatives and the six scenarios ranged from 11% to 60% of the total number of parcels in the study area. *A copy of the Resilience Evaluation is provided in Appendix C*.

Regardless of the alternative selected by the City, grades along the river may need to be raised or lowered in order to achieve ADA compliance for the Riverwalk. A new bridge structure will likely be required over Strongwater Brook. The existing Caller Street Bridge creates a design constraint for all alternatives considered. Each alternative has taken into account the need to accommodate the existing river width opening at the Caller Street Bridge. Each alternative will require the handling of contaminated / potentially-contaminated soils to some extent. Easements or property acquisition will be required for each alternative to accommodate the Riverwalk, with some alternatives requiring more property than others. Multiple storm drains exist in the area of the proposed new wall alternatives; these drains will need to be accommodated and accounted for later in the design process. Typical cross sections of each alternative are provided in *Appendix B - Engineering Evaluation & Design Alterative Analysis Report.*

Since the north wall is at a lower height elevation than the current south wall for about half of the river length being considered, raising the south wall height would create more flooding on the north side of the river. If additional flood storage is desired, each alternative could be adjusted to allow for river widening in addition to repairing the south wall. All design alternatives considered in this study propose that the new south wall height be constructed to match the existing south wall height.

4.5 Permitting Strategy

The permitting strategy evaluation reviewed each proposed alternative for the amount of impact to resource areas, the required environmental permits associated with those impacts, permitting timelines, and estimated permitting costs. In addition, an evaluation of the different wall options and associated permitting was also conducted based on the anticipated ease or feasibility of implementation with regulatory agencies, and other additional studies or requirements, and their associated costs, that may be required as part of for each wall alternative. The permitting strategy did not include any MCP permitting associated with the contamination found.

The permitting strategy provided the following information:

- An overview of the type of work and regulatory jurisdiction that will be encountered.
- A Graphic Matrix (shown in tabular form) that identified each alternative and how each alternative will be impacted from a permitting perspective. The matrix identified the permit, the requirement that triggers each permit, the timeline of review, the cost associated with the application, and any critical issues that will need to be addressed for that permit.
- A table of total cost to obtain permits for each alternative.
- Anticipated schedule to get through the permitting process for each alternative.
- A brief overview of each permit identified in the Matrix, with a description of important documents that will need to be compiled in order to apply for the permit coverage and a strategy on how to quickly and efficiently apply for the permit.

Weston & Sampson evaluated each wall alternative for the different variables, including impacts to protected environmental resources, required permits, permit costs, permit approval schedule, and regulatory favorability. For each alternative, each variable was given a value, with lower values indicating lesser preferred alternative results. A summary table showing each alternative with five different variable results are provided in *Appendix B.*

In general, the more complicated the wall repair, the greater the number of environmental resources and impact areas, which results in a greater number of environmental permits being required along with increased costs and schedule duration. As a result of this analysis, it should be noted that the alternatives fall into one of two groups, those that require permanent work within land under water (Alternative A and B), and those that do not require permanent work within land under water (Alternative C, D, and E). For those alternatives that impact land under water, an additional permit (MassDEP Chapter 91) will be required and result in additional project costs and permitting approval duration.

In general, the only difference between these two groups of alternatives from a permit cost and schedule context is approximately $5k-$10k in costs and 7-8 months in review. However, when providing additional overall project cost analysis study, the cost of C, D, and E are comparable to Option 1 in both Alternatives A and B. Furthermore Option 2 in Alternatives A and B add even more costs associated with further design required for mitigation of lost resource areas. Therefore, Option 1 in Alternative A and B, Alternative C, Alternative D, and Alternated E all have roughly the same costs when factoring in the Permit costs and Additional Overall Cost Analysis. The additional studies required as part of Option 2 for Alternative A and B would make those choices more expensive. See table below:

Potential Permitting Costs

	Alt A, Opt. 1	Alt A, Opt. 2	Alt. B, Opt. 1	Alt. B, Opt. 2	Alt. C, Opt. 1	Alt. C. Opt. 2	Alt. D	Alt. E
Costs ($)	$25,000 - $50,000	$35,000 - $65,000	$25,000 - $50,000	$35,000 - $65,000	$25,000 - $50,000	$25,000 - $50,000	$25,000 - $50,000	$25,000 - $50,000

Given the relatively small difference in cost and timing of the permits required for each alternative, Weston & Sampson evaluated the anticipated favorability of each alternative from a regulatory perspective. Each permitting agency will be evaluating the potential impacts of resource areas that will be impacted by the proposed alternative; most notably bank and land under water. Although any repair alternative work will be performed within the flood plain, the intent of the overall project will be to increase flood storage and not fill the flood plain, which will also be looked at favorably by the regulatory agencies. Additionally, work will also be completed in the riverfront area, however the portion of the riverfront area that will be impacted is previously developed and any project of this magnitude that has a goal of cleaning up the riverfront is anticipated to be looked at favorably by the permitting agency reviewer.

The following is an excerpt of the performance standards for bank and land under water in the wetland's protection act:

"General Performance Standards [Land Under Water (LUW)].

(a) Where the presumption set forth in 310 CMR 10.56(3) is not overcome, any proposed work within Land under Water Bodies and Waterways shall not impair the following:

1. *The water carrying capacity within the defined channel, which is provided by said land in conjunction with the banks;*
2. *Ground and surface water quality;*
3. *The capacity of said land to provide breeding habitat, escape cover and food for fisheries; and*
4. *The capacity of said land to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 5,000 square feet (whichever is less) of land in this resource area found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures established under 310 CMR 10.60."*

"General Performance Standard (BANK).

(a) Where the presumption set forth in 310 CMR 10.54(3) is not overcome, any proposed work on a Bank shall not impair the following:

1. *the physical stability of the Bank;*
2. *the water carrying capacity of the existing channel within the Bank;*
3. *groundwater and surface water quality;*
4. *the capacity of the Bank to provide breeding habitat, escape cover and food for fisheries;*
5. *the capacity of the Bank to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of Intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 50 feet (whichever is less) of the length of the bank found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures contained in 310 CMR 10.60."*

Although they are listed as two (2) different resource areas, the performance standards for both are very similar. Essentially LUW and Bank need to provide the following:

- Stability
- Water carrying capacity
- Ground water and surface water quality
- Habitat for fisheries
- Capacity of land to provide other wildlife habitat functions

Although these are just performance standards under the Massachusetts Wetlands Protection Act, and both resource areas are also protected under the Army Corp Section 404 and Mass DEP Section 401 of the Clean Water Act, as well as Mass DEP Chapter 91 regulations, the intent of the protection remains the same throughout.

When evaluating each alternative, Weston & Sampson reviewed these standards to see if they Meet (M), Improve (I) or Diminish (D) each standard.

Alternative Evaluation against Performance Standards

	Stability	Water Carrying	Water Quality	Habitat for Fisheries	Wildlife Habitat	Total
Alternative A Option 1	Improve	Improve	Improve	Improve	Meet	4 I, 1 M
Alternative A Option 2	Improve	Diminish	Diminish	Diminish	Meet	1 I, 1 M, 3 D
Alternative B Option 1	Improve	Improve	Improve	Improve	Improve	5 I
Alternative B Option 2	Improve	Diminish	Diminish	Diminish	Improve	2 I, 3 D
Alternative C Option 1	Improve	Improve	Meet	Meet	Meet	2 I, 3 M
Alternative C Option 2	Improve	Improve	Meet	Meet	Improve (if veg berm)	3 I, 2 M
Alternative D	Improve	Meet	Meet	Meet	Meet	1 I, 4 M
Alternative E	Improve	Meet	Meet	Meet	Meet	1 I, 4 M

As can be seen above, Option 2 for both Alternative A and B would diminish the quality of the resource areas impacted by the project. Based on the location of the wall in both scenarios, fill would need to be placed within the existing land under water. This would diminish the river's existing ability to carry water, treat the water and provide fish habitat. Because these alternatives would result in a diminished resource area, the agencies would more than likely require some type of mitigation to replicate the lost function of the resource area lost. This would require additional studies (hydraulic, water quality, habitat evaluations, etc.) and design of replication/restoration areas in order to determine exactly what functions were being lost and how to best replicate them on the same stretch of river.

Alternatives D and E would meet the standards, but would provide no benefit or improvement, except for stabilizing the wall. Alternatives C - Option 1 rates slightly higher as it would improve on 1 standard by increasing water carrying capacity. Because the river is currently confined between two vertical walls

throughout this stretch, an argument could be made that all three alternatives should be allowable, as the work will not diminish what currently exists. Agencies would most likely require additional information to determine why these three alternatives were preferred over others that may provide more benefit to the site. Additional information could include an overall project cost analysis of each alternative and additional information on property rights along the river. For instance, acquisition of private land in order to complete Alternative B may be cost prohibitive and not preferred over another alternative that had a smaller footprint and required less acquisition of land. The proponent would be required to prove that the selected alternative, although possibly not the most environmentally preferred, was selected for other preferential reasons.

Alternative B - Option 1, Alternative A - Option 2, and Alternative C - Option 2 provide the most favorable alternatives when compared to the standards. Because these options include the expansion of the width of the river, the creation of Land Under Water and the gradual sloping of the bank, all three options would improve upon various criteria within the standards.

Although not called out specifically in the performance standards, there are still other environmental considerations that will factor into overall favorability. Special consideration should also be given to alternatives that provide other benefits, such as the creation of flood storage volume. When rating each alternative based on their potential long-term impact to increasing storage along the river, Alternative B - Option 1, Alternative A - Option 1, and Alternative C - Option 2 rate out the most favorable, in that order.

In summary, the evaluated alternatives ranked accordingly highest to lowest based on regulatory favorability:

- Alternative B - Option 1 (provides 5 improvements and provides flood storage)
- Alternative A - Option 1 (provides 4 improvements and provides flood storage)
- Alternative C - Option 2 (provides 3 improvement and provides flood storage)
- Alternative C - Option 1 (provides 2 improvement and meets others)
- Alternative D (provides 1 improvement, additional study required to show why selected)
- Alternative E (provides 1 improvement, additional study required to show why selected)
- Alternative B - Option 2 (will diminish resource area, additional studies for impact and replication)
- Alternative A - Option 2 (will diminish resource area, additional studies for impact and replication)

4.5.1 Summary and Future Considerations

Using the five standards and flood plain considerations mentioned above, Weston & Sampson generated the Permitting Strategy Matrix on the following page for the project. Although the matrix ranks four alternatives relatively closely, careful consideration should be taken to which variables are most important to the City.

Given the relatively small difference in cost and timing of the permits (when compared to the general wall repair costs, etc.) these factors are less likely to impact the City's decisions as to which alternative to choose. More important factors, such as favorability or the likelihood and ease of which approvals can be obtained from the agencies might be the governing factor. This would be evident in the favorability ranking of each alternative. Please refer to the Permitting Strategy Matrix Summary provided on the following page:

Permitting Strategy Matrix Summary

	A.1 - Rip Rap Slope	A.2 - Rip Rap Slope	B.1 - Vegetative Berm	B.2 - Vegetative Berm	C.1 - Sheet Pile Wall	C.2- Sheet Pile Wall w/ Sloped Bank	D - Cantilever Concrete Retaining Wall	E - Stone Masonry Wall
Impacts (1-7)	3	1	4	2	5	5	7	6
Permits (1-7)	5	1	5	1	6	6	6	6
Costs (1-7)	3	1	3	1	3	3	3	3
Favorability (1-8)	7	1	8	2	3	6	3	3
Schedule (1-7)	3	1	3	1	4	4	4	4
Total Average	4.2	1.0	4.6	1.4	4.2	4.8	4.6	4.4

lower number = less preferred alternative
higher number = more preferred alternative

4.6 Comprehensive Wall Repair Alternative Comparative Matrix

The following is the comprehensive comparative matrix used to assist the City when comparing each of the repair design alternatives outlined in this report. Please note that this is not a final construction cost estimate. The preliminary cost estimates provided for each conceptual alternative only include major items associated with each wall design and are to be used for comparative purposes only. These preliminary cost estimates are not representative of the final construction costs as they do not include minor items that will be required for the implementation of each alternatives such as site preparation work, clearing and grubbing, erosion controls, etc.

Please refer to the assumptions presented in the ***Wall Alternative Cost Estimates provided in Appendix B.*** Please note that the cost estimates assume that only impacted soils associated with wall repair activities are removed from the site and are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the future construction of the proposed Riverwalk, etc., as the preliminary design of the Riverwalk has not been completed to an extent that it can be provided at this time.

	Resiliency & Flood Storage	Durability & Maintenance	Estimated Excavation	Construction & Easements	Permitting & Regulatory Favorability	Preliminary Cost Estimate*
Alt A - Rip Rap Option 1	- Approx. 18 cu.ft./ft additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 30%-55%	- Minimum design service life 50 years - Low maintenance (i.e. replace dislodged rip rap after storm events)	- Requires excavating ~3000 CY of contaminated soils	- Requires 25-ft permanent easement from edge of river - Additional 15-ft temporary easement for construction - Approx. 5-month construction	-4th in Total Permitting Favorability (tie) - 2nd in Regulatory Favorability - 4 Improved Resources	$2,607,000 – $9,926,000
Alt A - Rip Rap Option 2	- Approx. 1 cu. ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 11%-17%	- Minimum design service life 50 years - Low maintenance (i.e. replace dislodged rip rap after storm events)	- Requires excavating ~1500 CY of contaminated soils	- Requires 21-ft permanent easement from edge of river - Additional 15-ft temporary easement for construction - Approx. 5-month construction	- Lowest scoring (8th) alternative in Total Permitting Favorability - Lowest (8th) Regulatory Favorability -Diminishes Resources & Need for additional studies	$2,615,000 - $8,459,000
Alt B - Vegetative Berm Option 1	- Approx. 20 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 31%-60%	- Minimum design service life 50 years - Low to Moderate maintenance required (i.e. maintain vegetation, replace rip rap and/or soils, etc. after storm events)	- Requires excavating ~3000 CY of contaminated soils	- Requires 28-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Approx. 5-9-month construction (depends on growing season)	- 2rd in Total Permitting Favorability (tie) - Highest (1st) Regulatory Favorability -5 Improved Resources	$2,479,000 - $9,712,000

	Resiliency & Flood Storage	Durability & Maintenance	Estimated Excavation	Construction & Easements	Permitting & Regulatory Favorability	Preliminary Cost Estimate*
Alt B - Vegetative Berm Option 2	- Approx. 1 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 11%-17%	- Minimum design service life 50 years - Low to Moderate maintenance required (i.e. maintain vegetation, replace rip rap and/or soils, etc. after storm events)	- Requires excavating ~1400 CY of contaminated soils	- Requires 25-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Approx. 5-9-month construction (depends on growing season)	- 5th in Total Permitting Favorability - 7th (second to last) in Regulatory Favorability - Diminishes Resources & Need for additional studies	$2,421,000 - $8,103,000
Alt C - Sheet Pile Wall Option 1	- Approx. 8.5 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 20%-45%	- Minimum design service life 75 years - Low maintenance required (i.e. monitor sheet piles for corrosion, crack and spall repairs of concrete cap)	- Requires excavating ~400 CY of contaminated soils	- Requires 13-foot permanent easement from edge of river -Additional 15-foot temporary easement for construction - Specialized construction methods - Approx. 4-5-month construction	- 4th in Total Permitting Favorability (tie) - 4th in Regulatory Favorability - Limited Improvements & Need for additional studies	$2,678,000 - $3,422,000
Alt C - Sheet Pile Wall Option 2 w/ Sloped Bank	- Approx. 20-25 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 31%-60%	- Minimum design service life 50 years - Low to Moderate maintenance required (i.e. monitor sheet piles for corrosion; replace dislodged rip rap after storm events; maintain vegetative berm which is less stable than rip rap during and after storm events and may require minor repair)	- Requires excavating: ~2600 CY of contaminated soils for Rip Rap option ~1500 CY of contaminated soils for Earthen Berm	- Requires 28-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Approx. 5-month construction	- Highest (1st) in Total Permitting Favorability - 3rd in Regulatory Favorability -3 Improved Resources but Meet all others	$2,332,000 - $5,060,000 (w/ Earthen Berm) $2,726,000 - $7,214,000 (w/ Rip Rap)

	Resiliency & Flood Storage	Durability & Maintenance	Estimated Excavation	Construction & Easements	Permitting & Regulatory Favorability	Preliminary Cost Estimate*
Alt D - Concrete Cantilever Retaining Wall	- No increased river flood storage - Future height increase possible - No % of parcels protected	- Minimum design service life 75 years - Moderate maintenance required (i.e. crack and spall repairs)	- Requires excavating ~1900 CY of contaminated soils	- Requires 13-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Requires removal of organic soils to prevent settlement - Approx. 6-8-month construction	- 2nd in Total Permitting Favorability (tie) - 5th in Regulatory Favorability - limited Improvement & need for additional studies	$4,832,000 - $9,834,000
Alt E - Stone Masonry Wall	- No additional river flood storage - Future height increase possible - No % of parcels protected	- Minimum design service life 50 years - Moderate maintenance required (i.e. repointing of mortar, replace dislodged stones)	- Requires excavating ~2100 CY of contaminated soils	- Requires 13-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Requires removal of organic soils to prevent settlement - Approx. 7-9-month construction - Requires removal of organic soils to prevent settlement	- 3rd in Total Permitting Favorability - 6th in Regulatory Favorability - limited Improvement & need for additional studies	$4,328,000 - $9,702,000

*Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions

4.7 Conclusions

A comparative matrix was used to determine the highest-ranking wall alternative option for the project. Factors with the most importance during this evaluation were: cost, quantity of impacted soils requiring excavation and off-site disposal, volume of dredged material, favorability by regulatory agencies in obtaining permits, feasibility of providing additional flood storage, and the ease of adding a Riverwalk behind the wall.

In general, the least expensive alternatives were: 1) Alternatives C - Sheet Pile options; 2) Alternatives B - Vegetative Berm options; and Alternatives A - Rip Rap options. The alternatives which require the least estimated amount of material to be dredged from the canal are: 1) Alternatives C - Sheet Pile options; 2) Alternative D - Cantilever Wall; and 3) Alternative E - Stone Masonry wall. Adding a Riverwalk behind the sheet pile wall option 1, concrete cantilever wall or stone masonry wall may prove difficult at certain locations where a cantilever walkway would become necessary. At those difficult locations, the two rip rap options, the two vegetative berm options, and sheet pile option 2 would allow for the use of piers to avoid a cantilever walkway and thus likely reduce costs.

Therefore, Alternative C - Sheet Pile Wall Option 2 with Sloped Bank is the highest scoring alternative. However, Alternative C - Option 2 may not be feasible along the entire length due to existing structures and grade, such as the parking lot at 21 Caller Street, and may require a limited length of one of the other wall alternatives to be considered. As an example, the Sheet Pile Wall Option 1 could be used for a short distance along the bank until a larger portion of land is available behind the wall to return to the Sheet Pile Wall Option 2. The feasibility in areas such as 21 Caller Street was required to be further evaluated during the preliminary design phase and may depend on other factors such as final property easements or acquisition potential.

Other well-scoring options during the comparison evaluation were: Alternative C - Sheet Pile Wall - Option 1; Alternative B - Vegetative Berm - Option 1; and Alternative A - Rip Rap - Option 1. The highest-ranking wall option, Alternative C - Sheet Pile Wall - Option 2 with Sloped Bank, combines all the favorable qualities of Alternatives A and B with the favorable qualities of Sheet Pile Option 1 and provides the highest percentage of potential parcel protection for all six flood-climate change projection scenarios.

While Alternative C - Sheet Pile Wall options generally cost about the same as Alternative B - Vegetative Berm Option 1, the sheet pile walls' low maintenance, ease of construction and long lifespan make it a good option and this alternative also does not require any material to be dredged from the canal. Alternative A - Rip Rap Option 1 was ranked closely behind Alternative B because of its similar characteristics to the Vegetative Berm Option 1 but ranked slightly lower due to its greater construction costs and lower total permitting favorability. The estimated cost of Alternative C - Sheet Pile Wall - Option 2 is slightly lower than these other well-scoring options due to the limited excavation and channel dredging required. Alternatives A - Option 1, B - Option 1, and C - Option 2 require roughly the same easement widths.

A copy of the Engineering Evaluation & Design Alterative Analysis Report is provided in Appendix B.

5.0 SOUTH WALL PRELIMINARY 25% DESIGN

Following the completion of the engineering evaluation and design alternative analysis of the existing south wall, the City decided to pursue the highest scoring wall repair alternative option, Alternative C - Sheet Pile Wall Option 2 with Sloped Bank. The proposed sheet pile wall would be installed behind the existing south wall. The existing wall would then be removed down to at least the streambed elevation. The top of the sheet pile would be set at approximately the ordinary high-water level or higher based on constraints to provide a sloped embankment behind it. The sheet pile will protect the toe of the slope from scouring and the rip rap/vegetation will protect the slope from erosion during flood events. This alternative provides the most additional flood storage, will provide a long service life, requires minimal maintenance, can be modified to accommodate future flood events, minimizes environmental and right-of-way impacts, and was anticipated to have a high regulatory favorability.

On April 2, 2019, the City and Weston & Sampson had a pre-application meeting with several divisions of MassDEP to get their feedback regarding the proposed wall repair alternative and proposed Riverwalk project. Conceptually, MassDEP fully supported preferred alternative and is looking forward to working with the City on the next phase of the project.

Following the meeting with MassDEP, Weston & Sampson completed the 25% design of the preferred alternative. The 25% conceptual design phase work for the replacement of the south wall of North River Canal required evaluating the alignment of the new sheet pile wall along the canal, and the location of the new wall with respect to the existing wall. For construction feasibility, the alignment of the sheet pile wall was designed to follow a straight line behind the existing canal wall alignment, and only curving at necessary locations. The sheet pile wall will extend at minimum 15 feet below the top of the riverbed. The sheet pile wall height above the riverbed will vary depending on location. At most locations, the sheet pile wall height will be between two and three feet above the riverbed, with a sloped bank behind the sheet pile wall. The top of the sloped bank will be designed to match the current height of the existing wall. By matching the existing wall height, the sloped portion of the bank will provide additional flood storage for the canal, without creating new flooding to other parcels of land nearby. The sheet pile wall will be installed one foot (from back face of existing wall to front face of sheet pile) behind the existing wall. This will allow enough room for demolition and removal of the existing south wall after installation of the sheet pile wall is complete.

At a few locations along the canal alignment, it is not feasible to provide the sloped bank because of existing driveways, retaining walls or other design constraints and physical obstacles. At these locations, particularly 13 Wallis Street, the east edge of 24 Caller Street, the entirety of 21 Caller Street, and either side of Strongwater Brook, the sheet pile wall will extend to a height matching the existing wall at that location, and no sloped bank will be provided. The sloped banks adjacent to these locations will be graded to come up to the sheet pile wall height on the sides of the wall. At Strongwater Brook, a new bridge structure will need to be constructed.

Weston & Sampson worked with the City to develop proposed permanent and temporary property easements along the length of the canal. The permanent easements range from 15 feet to 31 feet behind the proposed sheet pile wall to allow space for the proposed 8-foot-wide Riverwalk at the top of the sloped bank, with 4 feet of vegetative area on either side of the path to allow for stormwater management. The temporary easement will be used during construction and is 15-feet wide along the length of the canal, except at 21 Caller Street, where it is 20-feet wide.

A copy of the South Wall Preliminary 25% design is provided in Appendix D.

6.0 RIVERWALK PRELIMINARY 25% DESIGN

The City of Peabody's proposed Riverwalk will be a shared-use path along the south bank of the North River. Pedestrians and bicyclists will enjoy a continuous community open space corridor that will provide a new transportation and recreation opportunity between Wallis and Howley Streets. Importantly, the Riverwalk will also optimize and maximize green infrastructure, resiliency, and flood storage as part of its integrated design.

The Riverwalk project includes a comprehensive community participation component. Coordination with various City entities and engagement with community stakeholders has been ongoing. Understanding the community's vision for this important open space has led to consideration of available space and includes addressing property ownership. The project will require permanent and temporary right-of-way easements to ensure the vision can be brought to fruition.

Weston & Sampson prepared a Preliminary Design of the preferred Riverwalk design scheme. Complementing improvements to the River's edge with the new wall and embankment treatment is the design of the 16-foot wide (minimum) Riverwalk Zone which begins at the top of the embankment slope. Within that Zone, an 8-foot minimum pathway will accommodate pedestrian and bicycle traffic. An additional 4-feet of vegetation on each side of the path will provide stormwater management. On either side of Caller Street (about 172 feet of 24 Caller St. and the entirety of 21 Caller St.) the Riverwalk Zone will have a reduced width because of existing constraints.

Various surface material treatments and details are being considered to ensure contextually appropriate design elements are as practical and durable as they are delightful. The Riverwalk will take advantage of its proximity along the North River to capture water-side views, share Peabody's history along North River, and inform the general public about the River's and corridor's new use as an important community space and community infrastructure resource. Vegetated pathway edges and raingarden opportunities within the Riverwalk Zone will enhance the user experience while serving a pragmatic stormwater and flood storage management use. All Riverwalk areas will be designed and constructed to accommodate flooding. Low maintenance groundcover and tree plantings will supplement the existing vegetation, provide shade, and reduce the heat island effect.

With the installation of new hybrid pedestrian signalization and the alterations described above, this is a corridor where pedestrian circulation is of major importance. The design includes various access/rest-stop/activity areas along the length of the linear park, which provides access to the City of Peabody's Central Business/Industrial District. The project involves the creation of an open space area at 24 Caller Street, with seating, tree shelter, and the opportunity for additional stormwater management, as well as connections to Main Street. Major pedestrian gateways at Howley and Wallis Streets will denote the entrance to the Riverwalk, be designed with a sensitivity to the former tanneries and site's history, and enhance economic development in the business district.

A copy of the Riverwalk Preliminary 25% design is provided in Appendix E.

7.0 COMMUNITY OUTREACH

Weston & Sampson assisted the City in engaging the public to ensure that the viewpoint and interests of residents, adjacent property owners, local businesses, etc. are understood and considered during the project. The Riverwalk, bridge design, and flood storage areas are all expected to generate considerable attention in the community.

Weston & Sampson assisted the City at a public meeting held on May 30, 2019 to engage community groups and ensure that the park's features satisfy their needs. The following information was presented at the meeting:

- Project Summary
- The multi-disciplinary nature and the project and key Weston & Sampson staff Resiliency Evaluation
- Wall Analysis & Repair Alternative Evaluation
- Conceptual Riverwalk Plan
- Next Steps
- Questions & Answers

Approximately thirty (30) people attended the public meeting. The project was generally well received by the public. A copy of the sign-in sheet and power point presentation are provided in ***Appendix F - Community Engagement Materials & Solicited Feedback***. In addition, pictures of the interactive public feedback boards, including dot survey results regarding potential Riverwalk features and a comment and suggestion board, are also provided. Weston & Sampson anticipates that the City will continue to host several interactive sessions at which the community will offer feedback on alternatives being considered and identify priorities and vision for the community open space.

General public comments/questions from the meeting, and the City's responses, are summarized below:

1. A request was made for the City to post the presentation on the City's website.
    - The City agreed to the request.
2. Will a subcommittee or community group be created to provide input regarding the Public?
    - The City will consider the request and will reach out if such group(s) will be formed.
3. What is the water quality of the river?
    - All surface water bodies in the City are classified as Category 5 (impaired, and requiring one or more Total Maximum Daily Loads (TMDLs).
4. Graffiti and vandalism are problems in the City of Peabody. This needs to be taken into consideration when designing the proposed Riverwalk.
    - The City concurred with this comment.
5. Cameras should be installed along the proposed Riverwalk for safety and security reasons.
    - The City agreed to consider this recommendation.
6. The Salem Sound Coast Watch (SSCW) noted that they are doing work in the area of Howley Street to increase the habitat for smelt. The SSCW asked if ecological impacts have been considered as part of the proposed design.
    - The City noted that ecological type considerations and potential impacts are generally evaluated and performed as part of the regulatory permitting process, which will occur during the next phase of the project.

7. Will the Riverwalk be designed for bicycles and pedestrians?
    - Due to existing structural constraints in certain locations along the proposed Riverwalk, there is not enough space to meet the minimum requirements for a multi-modal path for the entire extent of the proposed Riverwalk with the existing proposed easements, etc. However, the City anticipates that users of the Riverwalk will include bicyclists.
8. A representative from the Azorean Brothers, a private property owner located along the proposed Riverwalk, expressed their support for the project and their excitement in seeing the proposed Riverwalk plans move forward. The Azorean Brothers requested that considerations be included in the design that protect children from falling into the river.
    - The City concurred that railings and/or deterrent vegetation will be considered as part of the design process to deter children from directly accessing the river.
9. Will there be any improvements to Strongwater Brook?
    - The City confirmed that improvements will be limited to the crossing of Strongwater Brook and no improvements will be completed upstream of that location.
10. An upstream resident noted that flooding that occurs in the area and the impacts it has on his and the neighboring community's properties. The resident questioned if stormwater storage option areas have been considered and whether widening or dredging of the river would occur as part of the proposed project.
    - The City explained that the existing wall would be removed as part of the proposed conceptual design plan which would increase flood storage in the area; however, river widening and dredging will not be conducted as part of the proposed project. In addition, it is the City's intent to design the Riverwalk to flood and to evaluate additional potential storage options on the 24 Caller Street property. Any additional storage generated as part of the project would be a benefit to the community.
11. What is the timeline of the proposed project?
    - The City expressed that they are aggressively seeking funding opportunities to move the project forward and expects to hear on the next round of EEA MVP and EPA Brownfields grant funding within the month. Furthermore, the City described the next step would be to bring the project to 75% design and permitting.
12. What are the anticipated costs?
    - The City agreed to provide a copy of the preliminary cost estimates and associated assumptions provided in the alternative analysis report.

Information about the project has also been posted on the City's website.

8.0 PROJECT MANAGEMENT OF THE GRANT

Weston & Sampson assisted the City in completing grant programmatic requirements, including monthly progress reports and the generation of this final project report for submittal to the MassEEA. In addition, Weston & Sampson participated in monthly check-in meetings, and other correspondence, with the City to discuss project progress and findings. Weston & Sampson also performed project management activities including work plan implementation; correspondence and coordination with appropriate site contacts and subcontractors, the laboratory, and the City; project staffing oversight; schedule, budget tracking, and control; invoice preparation and submittal; and other general programmatic and project management activities.

Copies of the monthly progress reports are provided in Appendix G - Project Management - Monthly Progress Reports.

9.0 LIMITATIONS

This report has prepared for the use by the City of Peabody and the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA), exclusively. The findings provided by Weston & Sampson in this report are based solely on the information reported in this document. Future subsurface investigations, sampling, and/or other information that was not available to Weston & Sampson at the time of the study, may result in a modification of the findings stated in this report.

Should additional information become available concerning this project or neighboring properties, which could directly impact the project site in the future, that information should be made available to Weston & Sampson for review so that, if necessary, conclusions presented in this report may be modified. The conclusions of this report are based on project site conditions observed by Weston & Sampson personnel at the time of the study, information provided by the City of Peabody, and samples collected and analyzed on the dates shown or stated in this report. Any modification of the report without written verification or adaptation by Weston & Sampson, as appropriate for the specific purpose intended, will be at the City and MassEEA's sole risk and without liability or legal exposure to Weston & Sampson or to Weston & Sampson's consultants. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty, expressed or implied, is given.

FIGURES



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No.	Date	Description	Dr.By	Ck.By	App.By
		APPROVED			

DATE

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CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 1 - Locus Plan

CADD NO.	SCALE:	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
	AS NOTED	1	2180658	-	-	-	-

S-1

FILE NO.

SHEET 1 OF 1

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NOTES:

1. THIS DRAWING IS BASED ON JUNE 2017 SOUTH WALL EVALUATION PLANS PREPARED BY WESTON & SAMPSON.
2. BORING LOCATIONS SHOWN ON THIS PLAN ARE BASED ON FIELD MEASUREMENTS RELATIVE TO EXISTING SITE FEATURES.

LEGEND:

- B-# — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL ENGINEERING STAFF BETWEEN NOVEMBER 5 AND 9, 2018.
- TP-# — DESIGNATION AND APPROXIMATE LOCATION OF TEST PITS COMPLETED BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL AND STRUCTURAL ENGINEERING STAFF ON NOVEMBER 6 AND 7, 2018.
- WS-# — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY GEOLOGIC EARTH EXPLORATIONS, INC. OF NORFOLK, MA AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL ENGINEERING STAFF BETWEEN MARCH 21 AND 23, 2007.
- TP-# (2007) — DESIGNATION AND APPROXIMATE LOCATION OF TEST PIT OBSERVED BY WESTON & SAMPSON ON MARCH 8, 2007.
- B-# (GSI) — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY NEW HAMPSHIRE BORING AND OBSERVED BY GEOTECHNICAL SERVICES, INC. BETWEEN OCTOBER 31 AND NOVEMBER 4, 2002. (GSI) HAS BEEN TO THE BORING ID TO DIFFERENTIATE FROM RECENT BORINGS COMPLETED BY WESTON & SAMPSON.

85-38±
0

85-41
15 WALLIS ST

85-37
45 WALNUT ST

85-36
49 WALNUT ST

85-39A
0

85-39B
0 WALNUT

APPROXIMATE LOCATION OF 78 IN. SEWER

CONCRETE VAULT

SMH R=15.70

SMH R=15.84

SMH R=12.09

WALLIS STREET

NORTH RIVER CANAL

TP-5 (2007)

B-1 (GSI)

WS-1

APPROXIMATE EDGE OF WATER

B-2 (GSI)

B-3/MW-4 (GSI)

B-4 (GSI)

B-5 (GSI)

B-6 (GSI)

B-7/MW-1 (GSI)

B-8/MW-3 (GSI)

PROPANE TANK

GOOD | GOOD | POOR | FAIR | GOOD | POOR | POOR | POOR | FAIR

00-25 00-19 0+00 1+00 01+50 01+70 2+00 02+30 3+00 03+20 03+30 03+50 03+70 4+00 04+80

STONE WALL WITH MORTAR

CONCRETE WALL ON TOP OF STONE WITH MORTAR

13 WALLIS ST

24 CALLER ST

REINFORCED CONCRETE (BRIDGE ABUT+WING)

100 FT WETLAND BUFFER

200' RIVER FRONT PROTECTION AREA

20 10 0 20 40
SCALE: 1"=20'

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A	P	P	R	O	V	E	D		

REGISTERED PROFESSIONAL ENGINEER

DATE

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 2 - Site Plan STA. 00-25 to 04+80

CADD NO.	SCALE: AS NOTED	CONTRACT: 1	JOB NO. 2180658	DR.BY -	DSN.BY -	CHK.BY -	APP.BY -

FILE NO. S-2

SHEET 1 OF 3

\\wse03.local\WSE\Projects\WA\Peabody MA\WP Action Grant 2018\Task 2 – Engineering Services & Alternatives Analysis\Geotechnical\CAD\North River – South Wall Eval new.dwg

NOTES:

1. THIS DRAWING IS BASED ON JUNE 2017 SOUTH WALL EVALUATION PLANS PREPARED BY WESTON & SAMPSON.
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85-39B
0 WALNUT ST

86-140
65 WALNUT ST

86-139
75 WALNUT ST

86-141
27 CALLER ST

APPROXIMATE LOCATION OF 78 IN. SEWER

SMH R=12.09

SMH R=11.97

SMH R=10.50

SMH R=10.68

SMH R=11.58

SMH R=12.60

SMH R=13.48

STA 505+7

STA 5+88

JZ120

SKZ24

NORTH RIVER CANAL

APPROXIMATE EDGE OF WATER

CALLER STREET

3'-0"

GRANITE BLOCK PILE

B-2 B-3 B-4

TP-1 TP-2 TP-3 TP-4 TP-5 TP-6

WS-3 WS-4

04+80	5+00	6+00	06+35	7+00	07+35	8+00	08+16	08+65	9+00	09+65	09+75	10+00	10+10	10+60
FAIR WITH ISOLATED POOR		FAIR		POOR		FAIR		FAIR	FAIR WITH ISOLATED POOR		POOR	FAIR WITH ISOLATED POOR	POOR	FAIR W
STONE WITH MORTAR				CONCRETE WALL ON TOP OF STONE WITH MORTAR				CONCRETE BRIDGE ABUTMENT ON GRANITE BLOCK WITH MORTAR	STONE WITH MORTAR			STACKED GRANITE BLOCK ON STONE RUBBLE (NO MORTAR)		STACKED GRA
24 CALLER ST												21 CALLER ST		18 H

20 10 0 20 40
SCALE: 1"=20'

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CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 2 - Site Plan STA. 04-80 to 10+60

CADD NO.	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
	1	2180658	-	-	-	-

SCALE: AS NOTED

FILE NO.

S-3

SHEET 2 OF 3

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86-139
5 WALNUT ST

86-141
CALLER ST

86-138
77 WALNUT ST

86-150A
166 MAIN ST (R)

N/F
26 HOWLEY STREET TRUST
"FLEA MARKET"

1 STORY BRICK

3 STORY BRICK

CONNECTION FROM CATCH BASINS UNKNOWN

300mmCMP

TOP STEP

GRANITE BLOCK RET. WALL

PORTION OF CONC. FOUNDATION ON GRANITE WALL

1 STORY CONC. BLOCK ON CONC PIERS (RIVER BELOW)

0.6m sq. CONC. PIER (TYP.) EL=3.127

(EL. UNDER BLDG)

NORTH RIVER

FLOW

STONE BRIDGE

BITUMINOUS

"NO PARKING"

#8 W/TRANS

SESD DISK "B1125"

150mm INV=1.9

APPROX. L.O. LINE

RAILROAD TIE RET. WALL

GRANITE BRIDGE SUPPORTS

PK NAIL "HOW_C" EL=2.887

N/F
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

MASSACHUSE

TP-6

GRAINTE RIDGE PILE

WS-3

APPROXIMATE EDGE OF WATER

B-6

B-7

WS-2

BITUMINOUS

1 STORY WOOD FRAME

R=2.635
PIPE BLOCKED
H20 EL=1.66

R=2.708
PIPE BLOCKED
H20 EL=1.63

#22

BM#1

POSSIBLE END OF GAS LINE – SCALED FROM GAS PLANS

"RR CROSSING"

"STOP"

7' CLF

VAULT

"WEIGHT LIMIT"

CONST. B

GOOD

POOR

FAIR WITH ISOLATED POOR

POOR

POOR

POOR

POOR

POOR

POOR

FAIR WITH ISOLATED POOR

POOR

10+60 | 11+00 | 11+49 | 11+57 | 12+00 | 12+25 | 13+00 | 13+25 | 13+35 | 13+36 | 13+46 | 14+00 | 14+09 | 15+00 | 15+09 | 15+53 | 15+59

STACKED GRANITE BLOCK (NO MORTAR)

EARTH EMBANKMENT OR BURIED WALL

STACKED GRANITE BLOCK (NO MORTAR)

TIMBER TIE BEHIND EARTH EMBANKMENT

TIMBER TIE BEHIND CONCRETE COLUMN

EARTH EMBANKMENT OR BURIED WALL

CK ON
ORTAR)

18 HOWLEY ST

166 MAIN ST.

BRIDGE

COLLAPSED/MISSING WALL

STACKED GRANITE BLOCK WITH CONCRETE CAP

STACKED GRANITE BLOCK ON STONE RUBBLE

REINFORCED CONCRETE WITH RIPRAP PROTECTION

CONCRETE FOUNDATION

MAG NAIL SET

N/F
THE AZOREAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC.

1 STORY CONC. BLOCK

#20

APPROX. L.O. LINE

HOWLEY

#55-4 W/RISER SL & TRANS

APPROX. L.O. LINE

R=3.012
BOT. VAULT = 0.878

R=2.821
I=0.75(IN)
I=0.05(OUT)

R=2.870
I=1.62(IN)
I=1.59(OUT)

R=2.787
I=2.13(NE)
I=2.14(SE)
I=2.13(SW)

450mm RCP

100 mm HP FLOW

150mm PVC

VGC

VCC

CONCRETE

20 10 0 20 40
SCALE: 1"=20'

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No.	Date	Dr.By	Ck.By	App.By	Description	DATE
		A	P	P	R O V E D	

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 2 - Site Plan STA. 10-60 to 15+58

S-4

CADD NO.	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
	1	2180658	-	-	-	-

SCALE: AS NOTED

FILE NO.

SHEET 3 OF 3

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TABLES

TABLE 1 - SUMMARY OF EXISTING CONDITIONS

Property	Approximate Station Boundaries	Approximate Ground Surface Elevations at Back of Canal Wall (Feet NAVD88)	Surface Conditions
13 Wallis St	0+00 to 02+80	12 to 13	The property is currently a vacant lot with debris, gravel, and vegetation. The area adjacent to the canal is covered with trees and overgrown vegetation.
24 Caller St	02+80 to 08+16	11 to 12	The property is currently developed with several warehouse buildings, a gravel lot used for vehicle and drum storage, and an asphalt concrete paved driveway. Trees and vegetation line the edge of the canal wall.
Caller Street Bridge	08+16 to 08+65	12	Asphalt concrete paved roadway bridge with concrete sidewalks
21 Caller St	08+65 to 10+55	10 to 12	The property is currently developed with a three story commercial and residential building with a paved parking lot. The parking lot is retained by an approximately 3 to 6 foot high masonry retaining wall which runs parallel to the south wall of the canal. The area in between the retaining wall and the canal is about 10 feet wide, and is covered with trees, vegetation, and debris.
18 Howley St	10+55 to 11+49	8 to 9	The property is currently vacant. The area adjacent to the canal is covered with trees, vegetation, and debris including a granite rock pile.
166R Main St	11+49 to 14+25	7 to 9	The property is currently vacant. The Strongwater Brook canal meets the North River Canal at about Sta. 11+49 to 11+57. Asphalt pavement, rail ties, and old building foundations (raised slabs) exist close to the canal wall east of Strongwater Brook.

APPENDIX A

Riverwalk along North River Corridor – South Wall Evaluation – 2017

June 02, 2017

5 Centennial Drive, Peabody, MA 01960
Tel: 978.532.1900

Brendan Callahan
Planner
City of Peabody
24 Lowell Street
Peabody MA 01960-3111

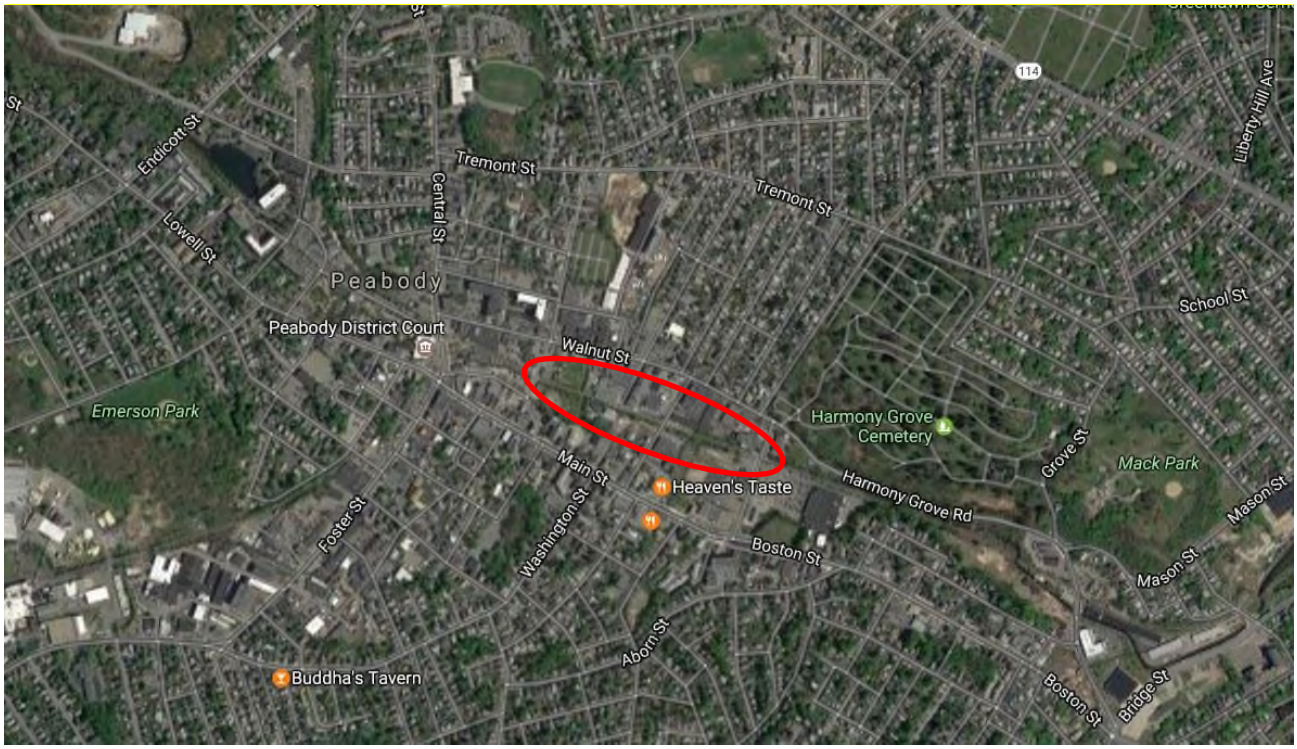
Re: **Riverwalk along North River Corridor – South Wall Evaluation**

Dear Mr. Callahan:

Weston and Sampson has completed the inspection and evaluation of the South Wall of the North River Corridor. This report provides a description of the structure, a summary of the observed conditions, evaluation of the overall condition, and recommendations for future action.

Purpose of the Inspection and Evaluation

The City of Peabody is investigating the possibility of constructing a Riverwalk along the south side of the North River Corridor between Wallis Street and Howley Street (See Project Location Map below). In 2008, sections of the walls forming the north side of the channel were repaired. At that time, the walls forming the south side of the channel were not included in the improvements. The purpose of this inspection and evaluation is to determine the general condition of the south wall, note observations, and recommend future actions. Observations and evaluation are broken up into two sections; those pertaining to the wall in its existing state and future considerations if a Riverwalk is to be constructed.



Project Location Map

Existing Information and Method of Inspection

Weston and Sampson reviewed existing information including previous work performed on the north canal wall, existing survey information, and existing subsurface investigation data. Existing plans of the wall were not available at the time of inspection.

Weston & Sampson performed a visual inspection of the wall and surrounding area. Measurements were taken using a survey wheel, survey tape, and tape measure. The canal was accessed in isolated areas with hip waders. Light probing of isolated scoured areas was performed using a ½" diameter steel foundation probe and a piece of steel reinforcing bar.

Wall Description

To aid in description of the wall a project stationing was chosen and used throughout this report to help illustrate extents and relative locations of observations. The stationing chosen matches the stationing previously used for the north wall repairs. This will avoid confusion in the future if both projects are reviewed simultaneously. The portion of wall nearest Wallis St is located between station 00-25 and 00-19. The western edge of the Howley St bridge is located at station 15+58. The limits of inspection and observation contained in this report extend from stations 00-25 to 15+58. See attached plan sheets (Appendix C) for a graphic illustration of the plan view and stationing. Additionally, a series of photos (Appendix A) and a summary table (Appendix B) are included to further illustrate/describe conditions and extents.

Starting near Wallis St the canal is initially oriented North/South and extends from the property at 15 Wallis St. beneath a timber railroad bridge. In this location, the west wall was inspected since it transitions into what will be the south wall for most of the canal. The west wall for this portion of the canal (STA. 00-25 to STA. 00-19) is of reinforced concrete construction and doubles as the bridge abutment and wingwall (See photo 001). South of the bridge the canal makes a 90 degree turn and transitions into an East/West orientation. Around the bend (STA. 00-19) the wall transitions from reinforced concrete construction to stone with mortar construction (See photos 002 to 003). The stone with mortar construction wall continues for 349 feet (STA. 00-19 to STA. 03+30) (See photos 003 to 009). The next 40 feet of wall (STA. 03+30 to STA. 03+70) consist of concrete construction on top of stone with mortar construction (See photos 009 to 011). At the end of the concrete construction the stone with mortar portion continues for 330 feet (STA. 03+70 to STA. 07+00) (See photos 012 to 017). At this point in the structure another concrete wall begins on top of the stone with mortar construction. This concrete on top of stone with mortar construction extends for 116 feet (STA. 07+00 to STA. 08+16) until it reaches the Caller Street Bridge (See photos 018 to 021).

The Caller Street Bridge appears to be founded on the next portion of wall which extends to the eastern edge of the bridge (STA. 08+16 to STA. 08+65) and is of granite block and mortar construction (See photos 022 to 026). East of the Caller Street Bridge the wall is of stone with mortar construction which extends for 100 feet (STA. 08+65 to STA. 09+65) (See photos 027 to 029). The next 95 feet of wall (STA. 09+65 to STA. 10+60) consist of stacked granite blocks on top of stone rubble without mortar (See photos 030 to 033). This is followed by an 89-foot section (STA. 10+60 to STA. 11+49) of full height stacked granite block construction which extends to the west bank of the Strongwater Brook canal (See photos 034 to 036).

The Strongwater Brook canal which is approximately 6-8ft wide meets the North River canal at this point. There is an abandoned railroad bridge (STA. 11+49 to STA. 11+57) which crosses the Strongwater Brook which is centered about 6 feet behind the south wall of the North River canal (See photos 037 to 038). East of the Strongwater Brook is a 68-foot section (STA. 11+57 to STA. 12+25) of earth embankment or buried wall (See photos 039 to 040). The next 100 feet of wall (STA. 12+25 to STA. 13+25) consist of stacked granite blocks without mortar (See photo 041 to 043). The following section of wall (STA. 13+25 to 13+35) is collapsed or missing (See photos 044 to 045). This section leads up to and continues through a 90-degree bend in the canal which transitions the canal into a North/South orientation. Following the bend (STA 13+35 to STA 13+36), the Eastern canal wall is made up of stacked granite blocks on top of stone rubble which extends to a timber railroad bridge (See photos 046 to 047).

The railroad bridge appears to rest on a granite slab which sits on top of the next section of wall which consists of a concrete cap on top of stacked granite blocks (See photo 048). This section of wall extends northward (STA. 13+40 to STA. 13+46) until the canal makes another 90-degree bend which transitions the canal back into an East/West orientation. East of the bend, the south canal wall is made up of a timber tie structure behind earth embankment (See photos 049 to 050). This section of wall extends until it meets the building located at 26 Howley St. which extends over the canal (STA. 13+46 to STA. 14+09). The timber tie structure continues behind the building's concrete columns for approximately 100 feet (STA. 14+09 to STA. 15+09) (See photos 051 to 052). East of the building is a section of earth embankment or buried wall which extends until it meets the Southwest wingwall for the Howley St. Bridge (STA. 15+09 to STA. 15+53) (See photo 053). The Howley St. Bridge Southwest wingwall which is of reinforced concrete construction protected by riprap slope extends approximately 5 feet until it meets the Howley St. Bridge (See photo 054).

Observations

See condition table in appendix for observations pertaining to both the existing condition and to future Riverwalk considerations.

Evaluation - Existing State

The wall condition varies drastically over the length of the structure ranging from good to poor. Wall conditions specific to each section along the length are noted in the photos in Appendix A, in the summary table in Appendix B, and in the plan sheets in Appendix C. Sections labeled as good are assumed to require minor or no repair to continue functioning acceptably. Sections labeled as fair are assumed to require more substantial repairs to continue functioning acceptably. Sections labeled as poor are assumed to require either full or partial reconstruction in order to function in an acceptable manor. The above assumed conditions are based on review of available existing materials and limited visual observation of the wall only. In general, most of the noted issues with the wall appear to be driven/exacerbated by waterflow, overgrown vegetation (such as trees with invasive roots), and changes in the surrounding conditions. In addition to addressing the issues it is recommended that addressing the cause of the issues be considered where possible.

Evaluation – Future Considerations for Riverwalk

In addition to the items mentioned above in the existing state evaluation, a number of additional items should be considered for the future Riverwalk. The proposed Riverwalk directly behind the south canal wall would apply additional loading to the wall beyond what it is currently subject to. Analysis of the wall for additional proposed loading would be required. As a result, modifications to sections noted as fair or good above may be required. Near Wallis street the proposed Riverwalk location appears to be close to the existing railroad line. A buffer or fencing may be required for safety. The land directly south of the wall is heavily vegetated containing plants, bushes, and trees. The vegetation would need to be cleared to install a walkway. The existing grading is not adequate for an ADA compliant walkway. The walkway would need to be relatively level both along the width and along the length of the walkway. To achieve ADA compliant grading sections of wall would need to be constructed or demolished and existing soil grades would need to be lowered or raised. Lowering and raising of grades is problematic with the existing grade occupying a flood zone. Adjusting the existing grades may require construction of new sections of wall south of the Riverwalk. Majority of the walkway adjacent to the canal would require railing. Some of the adjacent property lines appear to be very close to the south canal wall and property acquisition may be required to construct a Riverwalk. Caller Street Bridge railing termination extends beyond the bridge limits and appears to extend into the proposed Riverwalk location. Additionally, utilities and what appears to be a storm drain both appear to conflict with the proposed Riverwalk location. Any modifications to the Caller Street Bridge or it's railing may be subject to MassDOT Chapter 85 review. East of the Caller Street Bridge there is a large wall behind the south canal wall. Analysis of this wall would be required if the grades are modified or the loading condition is changed. At the Strongwater brook canal location the existing abandoned bridge structure does not appear to be adequate to carry a Riverwalk over Strongwater brook. A new bridge structure or extensive modifications to the existing structure may be required. East of the Strongwater brook canal it appears that existing railroad ties and

possibly rail may be abandoned in place and covered with asphalt. If present this could add difficultly to excavation or construction. An abandoned building foundation exists close to the south canal wall east of the Strongwater Brook Canal. Land may need to be acquired and this foundation would need to be partially demolished and a retaining structure may be required south of the Riverwalk to ensure any remaining portion is stable. Near Howley street the proposed Riverwalk location appears to be close to an active railroad line operated by Pan Am. A buffer or fencing may be required for safety.

Recommended Actions

1) Delineate the corridor to determine wetlands extents, and identify bordering vegetated wetlands.
2) Conduct additional field survey to supplement and update the existing survey.
3) Perform additional subsurface investigation to explore wall type and possible repair options. Recommended additional investigation measures and locations as shown on the attached plan sheets S-01 through S-03. Additional subsurface investigation may be necessary as design progresses.
4) Following the additional investigation mentioned in action items 1-3 above, create an alternative analysis report evaluating repair options which take into account the information gained in the above investigations to determine the correct course of action for wall repairs. The alternative analysis report would take into account structural, geotechnical, and environmental permitting considerations for each repair alternative and compare them based on anticipated durability, environmental impact, construction schedule, and cost.
5) Develop contract documents including detailed plans, specifications, and estimate to perform chosen wall repairs from report generated in action item 4.

If you have any questions regarding the above evaluation, please contact me at (978) 977-0110, ext 7402.

Sincerely,

WESTON & SAMPSON

Richard A. Campbell, PE
Senior Associate

Nathan L. Rosencranz, PE
Project Engineer

APPENDIX A

(PHOTOS)



Photo 001: STA 00-25 to STA 00-19 (Bridge Abutment – Good Condition)



Photo 002: STA 00-25 to STA 00-19 (Bridge Wing – Separating from Abutment)



Photo 003: STA 00-19 to 01+50 (Stone with Mortar – Good Condition)



Photo 004: STA 00-19 to 01+50 (Stone with Mortar – Good Condition)



Photo 005: STA 00-19 to 01+50 (Stone with Mortar – Good Condition)



Photo 006: STA 01+50 to 01+70 (Stone with Mortar – Poor Condition - Tree Growing Through Wall)



Photo 007: STA 01+70 to 02+30 (Stone with Mortar – Fair Condition)



Photo 008: STA 02+30 to 03+20 (Stone with Mortar – Good Condition)



Photo 009: STA 03+20 to 03+30 (Stone with Mortar – Poor Condition – Cap Stones Displaced by Tree)



Photo 010: STA 03+30 to 03+50 (Concrete over Stone with Mortar – Poor Condition – Rotation)



Photo 011: STA 03+50 to 03+70 (Concrete over Stone with Mortar – Poor Condition – Crack)



Photo 012: STA 03+70 to 04+80 (Stone with Mortar – Fair Condition)



Photo 013: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 014: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition – Example of Poor Area)



Photo 015: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 016: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 017: STA 06+35 to 07+00 (Stone with Mortar – Fair Condition – Aggressive Slope Behind)



Photo 018: STA 07+00 to 07+35 (Concrete over Stone with Mortar – Poor Condition – Broken up with Voids)



Photo 019: STA 07+35 to 08+16 (Concrete on top of Stone with Mortar – Fair Condition – Rotating)



Photo 020: STA 07+35 to 08+16 (Concrete on top of Stone with Mortar – Fair Condition – Middle Joint)



Photo 021: STA 07+35 to 08+16 (Concrete on top of Stone with Mortar – Fair Condition – Joint at Bridge)



Photo 022: STA 08+16 to 08+35 (Concrete Abutment on Granite Block with Mortar – Fair Condition)



Photo 023: STA 08+16 to 08+35 (Concrete Abutment on Granite Block with Mortar – Fair Condition)



Photo 024: STA 08+16 to 08+35 (Concrete Abutment on Granite Block with Mortar – Fair Condition)



Photo 025: STA 08+16 to 08+35 (Caller St. Bridge – Bridge Rail)



Photo 026: STA 08+16 to 08+35 (Caller St. Bridge – Utilities)



Photo 027: STA 08+65 to 09+65 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 028: STA 08+65 to 09+65 (Stone with Mortar – Closeup of Isolated Poor Condition)



Photo 029: STA 08+65 to 09+65 (Stone with Mortar – Closeup of Isolated Poor Condition)



Photo 030: STA 09+65 to 09+75 (Stacked Granite Block on Stone Rubble – Poor Condition)



Photo 031: STA 09+75 to 10+10 (Stacked Granite Block on Stone Rubble – Fair with Isolated Poor Condition)



Photo 032: STA 10+10 to 10+60 (Stacked Granite Block on Stone Rubble – Poor Condition)



Photo 033: STA 10+10 to 10+60 (Stacked Granite Block on Stone Rubble – Condition Behind Wall)



Photo 034: STA 10+60 to 11+49 (Stacked Granite Block – Fair with Isolated Poor Condition)



Photo 035: STA 10+60 to 11+49 (Stacked Granite Block – Fair with Isolated Poor Condition)



Photo 036: STA 10+60 to 11+49 (Stacked Granite Block – Fair with Isolated Poor Condition)



Photo 037: STA 11+49 to 11+57 (Strongwater Brook – Abandoned RR Bridge)



Photo 038: STA 11+49 to 11+57 (Strongwater Brook – Abandoned RR Bridge)



Photo 039: STA 11+57 to 12+25 (Earth Embankment or Buried Wall – Poor Condition)



Photo 040: STA 11+57 to 12+25 (Earth Embankment or Buried Wall – Poor Condition)



Photo 041: STA 12+25 to 13+25 (Stacked Granite Block – Poor Condition)



Photo 042: STA 12+25 to 13+25 (Stacked Granite Block – Abandoned Timber Ties)



Photo 043: STA 12+25 to 13+25 (Stacked Granite Block – Condition Behind Wall)



Photo 044: STA 13+25 to 13+35 (Collapsed or Missing Wall – Poor Condition)



Photo 045: STA 13+25 to 13+35 (Collapsed or Missing Wall – Condition Behind Wall)



Photo 046: STA 13+35 to 13+40 (Stacked Granite Block on Stone Rubble – Poor Condition)



Photo 047: STA 13+35 to 13+40 (Stacked Granite Block on Stone Rubble – Condition Behind Wall)



Photo 048: STA 13+40 to 13+46 (Stacked Granite with Concrete Cap – Fair with Isolated Poor Condition)



Photo 049: STA 13+46 to 14+09 (Timber Tie Behind Earth Embankment – Poor Condition)



Photo 050: STA 13+46 to 14+09 (Timber Tie Behind Earth Embankment – Poor Condition)



Photo 051: STA 14+09 to 15+09 (Timber Tie Behind Concrete Columns – Poor Condition)



Photo 052: STA 14+09 to 15+09 (Timber Tie Behind Concrete Columns – Poor Condition)



Photo 053: STA 15+09 to 15+53 (Earth Embankment or Buried Wall – Poor Condition)



Photo 054: STA 15+09 to 15+53 (Reinforced Concrete with Riprap Protection – Good Condition)

APPENDIX B

(SUMMARY TABLE)

STATION	WALL TYPE	Observations - Existing Condition	Observations - Riverwalk Considerations	PHOTOS
00-25				
	Reinforced Concrete	Bridge Abutment - Good Condition Bridge Wing - Seperating from Abutment w/ minor vegetation growth in seperation		001 - 002
00-19				
	Stone w/ Mortar	Good Condition w/ isolated scour locations below the water line	Heavy vegetation behind. Ground behind wall slopes down to top of wall	003 - 005
01+50				
	Stone w/ Mortar	Poor Condition - Tree growing through wall - breaking joints and dislodging stones	Heavy vegetation behind. Ground behind wall slopes down to top of wall	006
01+70				
	Stone w/ Mortar	Fair Condition - Failing mortar joints and dislodged stones	Heavy vegetation behind. Ground behind wall slopes down to top of wall	007
02+30				
	Stone w/ Mortar	Good Condition w/ isolated scour locations below the water line	Heavy vegetation behind. Ground behind wall approximately level	008
03+20				
	Stone w/ Mortar	Poor Condition - Cap stones displaced by tree	Heavy vegetation behind. Ground behind wall approximately level	009
03+30				
	Concrete Wall on top of Stone wall w/ Mortar	Poor Condition - Concrete section rotating due to tree	Heavy vegetation behind. Ground behind wall approximately level	010
03+50				
	Concrete Wall on top of Stone wall w/ Mortar	Poor Condition - Concrete section cracked	Heavy vegetation behind. Ground behind wall approximately level	011
03+70				
	Stone w/ Mortar	Fair Condition - Failing mortar joints and dislodged stones	Heavy vegetation behind. Ground behind wall slopes down to top of wall	012
04+80				
	Stone w/ Mortar	Fair Condition with Isolated Poor Areas Failing mortar joints and dislodged stones stones displaced by trees in poor areas abandoned foundation behind appears to be forcing tree roots into wall	Abandonded Foundation behind wall appears to conflict with proposed riverwalk Removing the abandoned foundation may require additional wall south of riverwalk It appears that property acquisition would likely be requred at this location Heavy vegetation behind wall Ground behind wall slopes down to top of wall	013 - 016
06+35				
	Stone w/ Mortar	Fair Condition - failing mortar joints and dislodged stones	Aggressive slope behind wall. About a 3 ft drop over a 3 ft width Slope retained by loose granite blocks, some appear to have slid into the water May need to cut slope and add wall or retain with riprap Heavy vegetation on slope	017
07+00				
	Concrete Wall on top of Stone wall w/ Mortar	Poor Condition - Concrete section broken up w/ large voids	Heavy vegetation behind. Ground behind sloped down to wall.	018
07+35				
	Concrete Wall on top of Stone wall w/ Mortar	Fair Condition - Concrete Wall looks to be in good shape, but appears to be rotating	Heavy vegetation behind. Ground behind wall approximately level	019 - 021

STATION	WALL TYPE	Observations - Existing Condition	Observations - Riverwalk Considerations	PHOTOS
08+16				
	Caller Street Bridge Concrete Bridge abutment on top of granite block w/ mortar	Fair Condition - Concrete Abutment appears to be in good shape, Failing mortar joints and dislodged blocks in granite below Repairing joints may be subject to MassDOT Chapter 85 review process	Approach guardrail is damaged and appears to conflict with proposed riverwalk location Modifying guardrail may be subject to MassDOT Chapter 85 review process	022 - 026
08+65				
	Stone w/ Mortar	Fair Condition with Isolated Poor Areas Local Poor area around 08+90 Local Poor area about 09+35 to 09+45	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	027 - 029
09+65				
	Stacked Granite Block on Stone Rubble (No Mortar)	Poor Condition - Top section of wall missing or collapsed Tree growing through wall.	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	030
09+75				
	Stacked Granite Block on Stone Rubble (No Mortar)	Fair Condition with Isolated Poor Areas Trees disrupting/Growing through wall Irregular spaces between blocks / blocks misaligned	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	031
10+10				
	Stacked Granite Block on Stone Rubble (No Mortar)	Poor Condition - Granite Blocks missing or collapsed Blocks/Stones in canal adjacent to wall Trees disrupting/Growing through wall	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	032-033
10+60				
	Stacked Granite Block (No Mortar)	Fair Condition with Isolated Poor Areas Trees disrupting/Growing through wall Irregular spaces between blocks / blocks misaligned	Heavy vegetation behind. Ground behind sloped down to wall. Pile of granite behind wall would need to be moved or removed	034 - 036
11+49				
	Strongwater Brook Abandoned RR Bridge	No Wall in this region	Existing bridge consists of Rolled Steel beams encased in concrete at each end Beam spacing is about 5~ which does not appear adequate for proposed riverwalk Beam webs are heavily deteriorated and bridge has no deck Bridge would require repair and additional beams and deck to support walkway New bridge may be a better option	037 - 038
11+57				
	Earth Embankment or Buried Wall	Poor Condition - Wall is missing or buried	Heavy vegetation behind. Ground sloped down to wall. Ground behind is paved over existing railroad ties and possibly rails	039 - 040
12+25				
	Stacked Granite Block (No Mortar)	Poor Condition Irregular spacing between blocks. Blocks misaligned. Some blocks appear to be missing.	Heavy vegetation behind. Ground sloped down to wall. Ground behind is paved over existing railroad ties and possibly rails Abandoned foundation close behind canal wall Abandoned foundation would require demolition and possibly new wall construction It appears that property acquisition would likely be requred at this location	041 - 043

STATION	WALL TYPE	Observations - Existing Condition	Observations - Riverwalk Considerations	PHOTOS
13+25				
	Collapsed or missing wall	Poor Condition - Wall is collapsed or missing	Heavy vegetation behind. Ground sloped down to wall. Ground behind is paved over existing railroad ties and possibly rails Abandoned foundation close behind canal wall Abandoned foundation would require demolition and possibly new wall construction It appears that property acquisition would likely be requred at this location	044 - 045
13+35				
	Stacked Granite Block on Stone Rubble	Poor Condition Irregular joint spacing Misaligned Blocks	Heavy vegetation behind. Abandoned foundation close behind canal wall Abandoned foundation would require demolition and possibly new wall construction It appears that property acquisition would likely be requred at this location	046 - 047
13+40				
	Stacked Granite Block with Concrete Cap	Fair Condition with Isolated Poor Areas Irregular joint spacing Large crack with apparent differential settlement	Proposed riverwalk is not anticipated to impact this section of wall	048
13+46				
	Timber Tie behind Earth Embankment	Poor Condition Timber ties appear to be heavily deteriorated and rotated Earth Embankment is overgrown	Proposed riverwalk is not anticipated to impact this section of wall	049 - 050
14+09				
	Timber Tie behind Concrete Columns	Fair Condition Timber ties appear deteriorated Concrete columns exhibit cracking	Proposed riverwalk is not anticipated to impact this section of wall	051 - 052
15+09				
	Earth Embankment or Buried Wall	Poor Condition - Wall is missing or buried	Proposed riverwalk is not anticipated to impact this section of wall	053
15+53				
	Reinforced Concrete with Riprap Protection	Good Condition	Proposed riverwalk is not anticipated to impact this section of wall	054
15+58				

APPENDIX C

(PLANS)

N

Current Wall Condition
Good
Fair
Poor

E (P–#) EXISTING PROBE
E (B–#) EXISTING SOIL BORING
P (B–#) PROPOSED SOIL BORING
E (TP–#) EXISTING TEST PIT
P (TP–#) PROPOSED TEST PIT
WF–# WETLANDS FLAG FROM NORTH WALL REPAIR PROJECT

85–38±
0

85–39
0

85–41
15 WALLIS ST

85–37
45 WALNUT ST

85–36
49 WALNUT ST

85–39B
0 WALNUT

85–39A
0

APPROXIMATE LOCATION OF 78 IN. SEWER

CONCRETE VAULT

SMH R=15.70

SMH R=15.84

SMH R=12.09

WALLIS STREET

NORTH RIVER CANAL

WF1 WF2 WF3 WF4 WF5 WF6 WF7 WF8 WF9 WF10 WF11 WF12 WF13 WF14 WF15 WF16 WF17 WF18 WF19 WF20 WF21 WF22 WF23 WF24 WF25 WF26 WF27 WF28 WF29 WF30 WF31 WF32 WF33 WF34 WF35 WF36 WF37 WF38 WF39 WF40 WF41 WF42 WF43 WF44 WF45 WF46 WF47 WF48 WF49 WF50 WF51 WF52 WF53 WF54 WF55 WF56 WF57 WF58 WF59

E (B–84)
E (B–89)
E (B–85)
E (P1–2)
E (P2–2)
E (TP5)
E (B–1)
E (B–4)
E (BWS–1)
E (B–5 (MW–2))
E (B–2)
E (B–3 (MW–4))
E (B–6)
E (B–8 (MW–3))
E (B–7 (MW–1))

APPROXIMATE EDGE OF WATER

PROPANE TANK

86–142A
24 CALLER ST

86–142B
0 CALLER ST

GOOD
GOOD
POOR
FAIR
GOOD
POOR
POOR
POOR
FAIR

00–25 00–19 0+00 1+00 01+50 01+70 2+00 02+30 3+00 03+20 03+30 03+50 03+70 4+00 04+80

STONE WALL WITH MORTAR
CONCRETE WALL ON TOP OF STONE WITH MORTAR
REINFORCED CONCRETE (BRIDGE ABUT+WING)
100 FT WETLAND BUFFER
200' RIVER FRONT PROTECTION AREA

85–41B
9 WALLIS ST

85–72A
17 WALLIS ST

85–72
82 MAIN ST

20 10 0 20 40
SCALE: 1"=20'

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No.	Date	Dr.By	Ck.By	App.By	Description	DATE
A					APPROVED	

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

South Wall Evaluation STA. 00-25 to 04+80

CADD NO.	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
-	1	21770345	-	-	-	-

SCALE: AS NOTED

S-1

FILE NO.

SHEET 1 OF 3

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N

E (P-#) EXISTING PROBE

E (B-#) EXISTING SOIL BORING

P (B-#) PROPOSED SOIL BORING

E (TP-#) EXISTING TEST PIT

P (TP-#) PROPOSED TEST PIT

WF-# WETLANDS FLAG FROM NORTH WALL REPAIR PROJECT

Current Wall Condition
Good
Fair
Poor

85-39B
0 WALNUT ST

86-140
65 WALNUT ST

86-140
65 WALNUT ST

86-139
75 WALNUT ST

86-139
75 WALNUT ST

86-141
27 CALLER ST

86-141
27 CALLER ST

APPROXIMATE LOCATION OF 78 IN. SEWER

APPROXIMATE LOCATION OF 78 IN. SEWER

SMH R=12.08

SMH R=11.97

SMH R=10.50

SMH R=10.68

SMH R=11.58

SMH R=12.60

SMH R=13.48

STA 5057

STA 5+88

JZ120

JZ120

SKZ24

SKZ24

E (P2-1)

E (P3-2)

E (P4-2)

E (TP4)

E (TP3)

E (TP2)

E (B-82)

E (B-81)

E (BWS-4)

E (BWS-3)

WF45 WF44 WF43 WF42 WF41 WF40 WF39 WF38 WF37 WF36 WF35 WF34 WF33 WF32 WF31 WF30 WF29 WF28 WF27 WF26 WF25 WF24 WF23 WF22 WF21 WF20 WF19 WF18 WF17

NORTH RIVER CANAL

NORTH RIVER CANAL

3'-0"

P (TP1)

P (TP2)

P (TP3)

P (TP4)

P (TP5)

GRANITE BLOCK PILE

APPROXIMATE EDGE OF WATER

CALLER STREET

04+80	5+00	6+00	06+35	7+00	07+35	8+00	08+16	08+65	9+00	09+65	09+75	10+00	10+10	10+60
FAIR WITH ISOLATED POOR		FAIR		POOR		FAIR	FAIR	FAIR WITH ISOLATED POOR		POOR	FAIR WITH ISOLATED POOR		POOR	
STONE WITH MORTAR						CONCRETE WALL ON TOP OF STONE WITH MORTAR	CONCRETE BRIDGE ABUTMENT ON GRANITE BLOCK WITH MORTAR	STONE WITH MORTAR			STACKED GRANITE BLOCK ON STONE RUBBLE (NO MORTAR)			STACKED GRA

86-142B
0 CALLER ST

86-142B
0 CALLER ST

86-143
24 CALLER ST

86-144
22 CALLER ST

86-150B
0

86-151
0

20 10 0 20 40
SCALE: 1"=20'

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No.	Date	Dr.By	Ck.By	App.By	Description	DATE
					A P P R O V E D	

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

South Wall Evaluation STA. 04-80 to 10+60

CADD NO.	SCALE: AS NOTED	CONTRACT: 1	JOB NO. 2170345	DR.BY -	DSN.BY -	CHK.BY -	APP.BY -

S-2

FILE NO.

SHEET 2 OF 3

N

E (P-#) EXISTING PROBE

E (B-#) EXISTING SOIL BORING

P (B-#) PROPOSED SOIL BORING

E (TP-#) EXISTING TEST PIT

P (TP-#) PROPOSED TEST PIT

WF-# WETLANDS FLAG FROM NORTH WALL REPAIR PROJECT

Current Wall Condition

Good

Fair

Poor

86–139
5 WALNUT ST

86–141
CALLER ST

86–138
77 WALNUT ST

86–150
166 MAIN ST

86–150A
166 MAIN ST (R)

N/F
26 HOWLEY STREET TRUST
"FLEA MARKET"

1 STORY BRICK

3 STORY BRICK

1 STORY CONC. BLOCK ON CONC PIERS (RIVER BELOW)

(EL. UNDER BLDG)

N/F
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

N/F
THE AZOREAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC.

1 STORY CONC. BLOCK

1 STORY WOOD FRAME

STREET

HOWLEY

APPROX. L.O. LINE

CONSTRUCTION BASELINE (SEE NOTE 3)

N18°47'42"E 112.00'

CONNECTION FROM CATCH BASINS UNKNOWN

300mmCMP

300mm PVC

TOP STEP EL=

RAMP

FF EL.=3.716

FF EL.=4.171

FF EL.=3.457 (CONC. THRESH)

FF EL.=3.443 (CONC. THRESH)

CLOSED PIPE STRAIGHT THRU MANHOLE DOWN 1.3m

BITUMINOUS

CONCRETE

"RR CROSSING"

"NO PARKING"

"STOP"

"WEIGHT LIMIT"

CONST. B

GRANITE BLOCK RET. WALL

PORTION OF CONC. FOUNDATION ON GRANITE WALL

0.6m sq. CONC. PIER (TYP.) EL=3.127

RAILROAD TIE RET. WALL

GRANITE BRIDGE SUPPORTS

PK NAIL "HOW 1" EL=2.887

STONE BRIDGE

SESD DISK "B1125"

150mm INV=1.9

FLOW

NORTH RIVER

-0+55 -0+50 -0+40 -0+30 -0+20 -0+10 0+00 0+10 0+20

10+60 11+00 11+49 11+57 12+00 12+25 13+00 13+25 13+35 13+36 13+46 14+00 14+09 15+00 15+09 15+53 15+58

POOR

FAIR WITH ISOLATED POOR

STACKED GRANITE BLOCK (NO MORTAR)

EARTH EMBANKMENT OR BURIED WALL

STACKED GRANITE BLOCK (NO MORTAR)

TIMBER TIE BEHIND EARTH EMBANKMENT

TIMBER TIE BEHIND CONCRETE COLUMN

EARTH EMBANKMENT OR BURIED WALL

GOOD

BRIDGE

COLLAPSED/MISSING WALL

STACKED GRANITE BLOCK WITH CONCRETE CAP

STACKED GRANITE BLOCK ON STONE RUBBLE

REINFORCED CONCRETE WITH RIPRAP PROTECTION

CONCRETE FOUNDATION

MAG NAIL SET

APPROXIMATE EDGE OF WATER

RAINES DOCK PILE

P (TP5)

E (TP1)

E (BWS-1)

E (BWS-2)

P (B-1)

P (B-2)

P (B-3)

WF25 WF26 WF27 WF28 WF29 WF30 WF31 WF32 WF33 WF34 WF35

R=3.348 I=2.49(IN) I=2.45(OUT)

R=3.116 I=2.51

R=3.076 I=2.46

R=2.936 I=2.22

R=2.733 STONE SHELF EL=1.93 NPO

R=2.995 I=0.19(IN) I=0.92(OUT)

R=2.810 NPO

R=3.012 BOT. VAULT = 0.878

R=2.821 I=0.75(IN) I=0.05(OUT)

R=2.635 PIPE BLOCKED H2O EL=1.66

R=2.708 PIPE BLOCKED H2O EL=1.63

R=2.870 I=1.62(N) I=1.59(OUT)

R=2.787 I=2.13(NE) I=2.14(SE) I=2.13(SW)

VAULT

POSSIBLE END OF GAS LINE – SCALED FROM GAS PLANS

#8 W/TRANS

#55–4 W/RISER SL & TRANS

#55–5 W/RISER

#26

#22

#20

BM#1

BM#3

BM#4

20 10 0 20 40
SCALE: 1"=20'

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No.	Date	Dr.By	Ck.By	App.By	Description	DATE
A					APPROVED	

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

South Wall Evaluation STA. 10-60 to 15+58

CADD NO.	SCALE: AS NOTED	CONTRACT: 1	JOB NO. 21703345	DR.BY -	DSN.BY -	CHK.BY -	APP.BY -

FILE NO.

S-3

SHEET 3 OF 3

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APPENDIX B

Engineering Evaluation & Design Alternative Analysis Report

Weston & Sampson

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REPORT

March 2019

Engineering Evaluation & Design Alterative Analysis

Prepared for:

CITY OF
Peabody
MASSACHUSETTS

Funded by:

MASSACHUSETTS EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS (MASSEEA)

MUNICIPAL VULNERABILITY
PREPAREDNESS (MVP) ACTION GRANT

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EXECUTIVE SUMMARY

In 2018, the City of Peabody (the City) was awarded a Municipal Vulnerability Preparedness (MVP) Action Grant by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA). The MVP grant will allow the City to explore options for improving the flood resiliency of Peabody Square and was awarded based on a comprehensive project proposal to specifically target a stretch of the North River Canal that will improve flood resilience, address site contamination from historic use as a tannery district and evaluate a park resource and Riverwalk that would enhance public access and vitality of the area.

The proposed Riverwalk will be approximately 1,600 feet in length, following along the canal in the urban industrial section of downtown Peabody from approximately Wallis Street to Howley Street. The existing wall on the south side of the canal over the length of the proposed Riverwalk varies drastically in condition from good to poor. In 2017, Weston & Sampson determined that prior to the construction of the Riverwalk, the south canal wall would need to be repaired / replaced in order to support the construction of the proposed Riverwalk.

Weston & Sampson, on behalf of the City, has performed subsurface explorations immediately behind the Canal wall to obtain back of existing wall information, including wall type, dimensions, and subsurface conditions. Using that information, Weston & Sampson was able to perform preliminary geotechnical and structural analyses to evaluate repair/replacement design alternatives for the wall. Additional grant activities also included limited environmental sampling activities to better understand potential regulatory obligations under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000.

Weston & Sampson has developed five (5) design repair/replacement alternatives for the south canal wall to support the construction of a Riverwalk and improve flood resilience along the North River Canal. Wall alternatives include options for replacing the current wall with a new wall, as well as green options like providing protection with an earthen berm. Preliminary engineering cost estimates for each alternative have been provided. Weston & Sampson then conducted a preliminary analysis to evaluate the five (5) wall alternatives based on factors such as resiliency, anticipated durability, environmental impact, permitting, schedule, and costs. This was used to rank and prioritize alternatives for the wall.

Based upon the findings and comparative evaluations presented in this report, Alternative C – Sheet Pile Option 2 with Sloped Bank ranked as the highest scoring alternative. This alternative would provide the most additional flood storage with relatively low total cost and minimal maintenance when compared to other alternatives. In addition, Alternative C – Sheet Pile Option 2 with Sloped Bank requires a reasonable easement width from private property owners, would allow for the design of an adjacent Riverwalk, does not require any material to be dredged from the canal and had the highest total permitting favorability.

However, while this alternative works from a conceptual engineering and permitting evaluation perspective, Alternative C – Option 2 may not be feasible along the entire length of the wall due to existing structures and grade and may require a limited length of one of the other wall alternatives to be considered. The feasibility in such areas will need to be further evaluated during the preliminary design process and may depend on other factors such as property easements or acquisition potential.

Other well-scoring alternatives were: Alternative C - Sheet Pile Wall - Option 1; Alternative B - Vegetative Berm - Option 1; and Alternative A - Rip Rap - Option 1. The highest-ranking wall option, Alternative C - Sheet Pile Wall - Option 2 with Sloped Bank, combines all the favorable qualities of Alternatives A and B with the favorable qualities of Alternative C - Sheet Pile - Option 1 and provides the highest percentage of potential parcel protection for all six flood-climate change projection scenarios.

1.0 INTRODUCTION

The City of Peabody suffers from recurring flooding which is expected to worsen from climate change, including sea level rise and increased precipitation frequency and intensity. In 2018, the City of Peabody (the City) was awarded a Municipal Vulnerability Preparedness (MVP) Action Grant by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA). The MVP grant will allow the City to explore options for improving the flood resiliency of Peabody Square and was awarded based on a comprehensive project proposal to specifically target a stretch of the North River Canal that will improve flood resilience, address site contamination from historic use as a tannery district and evaluate a park resource and proposed Riverwalk that would enhance public access and vitality of the area. The North River Canal is a straightened and walled reach of the North River connecting Peabody Square to the tidal reach of the North River near the Salem-Peabody municipal boundary. The North River drainage basin discharges into Salem Sound

The proposed Riverwalk will be approximately 1,600 feet in length, following along the canal (i.e. Proctor Brook) in the urban industrial section of downtown Peabody from approximately Wallis Street to Howley Street. The south side of the canal abuts six (6) privately owned properties (from west to east: 13 Wallis Street, 24 Caller Street, [Caller Street crossing], 21 Caller Street, 18 Howley Street, 166R Main Street, and Massachusetts Bay Transit Authority (MBTA) property]. The existing wall on the south side of the canal over the length of the proposed Riverwalk varies drastically in condition from good to poor. In 2017, Weston & Sampson determined that prior to the construction of the Riverwalk, the south canal wall would need to be repaired / replaced in order to support the construction of the proposed Riverwalk.

This report presents the results of Weston & Sampson's geotechnical and structural feasibility studies that were conducted in the target area along the North River Canal as part of MVP Grant activities. The purpose of this engineering evaluation was to preliminarily explore subsurface conditions and assess geotechnical, environmental, structural, and regulatory permitting considerations for for repair/replacement alternatives for the North River Canal south wall to support the proposed Riverwalk.

The recommendations presented in this report are based on Weston & Sampson's understanding of the proposed project as described herein, subsurface conditions encountered at discrete exploration locations, and the provisions of the Limitations, provided in Section 11, of this report. Additional investigations, testing, and recommendations will be necessary for final design.

1.1 Project Understanding

The project site is in an urban industrial area of Peabody, between Wallis and Howley Streets, and crosses Caller Street, as shown in ***Figure 1 – Site Locus***. The south side of the North River Canal along the project limits abuts six (6) privately owned properties, from west to east: 13 Wallis Street, 24 Caller Street, [Caller Street crossing], 21 Caller Street, 18 Howley Street, 166 Main Street (R), and MBTA property. Refer to ***Figure 1*** and ***Figure 2 – Site Plan*** for the property limits, and ***Table 1 – Summary of Existing Conditions*** for a summary of existing conditions within the project area. Construction of the park and Riverwalk will require property acquisition or easements on these private properties.

The south canal wall along the length of the project limits consists of multiple sections including earthen embankment (or possible buried wall), a stacked timber railroad tie structure behind an earth embankment, reinforced concrete, granite blocks, or stone or stone rubble sections. Wall heights range from about 4 to 6 feet above the canal bottom. The wall's condition varies over its length, ranging from good, in need of minor or no repairs, to poor, requiring full or partial reconstruction. Refer to Weston & Sampson's report titled "Riverwalk along North River Corridor – South Wall Evaluation," dated June 2,

2017, in *Appendix A* for detailed description of the existing wall types and conditions along the project alignment.

The North River Canal has a history of flooding. The overall goal of the MVP grant project is to evaluate and incorporate resilient design measures to provide flood protection during storm events, which may include floodwater storage, increased canal wall height, and/or widening of the canal.

Proposed site development plans, including site grading, canal wall alignment and proposed elevations, were not developed at the time of this report.

2.0 DESCRIPTION OF EXISTING SITE CONDITIONS

2.1 Existing Wall Structure

In May and June of 2017, Weston & Sampson documented the existing conditions of the south wall in a report titled "Riverwalk along North River Corridor – South Wall Evaluation," dated June 2, 2017. In the report, Weston & Sampson recommended repair or replacement to sections of the wall for support of new loads associated with the proposed Riverwalk. The visual inspection performed on the south wall of the North River Corridor revealed that the wall's condition varies drastically over its length. Conditions range from "good," which need minor or no repairs, to "poor," which require full or partial reconstruction. Causes of deterioration include waterflow, overgrown vegetation (roots), and changes in the surrounding land conditions due to lack of maintenance. Materials used in construction of the wall vary along the wall's length and include earth embankment or buried wall, a timber tie structure behind earth embankment, reinforced concrete, granite blocks, and stone or stone rubble.

2.2 Existing Subsurface Conditions

2.2.1 Geologic Setting

Based on information available from the Massachusetts Office of Geographic Information (MassGIS), surficial geology conditions at the site are mapped as fine glaciomarine deposits overlying thin till and bedrock at depths less than 50 feet. Bedrock in the area of the site is mapped as the Peabody Granite formation. The nearest mapped bedrock outcrops are located approximately a quarter mile from the site, north of the North River Canal.

2.2.2 Subsurface Explorations

A total of ten (10) borings and five (5) test pits were completed in the past during previous subsurface explorations in the area. The following studies provide subsurface data relevant to our geotechnical assessment. The explorations are described below.

2002 Explorations by Geotechnical Services, Inc:
Six (6) borings, herein referred to as B-1(GSI) through B-6(GSI), were completed at the 13 Wallis Street property between October 31 and November 4, 2002 for a multi-family housing development proposed at the time. Boring depths ranged from 17 to 40 feet. The borings were performed by New Hampshire Boring, Inc. (now New England Boring Contractors) of Derry, New Hampshire, and logged by Geotechnical Services, Inc. (GSI) of Goffstown, New Hampshire. Approximate boring locations are shown in ***Figure 2***, and the boring logs prepared by GSI are included ***in Appendix B – Previous Subsurface Explorations – Boring Logs.***

2007 Explorations by Weston & Sampson:
Weston & Sampson explored subsurface conditions in the project area by advancing four (4) borings (WS-1 through WS-4) between March 21 and 23, 2007 during a previous phase of the North River Canal project. The borings were advanced to depths up to 41 feet below grade at the approximate locations shown on ***Figure 2***. Geologic Earth Explorations, Inc of Norfolk, MA performed the borings using drive and wash drilling methods. Boring logs from the 2007 explorations are included in ***Appendix B***.

The 2007 explorations also included five (5) test pits (TP-1 through TP-5) to observe the back of the canal wall. Test pits TP-1 through TP-4 were located at the north wall of the canal, outside of the current project area. TP-5 was located within the project area at 13 Wallis Street, at the approximate location shown on ***Figure 2*** (labelled TP-5(2007) on the figure). Photographs showing the conditions observed

in the test pit are included in *Appendix B*.

2.3 Existing Soil Contamination

There is known or suspected soil contamination along the proposed Riverwalk area that will need to be addressed as part of proposed wall repair activities and construction of the Riverwalk. Most of the area was formerly a tannery and it has known and potential environmental impacts. Weston & Sampson, on behalf of the City, conducted limited subsurface environmental assessments at several of the properties within the proposed Riverwalk area in 2017. Copies of the reports are provided in Appendix C - 2017 Limited Subsurface Investigations – Proposed Riverwalk Area. Additional information regarding known, existing current environmental conditions and recommendations to comply with the requirements of the Massachusetts Contingency Plan (MCP) are provided in Section 4.0 – Environmental Considerations and Recommendations.

2.4 Existing Flood Issues

The City of Peabody has suffered from recurring flooding events since the 1950's, with the most significant flooding occurring downtown in Peabody Square. Significant floods occurred in 1954, 1968, 1979, 1987, 1996 and 2006. In the past, flooding was largely attributed to post-WWII development and decreased discharge capacity of watercourses in downtown Peabody. However, flooding events have become more frequent with climate change. As noted in the 2008 Preliminary Design of Flood Mitigation Facilities for Peabody Square Area Report, developed for the City, Peabody experienced flooding in October 1996, June 1998, March 2001, April 2004, and May 2006. Three of these events were declared Federal Disasters and caused significant impacts to public safety and public health, substantial property damage, and widespread economic losses. Major transportation arterials that connect to I-95 and MA Routes 128 and 114 as well as commercial rail service were closed for several days. The May 2006 event alone caused the following significant impacts:

- The City's main fire station and police department were isolated by floodwaters for several days. FEMA estimated the cost of this impact at $1.4 million.
- Emergency responses during the flooding cost the City approximately $360,000.
- FEMA estimated the loss of associated with road closures, delays, and detours cost $4.2 million.
- FEMA insurance claims were paid to home and business owners to a total of more than $4.6 million.

The City also experienced significant flooding in March 2010, October 2011 and December 2014 from short duration and intense rain events.

Flooding in the project area is largely due to high flows in the North River Canal caused by precipitation in the upgradient watersheds of Procter Brook and the North River (Metcalf & Eddy-AECOM, 2008). Precipitation events are projected to be more extreme due to climate change, which would exacerbate riverine flooding in the project area. Currently tidal influences at Mean Higher High Water (MHHW) extend approximately 230 feet upstream of Howley Street (Metcalf & Eddy-AECOM, 2008). Sea level rise is expected to extend tidal influences further upstream into the project area.

The flood events negatively impact area businesses and make it difficult for Fire and Police Department staff to respond to emergencies.

3.0 SUBSURFACE INVESTIGATION ACTIVITIES

Weston & Sampson explored subsurface conditions in the project area by overseeing the advancement of six (6) borings (B-1 through B-6) and six (6) test pits (TP-1 through TP-6) between November 5 and 9, 2018. The borings extended to depths of up to 22 feet below grade. The test pit excavations were terminated due to groundwater seepage at depths ranging from 5.6 to 6.8 feet. The approximate exploration locations are shown on Figure 2.

New England Boring Contractors (NEBC) of Derry, New Hampshire advanced the borings using an ATV or truck-mounted drill rig and drive and wash drilling methods. Standard penetration tests (SPTs) were conducted at 2-foot to 5-foot intervals using a standard 24-inch long by 1-3/8-inch inside diameter (2-inch outside diameter) split spoon sampler driven by blows from a 140-pound safety hammer falling 30 inches. Following completion of drilling, the borings were backfilled with soil cuttings.

NEBC excavated the test pits along the back of the existing canal wall using a Kubota U17 excavator with a toothed bucket. The test pits were backfilled with the excavated soil upon completion.

Weston & Sampson geotechnical engineering staff monitored drilling and test pit activities in the field and prepared logs for each boring. A Weston & Sampson structural engineer was also onsite to observe the structural characteristics of the back of the canal wall during test pit activities. Weston & Sampson environmental staff was on site to collect the representative soil samples for disposal characterization data to support the potential excavation and off-site disposal of soil associated with future repairs to the canal wall and construction of the Riverwalk. Boring and test pit logs from the 2018 explorations are included in Appendix D.

A description of the subsurface conditions based on the 2002 borings by GSI and the 2007 and 2018 borings by Weston & Sampson is provided below. Refer to Table 2 – Summary of Subsurface Conditions for a summary of the explorations. The conditions of the existing canal wall observed in the test pits are also summarized in Table 2.

3.1 Subsurface Conditions

Subsurface conditions encountered in the explorations generally consisted of FILL overlying native SAND and SILT to the depths explored. ORGANIC SOILS were observed below the fill in six of the sixteen borings. The major soil groups encountered are described below, in general order of their occurrence with depth. Descriptions of the soils encountered are also included in the attached exploration logs. Variations may occur and should be expected outside of the exploration locations.

Fill: Very loose to very dense FILL (or probable fill) was encountered below surface materials (i.e. topsoil, bare earth, asphalt concrete pavement, or concrete) in all explorations except WS-3. The fill extended to depths ranging from about 4 to 15 feet, and generally consisted of fine to coarse sand with varying amounts of silt, gravel, organic matter, and debris including brick, glass, wood, asphalt, metal, and weathered mortar. Cobbles and boulders up to 28 inches in diameter were observed within the fill in test pits TP-2, TP-3, TP-5, and TP-6. Each of the test pits terminated within the fill.

Native soils: Loose to medium dense or very soft to medium stiff ORGANIC SOILS was encountered below the fill in borings B-1, B-3 through B-6, and WS-2. The organic soils extended to depths ranging from about 8 to 14 feet below existing grade.
Native SAND was encountered below the surface materials, fill, or organic soils in all borings. The sand was fine to coarse-grained or fine-grained, and contained varying amounts of silt and gravel. The sand

was generally described as medium dense to dense, except in borings advanced at 13 Wallis Street, where most of the sand samples were described as loose to medium dense. Roller bit grinding was noted within the sand in some borings, which may be indicative of the presence of cobbles and/or boulders. Medium stiff to hard SILT was encountered below or interlayered with the sand in borings WS-2, WS-3, WS-4, B-3, and B-5. Each of the borings terminated within the sand or silt.

Refusal: Borings B-1(GSI) and B-4(GSI) encountered auger refusal at depths of 40 feet and 32 feet, respectively. Rock coring was not performed, and therefore refusal could have been on cobbles, boulders, and bedrock.

3.2 Groundwater

Logs for borings B-1(GSI) through B-6(GSI) report groundwater depths ranging from 8 feet to 10.5 feet at the completion of drilling. Groundwater depths were not measured in borings WS-1 through WS-4 or B-1 through B-6 due to the drilling method (drive and wash) which introduces water into the borehole during drilling. Groundwater seepage was observed at depths ranging from about 4.6 to 6.7 feet below grade in TP-1 through TP-6. Groundwater levels are expected to be influenced by the water level in the North River Canal and may fluctuate due to local and regional factors including, but not limited to, precipitation events, seasonal changes, and periods of wet or dry weather.

3.3 Geotechnical Laboratory Testing

Select soil samples from the 2018 explorations were submitted to GeoTesting Express of Acton, Massachusetts for grain size analysis to confirm field classification and estimate engineering properties. Geotechnical Laboratory analytical results are included on the boring logs and in a copy is provided in Appendix E.

3.4 Conditions of Existing Canal Wall

Overall site conditions remained relatively unchanged from the 2017 structural evaluation report that was completed by Weston & Sampson and provided in ***Appendix A***, other than an increase in overgrown vegetation. It was also noted that the north wall was at a lower elevation than the south wall for about half the wall length.

The six (6) exploratory test pits described above (TP-1 through TP-6) were excavated in order to determine the condition of the wall behind the canal, and to determine if any footings or foundations belong to the wall. Three (3) test pits (TP-1 through TP-3) were completed on the 24 Caller Street property, and the remaining three (3) test pits (TP-4 through TP-6) were completed on the 21 Caller Street Property. Locations of test pits can be found in ***Figure 2***

At the originally proposed location of TP-1, the wall was in poor condition and a communal decision was made between engineers and the excavator operator to move about 12 feet eastward to a location of more stable wall, so as not to collapse the wall into the river during excavation. Test pit TP-1 revealed a rock wall consisting of large boulders about 34 inches in thickness. The canal-side face of the wall segment showed grout between each boulder. However, no grouted surfaces were found at the back of the wall. No visible footings or foundation were discovered after 6 feet of excavation. The top of wall was 3 feet 4 inches above the river bed, with 4 inches of water above the river bed.

At test pit TP-2, a concrete wall exists in good condition. At the test pit location, the wall thickness changes from 21 inches to 17 inches at a 90-degree bend. No structural foundation was discovered after 5 feet of excavation, however large rocks of similar size as at test pit TP-1 were encountered in test

pit TP-2 at the base of the wall and visible from the canal-side face of the wall. The top of wall was 6 feet 8 inches above the river bed with 1 foot 8-inches of water above the river bed.

Test pit TP-3 was excavated at a concrete wall segment in good shape and 21 inches thick. No footing was encountered after roughly six feet of excavation. The top of wall was 6 feet 4 inches to the river bed, with 1 foot 1-inch of water above the river bed.

The wall at test pit TP-4 was a stone wall with mortar on the front face and the excavated rear face. The wall was 16 inches thick. No visible footing was found after 6 feet of excavation. A hard and irregular shaped surface was encountered by probing with a metal rod about a foot below the test pit. The top of wall was 6 feet 4 inches above the river bed with 4 inches of water above the river bed.

The wall at test pit TP-5 consisted of roughly 20-inch thick stacked rocks. No visible grout or mortar was encountered on either side of the wall. No footing was encountered after 6 feet of excavation. The top of wall was 6 feet above the river bed with 2 feet of water above the river bed.

No wall was encountered during excavation at test pit TP-6. Small rocks were visible along the sloped shore line, with larger rocks at and just above the water level.

3.5 Disposal Characterization Sampling and Analysis

To support the potential excavation and off-site disposal of soil associated with future repairs to the canal wall and construction of the Riverwalk, Weston & Sampson collected one (1) composite soil sample (TP-5) from 5 to 6 feet below ground surface (bgs) from the test pit advanced on the 21 Caller Street property on November 6, 2018. The owners of 166R Main Street and 24 Caller Street would not allow Weston & Sampson to collect samples for environmental analyses.

The sample from the 21 Caller Street property was submitted for disposal characterization parameters pursuant to the Massachusetts Department of Environmental Protection (DEP) Policy #COMM-97-001, *Reuse and Disposal of Contaminated Soil at Massachusetts Landfill*, including: total petroleum hydrocarbons (TPH); Resource Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver); semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); pH; ignitability; specific conductivity; and reactivity. The sample was later analyzed for speciated chromium and Toxicity Characteristic Leaching Procedure (TCLP) metals analysis. A grab soil sample was submitted for laboratory analysis for volatile organic compounds (VOCs) from the test pit.

The results of the disposal characterization analyses are presented in ***Table 3***. The results were compared to the COMM-97-001 requirements for reuse at Massachusetts lined and unlined landfills. As shown in ***Table 3***, soil analytical results indicate concentrations do not exceed the RCS-1 thresholds or the COMM-97-001 Disposal/Reuse levels for In-State Lined and Unlined Landfills and were consistent with the analytical results for the soils collected in the 0-5 ft bgs interval in 2017. However, based on the history of the Site and the contaminant concentrations detected, surplus soils generated at 21 Caller Street as part of the Riverwalk project will likely be required to be managed and disposed of appropriately in accordance with the Massachusetts Contingency Plan (MCP).

A copy of the laboratory analytical report is included as ***Appendix F.***

4.0 ENVIRONMENTAL CONSIDERATINOS AND RECOMMENDATIONS

The City is considering property acquisition or easements on private property as part of the repair / replacement options for the southern canal wall and construction of the Riverwalk. As the City is aware, there is known or suspected soil contamination along the proposed area of these activities that will need to be addressed. Most of the area was formerly a tannery and it has known or potential environmental impacts, including several previously identified Disposal Sites as defined by the MCP; 310 CMR 40.0000.

In 2017, in support of the City of Peabody's desire to construct the Riverwalk along the North River Corridor, limited subsurface investigations were performed as part of a multi-parcel limited environmental assessment on the 21 and 24 Caller Street, 18 and 20 Howley Street, and 13 Wallis Street properties. Each assessment evaluated the top 5 feet of soils in an approximate 10-foot wide strip of land abutting the south side of the North River in Peabody, Massachusetts. Copies of the 2017 Limited Subsurface Investigation Reports are included as Appendix C. Analysis of soil samples identified concentrations of metals (i.e. antimony, arsenic, barium, trivalent chromium, unspeciated chromium (hexavalent), lead, and zinc) and polycyclic aromatic hydrocarbons (PAHs) (i.e. benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene and phenanthrene) above the applicable MCP RCS-1 thresholds and Method 1 S-1/GW-2 and S-1/GW-3 standards. Therefore, excess soils generated during construction activities associated with the construction of the wall will be required to be managed and disposed of appropriately in accordance with the MCP.

A summary of the estimated soil transportation and disposal cost estimates associated with each property evaluated as part of the wall alternative analysis is provided in Table 4 – Soil Transportation and Disposal Cost Estimate Summary. These cost estimates do not include any soils that may need to be removed from the properties associated with the future construction of the proposed Riverwalk, etc., as the preliminary design of the Riverwalk has not been completed at this time.

4.1 MCP Regulatory Considerations

4.1.1 13 Wallis Street

The property located at 13 Wallis Street is not listed as Disposal Site by MassDEP; however, it has a long, industrial history primarily in tannery operations. Currently, a US Post Office occupies the northwestern corner of the property and the remainder of the property is used to store miscellaneous construction equipment.

A subsurface investigation conducted in 2009 indicated the presence of fill material containing arsenic, chromium, and lead at concentrations in excess of the MassDEP Reportable Concentrations (RCs) for S-1 soil (RCS-1) at a depth of 0-5 feet below ground surface. Several additional metals and PCBs were detected at concentrations below the applicable MassDEP RCS-1 thresholds in shallow soil. PAHs were detected below the RCS-1 thresholds in deeper soil (5-10 feet below ground surface); however, PAHs were not analyzed in the 0-5 foot depth interval. Data collected during the 2009 sampling event is insufficient in that only two (2) boring locations were investigated, and no shallow soil was analyzed for PAHs. The concentrations of arsenic, chromium, and lead detected during the 2009 subsurface investigation above the RCS-1 thresholds were not reported to the MassDEP by the property owner.

The contaminant concentrations reported during Weston & Sampson's limited subsurface investigation in 2017 indicated that:

- A reportable condition exists at the Site due to the presence of arsenic, chromium, lead, and PAHs at concentrations above the RCS-1;
- The City is not currently obligated to report the RCS-1 exceedances to MassDEP, however, If the City takes ownership of the Site, the City will be responsible for reporting the release to MassDEP within 120 days of the property transfer;
- In general, contaminants in the 0-2 feet bgs depth interval tend to be similar to the concentrations of contaminants in soils in the 2-5 ft bgs depth interval;
- Excavation will require soil management under the MCP;
- The contaminated media (soil) will require disposal at an appropriate facility and documentation by a Licensed Site Professional (LSP); and
- The soil did not fail the leachability test and does not require disposal at a RCRA facility.

Prior to the start of construction at the Site, the detected release of PAHs, lead, and arsenic (detected during a previous investigation) will require reporting to the MassDEP, and construction will require management under a Release Abatement Measure (RAM). During construction of the preferred wall alternative selected by the City, soils will likely be excavated and will be required to be disposed of at a licensed facility.

Based upon currently available information, soils from 13 Wallis Street meet the disposal requirements for in-state unlined and lined landfills. However, Weston & Sampson has assumed that because each wall repair option at 13 Wallis Street generates less than 500 cubic yards of soils, all soils will be managed similarly across all properties as the cost difference among in-state and out of state non-hazardous disposal facilities does not exceed the cost to manage the soils separately. Out-of-state (non-hazardous) soil transportation and disposal currently costs approximately $65 / ton.

Potential MCP regulatory obligations to the City associated with the repair / replacement of the southern canal wall along the corridor at the 13 Wallis Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $40,000
  - Release Abatement Measure Plan (RAM) Plan, including Health and Safety Plan (HASP & Soil Management Plan (SMP)
  - RAM Status Report
  - Method 3 Risk Assessment for Riverwalk Area
  - Permanent Solutions Statement PSS (assumes no AUL based on existing data)
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Administration, Coordination & Oversight ~ $5,000 - $10,000

Estimated TOTAL = ~ $45,000 - $50,000 (not including release notification to MassDEP, soil transportation and disposal, wall repair design plans, regulatory permitting, bids and specifications or construction costs).

4.1.2 24 Caller Street

The property located at 24 Caller Street has a documented history of environmental releases and is regulated under the MCP. In 2000, 24 Caller Street [Release Tracking Number (RTN) 3-18180] was closed under the MCP with an Activity and Use Limitation (AUL) [i.e., an A-3 Response Action Outcome (RAO) and AUL].

The AUL is located on the northwestern portion of the parcel and is approximately 15,000 square feet of

the 42,776-square feet total parcel area. The AUL restricts any activity including, but not limited to excavation, which is likely to disturb contaminated soil located at 1 to 8 feet below grade. Residential use and any other use at which a child's presence is likely [i.e., an educational facility/school (with the exception of adult education), a daycare/nursery, a recreational facility (such as a park or athletic fields, etc.)] is also prohibited. The portion of the 24 Caller Street parcel that the City is interested in redeveloping into the Riverwalk is also within the AUL area.

No files are available on-line from MassDEP for RTN 3-18180. A copy of the RAO Statement for the 24 Caller Street property (RTN 3-18180), dated August 4, 2000, was provided by the City. The RAO report is incomplete and did not include relevant data tables, appendices and/or referenced historical reports. A file review was therefore completed at the MassDEP for RTN 3-18180 on December 8, 2016. Contaminants of concern include metals (lead / chromium / cadmium / arsenic), PAHs and VOCs, and to a lesser extent polychlorinated biphenyls (PCBs). In addition, the site file for RTN 3-18180 indicated that a historic 'landfill' was identified in the northeast portion of parcel.

Given that the property has continued to operate as a barrel reconditioner in the approximately 19 years since regulatory closure and the data gaps from the previous RAO, a Limited Subsurface Site Investigation was conducted by Weston & Sampson on behalf of the City to evaluate the quality of the surficial and near surficial soils. The investigation was confined to the area of the proposed Riverwalk only.

In summary, the data that was generated during the 2017 limited subsurface investigation completed by Weston & Sampson is generally consistent with the limited findings presented in the RAO report for RTN 3-18180. Based on the data collected, no new reportable conditions under the MCP were encountered. Because the Site is fenced with limited access, no Imminent Hazard (IH) condition was discovered. However, the concentrations indicate that:

- In general, contaminants in the 0-2 feet bgs depth interval tend to be greater than the concentrations of contaminants in soils in the 2-5 ft bgs depth interval;
- Excavation will require soil management under the MCP;
- The contaminated media (soil) will require disposal at an appropriate facility and documentation by a LSP; and
- The soil did not fail the leachability test and does not require disposal at a RCRA or hazardous waste disposal facility.

Future Site use for the property as a passive recreational facility will have a different exposure scenario than current site conditions, therefore a Method 3 Risk Characterization for the property will be needed to evaluate risks under the new conditions and with new (i.e., post-construction) exposure point concentrations. Specifically, recreational use (such as a park or athletic fields) and/or any other use at which a child's presence is likely, are currently prohibited at the Site, in accordance with the AUL.

In addition, any activity including, but not limited to, excavation which is likely to disturb contaminated soil located at 1 to 8 feet bgs associated with underground utility and/or construction work, without prior development and implementation of a Soil Management Plan (SMP) and a Health and Safety Plan (HASP) is also prohibited. The contaminated soil located at 1 to 8 feet below surface grade must remain at depth and may not be relocated, unless such activity is first evaluated by a Licensed Site Professional (LSP) who renders an Opinion which states that such activity poses no greater risk of harm to health, safety, public welfare, or the environment and ensures that a condition of No Significant Risk is maintained.

In summary, to repair the wall located at 24 Caller Street and construct the Riverwalk, soils will likely be excavated, and will need to be properly managed and disposed of at a licensed facility. Based upon currently available information, soils from 24 Caller Street must be disposed of at an out of state non-hazardous disposal facilities. Out-of-state (non-hazardous) soil transportation and disposal costs are currently estimated at approximately $65 / ton.

Following removal of impacted materials, soil sampling will be required to evaluate remaining conditions and associated risk under the MCP. A new risk characterization will be required for the property. A geotextile membrane barrier may also be required to separate impacted fill as part of the risk management strategy. A revised Activity and Use Limitation (AUL) will likely also be required to document and manage site risks.

Potential regulatory obligations to the City associated with the repair / replacement of the southern canal wall along the corridor at the 24 Caller Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $55,000
  - RAM Plan, including HASP & SMP
  - RAM Status Report
  - Additional sampling to support new risk characterization
  - Method 3 Risk Assessment
  - Revised PSS and AUL (and associated land survey)
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Administration, Coordination & Oversight ~ $5,000 - $10,000

Estimated TOTAL = ~ $60,000 - $65,000 (not including soil transportation and disposal, wall repair design plans, regulatory permitting, bids and specifications or construction costs).

As the City is interested in purchasing the entire 24 Caller Street parcel, a comprehensive Phase I/II Environmental Site Assessment (ESA) is recommended prior to the City taking title to the property in order to: 1) address data gaps; 2) to support the proposed reuse and evaluate exposure risks under non-industrial/commercial use; 3) to provide liability protection to the City; and 4) to evaluate regulatory obligations and costs to proceed with redevelopment of the property as a passive recreational facility. As detailed above, the RAO report for RTN 3-18180 was incomplete and did not include copies of relevant data / tables, appendices and/or referenced previous reports. Based upon our review, several data gaps exist at the property based upon the lack of information provided in the RAO report as well as the lack of any recent data relevant to the existing conditions at parcel based upon the barrel reclamation operations that have continued to be conducted at property since 2000.

4.1.3 21 Caller Street

The 21 Caller Street property has a documented history of releases to the environment and is regulated under the MCP. 21 Caller Street [Release Tracking Number (RTN) 3-0577] is closed with a Permanent Solution Statement with Conditions that includes an AUL, which restricts any activity or uses that involve the excavation, removal and/or disturbance of soils greater than 3 feet below grade. Additionally, the AUL prohibits the use of the property The AUL is applicable to the entire parcel but there has been limited assessment in the area of interest to the City along the canal.

Contaminants of concern are metals (i.e., cadmium, chromium and lead); however limited concentrations of Polycyclic Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs)

and/or Extractable Petroleum Hydrocarbons (EPHs) which have historically been detected at the property. Historical fill containing ash, cinders, brick, buffing dust, and/or leather scraps was also historically observed at approximately 1-8 feet below ground surface (bgs) across the property.

The data collected in 2017 was generally consistent with the findings in the PSS report filed for the Site under RTN 3-0577:

- In general, contaminant concentrations are similar in the 0-1 and 2-5 feet depth intervals, with the exception of 2-5 feet bgs soils at SP-3, which contains elevated concentrations of arsenic and lead;
- Excavation will require soil management under the MCP; and
- Surplus soil will require disposal at an appropriate facility and documentation by a Licensed Site Professional (LSP).

The Method 3 Risk Characterization presented in the PSS for the Site includes exposure scenarios consistent with the City's planned future for the Riverwalk. Specifically, "use of the [Site] without limitation to pedestrian and/or vehicle traffic" is permitted under the AUL. Furthermore, given that the 2017 and newly collected data is consistent with the previous data and findings of the PSS, an updated Method 3 Risk Characterization for the proposed Riverwalk (i.e. easement) area will not likely be necessary. However, activities inconsistent with the AUL including "excavation, removal, and/or disturbance of subsurface soil greater than three (3) feet below ground surface" are likely to occur during wall repair and redevelopment and will require a Release Abatement Measure (RAM) Plan to be filed with MassDEP, along with a Soil Management Plan (SMP) and Health and Safety Plan (HASP). A new risk characterization will not likely be required for the Riverwalk area and redevelopment is unlikely to require a separate AUL or PSS.

In summary, in order to implement a wall repair alternative, soils will likely be excavated and require disposal at an appropriate facility. Based upon currently available disposal characterization data collected from the proposed Riverwalk area of the property in 2017 and 2018, soils concentrations were less than RCS-1 and Comm-97 criteria for in-state unlined and lined landfills. However, Weston & Sampson has assumed that because each wall repair option at 21 Caller Street generates significantly less than 500 cubic yards of soils, all soils will be managed similarly across all properties as the cost difference among in-state and out of state non-hazardous disposal facilities does not exceed the cost to manage the soils separately. Out-of-state (non-hazardous) soil transportation and disposal currently costs approximately $65 / ton.

Potential regulatory obligations to the City associated with the repair / replacement of the southern canal wall along the corridor at the 21 Caller Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $30,000
  - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
  - RAM Status Report
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Administration, Coordination & Oversight ~ $5,000 - $10,000

Estimated TOTAL = ~ $35,000 - $40,000 (not including soil transportation and disposal, wall repair design plans, regulatory permitting, bids and specifications or construction costs).

4.1.4 18 Howley Street

The property located at 18 Howley Street has a documented history of environmental releases and is regulated under the MCP. 18 Howley Street, identified by MassDEP as RTN 3-0577, was closed under the MCP in 2013 with a B-2 Response Action Outcome (RAO) and Activity and Use Limitation (AUL) [i.e., a Permanent Solution Statement with Conditions].

The AUL restricts the use of the property as a residence, school, daycare, nursery recreational area (e.g., park or athletic field) and/or any other use in which a child's presence (other than incidental). The AUL also restricts the use of the property for growing produce for human consumption as well as any long-term (greater than 1 month) activity at the property that is likely to result in the excavation, relocation and/or removal of soils, unless such activity is first evaluated by an LSP. The AUL is applicable to the entire parcel, and therefore includes the Site.

The primary contaminants of concern are metals (i.e., arsenic, chromium and lead), PAHs, extractable petroleum hydrocarbons (EPHs), dioxins, and polychlorinated biphenyls (PCBs). Historical fill containing ash and/or coal has also been observed. Contamination appears to be limited to the top 8 feet of soil across the property.

The data collected by Weston & Sampson during the limited subsurface investigations in 2017 is generally consistent with the limited findings in the RAO report for RTN 3-0577. Based on the data collected, no new reportable conditions under the MCP were encountered. Concentrations indicate that:

- In general, contaminants in the 0-1 feet bgs depth interval tend to be greater than the concentrations of contaminants in soils in the 2-5 ft bgs depth interval;
- Excavation will require soil management under the MCP;
- The contaminated media (soil) will require disposal at an appropriate facility and documentation by an LSP; and
- The soil did not fail the leachability test and does not require disposal at a RCRA (hazardous waste) facility.

Future Site use for the Riverwalk trail will have a different exposure scenario than current site conditions; therefore, a Method 3 Risk Characterization for the proposed Riverwalk (i.e. easement) area will need to evaluate risks under the new conditions and with new (i.e., post-construction) exposure point concentrations. Specifically, recreational use (such as a park or athletic fields) and/or any other use at which a child's presence is likely, are currently prohibited at the Site, in accordance with the AUL. Likewise, any long-term (greater than 1 month) activity at the property that is likely to result in the excavation, relocation and/or removal of soils, unless such activity is first evaluated by an LSP.

In summary, during construction of the preferred wall alternative, soils will likely be excavated and disposed of at a licensed facility. Based upon currently available information, soils from 18 Howley Street must be disposed of at an out of state non-hazardous disposal facilities. Out-of-state (non-hazardous) soil transportation and disposal costs are currently estimated at approximately $65 / ton.

Following removal of impacted fill, soil sampling will be required to evaluate remaining conditions and associated risk. A new risk characterization will be required for the Riverwalk area. A geotextile membrane barrier may also be required to separate impacted fill as part of the risk management strategy. A separate AUL may also be required to document and manage site risks along the Riverwalk corridor area.

Potential regulatory obligations to the City associated with the repair / replacement of the southern canal wall along the corridor at the18 Howley Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $55,000
  - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
  - RAM Status Report
  - Additional sampling to support new risk characterization
  - Method 3 Risk Assessment for Riverwalk Area
  - Revised PSS and AUL for Riverwalk Area (and associated land survey)
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Administration, Coordination & Oversight ~ $5,000 - $10,000

Estimated TOTAL = ~ $60,000 - $65,000 (not including soil transportation and disposal, wall repair design plans, regulatory permitting, bids and specifications or construction costs).

4.1.5 166R Main Street

The property located at 166R Main Street has a documented history of environmental releases and is regulated under the MCP. 166R Main Street, identified by MassDEP as RTN 3-1444 and RTN 3-4322.

RTN 3-4322 was closed under the MCP in 1997 with a A-2 RAO [i.e., a Permanent Solution Statement].

RTN 3-1444 was closed under the MCP in 2007 with an A-3 RAO and AUL [i.e. a Permanent Solution Statement with Conditions]. The AUL restricts the use of the property for single family residential use or for growing of produce for human consumption. The AUL also restricts activity at the property that is likely to cause physical or chemical deterioration, breakage, or damage to the pavement or building foundations, unless such activity is first evaluated by an LSP. The AUL is applicable to the entire parcel. The primary contaminants of concern at the 166R Main Street property are metals (i.e., arsenic, chromium and lead), PAHs, EPH, and VHP. Historical fill has also been observed in the top 8 to 10 feet of soil.

The property owner did not provide the City access to allow Weston & Sampson to collect samples for disposal characterization from the area of the proposed wall improvement activities and proposed Riverwalk. Therefore, for cost-estimation purposes, based upon the limited historical data available for the property and the data collected to date from the adjacent properties in the area, it has been assumed that soils generated during construction of the preferred wall alternative at 166R Main Street will be required to be disposed of at an out of state non-hazardous disposal facilities. Out-of-state (non-hazardous) soil transportation and disposal costs are currently estimated at approximately $65 / ton.

Future use for the Riverwalk trail will have a different exposure scenario than current site conditions; therefore, a Method 3 Risk Characterization for the proposed Riverwalk (i.e. easement) area will need to evaluate risks under the new conditions and with new (i.e., post-construction) exposure point concentrations.

A geotextile membrane barrier may also be required to separate impacted fill as part of the risk management strategy. A separate AUL may also be required to document and manage site risks along the Riverwalk corridor area.

Potential regulatory obligations to the City associated with the repair / replacement of the southern canal wall along the corridor at the 166R Main Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $55,000
  - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
  - RAM Status Report
  - Additional sampling to support new risk characterization
  - Method 3 Risk Assessment for Riverwalk Area
  - Revised PSS and AUL for Riverwalk Area (and associated land survey)
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Administration, Coordination & Oversight ~ $5,000 - $10,000

Estimated TOTAL = ~ $60,000 - $65,000 (not including soil transportation and disposal, wall repair design plans, regulatory permitting, bids and specifications or construction costs).

4.2 MCP Environmental Regulatory Summary and Recommendations

The properties that will be impacted as part of the repair / replacement alternatives for the south wall of the North River Canal are known or suspected to be contaminated. Construction activities will require management of soils in accordance with the MCP and under a RAM Plan. Excess soils will be required to be disposed of at a licensed disposal facility. Given the approximate quantities to be generated at each individual property locations for the repairs of the wall, Weston & Sampson has assumed that all soils will be managed similarly across all properties as the cost difference among in-state and out of state non-hazardous disposal facilities does not exceed the cost to manage the soils separately.

Additional MCP regulatory compliance requirements may also include: RAM Status Reports, additional sampling to support new risk characterization for Riverwalk area, Method 3 Risk Assessments for Riverwalk Area; Revised PSSs and AULs for Riverwalk Area (and associated land surveys); RAM Completion Reports, Soil Management & Bills of Lading (BOLs); and Construction Administration, Coordination & Oversight. In total, MCP regulatory compliance requirements are currently estimated at approximately $260,000 - $285,000. Cost do not include out-of-state (non-hazardous) transportation and disposal cost for soils that need to be removed as part of the repairs to the wall, as these costs have been included in the wall alternative cost estimates provided in ***Appendix I.***

5.0 GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

The following sections provide preliminary geotechnical design considerations and recommendations for site design, and for evaluation and selection of preferred wall replacement alternative(s). Weston & Sampson should be contacted to provide specific geotechnical design and construction recommendations during final design. Additional information on the use of these geotechnical recommendations is provided in the document titled "Important Information about this Geotechnical Engineering Report" by Geoprofessional Business Association (GBA), Inc., included as Appendix G.

5.1 Existing Fill and Organics

Undocumented fill and organic soils were encountered to depths of up to 15 feet below grade, with organic soil thicknesses ranging from 1.5 to 8 ft. at locations explored. These materials are not suitable for support of structures due to the risk of differential settlement from variable rates of compression/decomposition of these materials. Fill and organics should be removed from within the "zone-of-influence" (ZOI) beneath new foundations and other rigid structures sensitive to settlement. The ZOI is defined by planes extending horizontally away from the bottom edge of the structure a distance of two feet, then down and away at a 1H:1V (horizontal:vertical) slope to the intersection with suitable native soils. The resulting excavation should be backfilled with compacted Structural Fill.

Placement of new fill above existing site grades will result in settlement due to compression of underlying existing fill and organic soils. The amount of settlement will vary with the load increase and the thickness and composition of existing fill and organics. Over-excavation and replacement of the unsuitable materials, the use of lightweight fill materials, or design for settlement should be considered if grade changes are proposed.

5.2 Retaining Walls

Concrete cantilever walls or stone masonry walls can be supported on a minimum 12-inch thick bedding layer of compacted Structural Fill overlying native, inorganic sand and/or silt following removal of existing fill and organic soils. The retaining wall bedding layer should extend at least 18 inches horizontally past the edges of the wall foundation or bottom blocks. Foundations should extend at least 4 feet below the nearest ground surface exposed to freezing.

Retaining wall foundations bearing on subgrades prepared as described herein can be designed using an allowable bearing pressure of 2000 psf for foundations constructed on loose sands such as at 13 Wallis Street, and 4000 psf for foundations constructed on medium dense (or denser) sand or medium stiff (or stiffer) silt or structural fill.

5.2.1 Lateral Pressures

Design lateral pressures should consider appropriate loading conditions including earth pressures, hydrostatic, wind, seismic, and surcharge loads such as sloped backfill, structures and adjacent traffic as appropriate. The design lateral pressures should be calculated by adding unbalanced earth and water pressures, and surcharge pressures from structures near the proposed wall.

Lateral earth pressures for design of new retaining walls may be computed using the preliminary soil parameters provided in the table below:

Preliminary Soil Design Parameters for Retaining Walls

Parameter	Values for			
	Existing Fill	Organics	Native Sand and Silt	Compacted Backfill
Angle of Internal Friction, ϕ	28°	26°	30°	34°
Total Unit Weight, γ (pounds per cubic foot)	125	115	125	130
Buoyant Unit Weight, γ' (pounds per cubic foot)	62.6	52.6	62.6	67.6

Groundwater level at the site should be assumed at ground surface. In addition, we recommend a minimum 150 psf lateral surcharge pressure be assumed over the full height of the wall, intended to account for vertical areal surcharge pressures at the top of the wall up to 300 psf. Additional lateral pressures equal to 0.5 times the additional surcharge pressures should be added to sections of wall where surcharge pressures exceed 300 psf.

Resistance to lateral loads should be calculated using a base friction coefficient of 0.35. For resistance to lateral loading we recommend a minimum factor of safety of 1.5 when using sliding friction alone. A larger magnitude of movement is required to engage passive resistance than sliding friction. Therefore, a minimum factor of safety of 2.0 is recommended when using passive pressure in addition to friction to resist lateral loads. Passive earth pressures should be ignored for a depth of 4 feet below bottom of canal.

Footings, floor slabs, and other improvements located above and behind retaining walls (including footings for upper walls in tiered retaining wall configurations) and within a zone defined by a plane extending upward at 1H:1V from the back of the bottom of the wall will increase lateral pressures on the wall. We should be consulted if footings or surcharges are located within this zone. The global slope stability of the proposed retaining walls will have to be confirmed once design progresses.

5.2.2 Seismic Considerations

Seismic site class is determined in accordance with the International Building Code (IBC) as adapted by the Massachusetts State Building Code using a weighted average of SPT blow counts in the upper 100 feet of soil at a site. Based on the soil types and consistencies encountered in the boring (to the depths explored), we recommend that new canal walls be designed using parameters presented in the table below:

Seismic Design Parameters

Design Parameter	Recommended Value
Site Class	E
S_s	0.240 g
S_1	0.073 g
F_a [IBC Table 1613.5.3(1)]	2.5
F_v [IBC Table 1613.5.3(2)]	3.5

Loose, potentially liquefiable native sands were encountered in borings WS-1, B-1(GSI) through B-3(GSI), B-5(GSI) and B-6(GSI) at 13 Wallis Street. Soil liquefaction describes a phenomenon in which saturated granular soils lose their strength during earthquake conditions, causing sinkholes, or deformation and/or settlement of structures they support. Liquefaction potential depends on the soil density, fines content, groundwater depth, and the magnitude of ground movements during seismic events. Additional borings and lab testing should be conducted in this area during final design to further evaluate the potential for liquefaction. Mitigation measures such as over-excavation and replacement may be necessary to address potential liquefaction.

5.3 Construction Considerations

Existing structures, pavements, curbing, vegetation, topsoil, tree roots greater than 1-inch in diameter, and surface debris should be removed from within the limits of construction during initial site preparation. The existing fill contains debris, cobbles, and boulders which may interfere with installation of driven wall elements. Pre-trenching may be required to remove these obstructions if a driven wall type is selected (such as soldier pile or sheet pile wall). Any existing utilities within the proposed development areas should be identified and properly removed, re-routed, or evaluated and approved to remain.

Excavations to remove and replace the existing canal walls will extend up to about 10 feet, or deeper where unsuitable soils are present at proposed structure bearing depths. Temporary excavation support will be required where excavations cannot feasibly be open cut, such as locations adjacent to structures and utilities, and where groundwater seepage is present. Groundwater is expected to be approximately equal with the water level in the canal and dewatering of excavations should be anticipated during construction.

Weston & Sampson should be contacted to evaluate exposed subgrades prior to placement of overlying materials and foundation construction.

5.3.1 Fill Materials and Placement

The existing fill at the site contains variable amounts of fines, organics, and debris. The existing fill is not suitable for use as Structural Fill (i.e., support of structures or other settlement sensitive features) but may be suitable for use as backfill in non-structural or landscape areas, provided it can be moisture conditioned and compacted to at least 92 percent maximum dry density as determined by ASTM D1557 (modified proctor).

Structural Fill beneath foundations and other settlement sensitive improvements (or where on-site materials are not available or suitable for re-use) should consist of well graded imported sand and gravel with less than approximately 10 percent fines (such as MassDOT M1.03.0- type B Gravel Borrow or M2.01.7 Dense-graded Crushed Stone). Structural fill should have a maximum particle size of 3 inches and be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557.

Crushed stone shall be wrapped in filter fabric, consisting of a woven geosynthetic with an AOS of #70 to #100 sieve, and a minimum puncture resistance of at least 120 pounds (such as Mirafi FW700 or equivalent).

6.0 WALL ALTERNATIVE ANALYSIS

Five wall alternatives are being considered for the repair of the south wall of the North River Canal from Wallis Street to Howley Street. The alternative wall types being considered are:

- Alternative A – Rip Rap Slope
- Alternative B – Vegetative Berm Above Rip Rap Slope
- Alternative C – Sheet Pile Wall
- Alternative D – Cantilever Concrete Retaining Wall
- Alternative E – Stone Masonry Wall

Regardless of the alternative chosen, grades along the river may need to be raised or lowered in order to achieve ADA compliance for the Riverwalk. A new bridge structure will likely be required over Strongwater Brook. The existing Caller Street Bridge creates a design constraint for all alternatives considered. Each alternative has taken into account the need to accommodate the existing river width opening at the Caller Street Bridge. Each alternative will require the handling of contaminated/potentially-contaminated soils to some extent. Easements or property acquisition will be required for each alternative to accommodate the Riverwalk, with some alternatives requiring more property than others. Multiple storm drains exist in the area of the proposed new wall alternatives; these drains will need to be accommodated and accounted for later in the design process. Typical cross sections of each alternative can be seen in ***Appendix H***.

Since the north wall is at a lower height elevation than the current south wall for about half of the river length being considered, raising the south wall height would create more flooding on the north side of the river. If additional flood storage is desired, each alternative can be adjusted to allow for river widening in addition to repairing the south wall. All design alternatives propose the new south wall height be constructed to match the existing south wall height.

Each alternative was analyzed for its resilience, durability, environmental impacts, constructability, construction schedule, and cost. The recommended alternative was decided by comparing these five aspects of each design alternative. The engineer's cost estimate for each alternative can be found in ***Appendix I.***

The resiliency of each wall alternative was evaluated based on the six design flood-climate change projection scenarios presented in Weston & Sampson's report entitled, *MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park – Resilience Evaluation (Resilience Evaluation)*, dated February 2019, and the estimate of the potential benefit in terms of volume of storage and the number of parcels that may be removed from the floodplain without increasing downstream flooding impacts. Fifty-eight parcels or portions of parcels were identified in the study area. The maximum percent of parcels protected for all wall alternatives and the six scenarios ranged from 11% to 60% of the total number of parcels in the study area. A copy of the Resilience Evaluation is provided in Appendix J.

6.1 Alternative A – Rip Rap Slope

Alternative A consists of placed rip rap on a slope of 1 vertical to 1.5 horizontal. The rip rap will be placed in a 3-foot thick layer, with diameters ranging from 8 to 24-inches, underlain with a 1-foot layer of bedding stone placed on top of geotextile fabric for permanent erosion control. The rip rap will extend 5-feet into the river bed and 3.5-feet below the river bed to maintain continuity with the slope. This alternative requires the removal of the existing south wall along the entire length in consideration.

Two options are considered for the location of the bottom of the rip rap slope. Option 1 is to set the bottom of the slope at the location of the existing wall which will provide some additional flood storage. Option 2 is to set the bottom of the slope into the river providing no additional flood storage but maintaining the storage the current river width provides.

6.1.1 Resilience

- Option 1 would provide 18 cu. ft./ft. additional flood storage capacity; Option 2 would match current flood storage capacity.
- The surface roughness of the rip rap would decrease flood flow speed.
- Allows flexibility to vary slope along river length to allow more flood storage at key locations.
- In the future, both options can accommodate the future flood elevations by constructing a berm on top of the would-be existing slope, however the north wall height will also need to be increased to not cause increased flooding on the north side. The Riverwalk pathway would need to be located away from the top of slope to allow room for this potential future berm to be constructed. Additional easement area or land acquisition would be required.
- Neither option requires compensatory storage for regulatory purposes since they both provide a greater than or equal amount of flood storage as existing conditions allow. If more flood storage is desired by the City then the land at 24 Caller Street can potentially be regraded to provide additional flood storage space.

6.1.2 Durability

- This alternative requires inspections to be performed after flood events and a minimum level of maintenance such as replacing any dislodged rocks after a flood event and managing vegetation to prevent overgrowth.
- With proper maintenance and routine inspection, a rip rap slope should provide a minimum life span of 50 years.

6.1.3 Environmental Impact

- Requires excavation of contaminated soils to form the rip rap slope.
- Requires dredging of the streambed to construct the toe of the rip rap slope.
- Stones in the existing channel wall can be incorporated into the riprap slope.

6.1.4 Constructability & Construction Schedule

- This alternative is easy to construct and does not require any special equipment or methods.
- Water control will be necessary to construct the rip rap slope.
- Requires excavation of abandoned rail road east of Strongwater Brook.
- Requires demolition of the abandoned building foundation east of Strongwater Brook.
- Estimated construction duration is 5 months.

6.1.5 Right-of-Way

- This alternative will require a maximum permanent easement that is approximately 25 feet wide from the face of the existing wall.
- A 15-foot-wide temporary easement for construction will be required as well.

6.2 Alternative B – Vegetative Berm Above Rip Rap Slope

Alternative B is similar to Alternative A except the rip rap slope for this alternative will stop at

approximately 3.5-feet above the river bed with the vegetative berm extending to the top of the slope. The slope of the vegetative berm would be 1 vertical to 3 horizontal. This alternative requires the removal of the existing south wall along the entire length in consideration.

Alternative B, like Alternative A, has the same two options for the location of the bottom of slope.

6.2.1 Resilience

- Option 1 would provide 20 cu. ft./ft. additional flood storage capacity; Option 2 would match current flood storage capacity.
- The surface roughness of the rip rap and vegetative slope would decrease flood flow speed.
- Allows flexibility to vary slope along river length to allow more flood storage at key locations.
- In the future, both options can accommodate the future flood elevations by constructing a berm on top of the would-be existing slope, however the north wall height will also need to be increased to not cause increased flooding on the north side. The Riverwalk pathway would need to be located away from the top of slope to allow room for this potential future berm to be constructed. Additional easement area or land acquisition would be required.
- Neither option requires compensatory storage for regulatory purposes since they both provide a greater than or equal amount of flood storage as existing conditions allow. If more flood storage is desired by City, then the land at 24 Caller Street can potentially be regraded to provide additional flood storage space.

6.2.2 Durability

- This alternative requires inspections to be performed after flood events and a minimum level of maintenance such as replacing any dislodged rocks after a flood event and managing vegetation to prevent overgrowth.
- With proper maintenance and routine inspection, a rip rap and vegetative slope should provide a minimum life span of 50 years.

6.2.3 Environmental Impact

- Requires excavation of contaminated soils to form the rip rap slope.
- Requires dredging of the streambed to construct the toe of the rip rap slope.
- Stones in the existing channel wall can be incorporated into the riprap slope.

6.2.4 Constructability & Construction Schedule

- This alternative is easy to construct and does not require any special equipment or methods.
- Water control will be necessary to construct the rip rap and vegetative slope.
- Requires excavation of abandoned rail road east of Strongwater Brook.
- Requires demolition of the abandoned building foundation east of Strongwater Brook.
- Estimated construction duration is 5 months, which does not include growing season of the vegetation.

6.2.5 Right-of-Way

- This alternative will require a maximum permanent easement that is approximately 28 feet wide from the face of the existing wall.
- A 15-foot-wide temporary easement for construction will be required as well.

6.3 Alternative C – Sheet Pile Wall

Alternative C Option 1 consists of a sheet pile wall installed behind the existing wall to an approximate depth of 20 feet below the top of slope. The existing wall structure would be removed after the sheet piles are installed, providing a small increase in flood storage. A concrete cap would be constructed along the top of the sheet pile wall for a more aesthetic look and to cover the jagged top of the sheet piling. An available option for this alternative is architectural cladding, such as a stone veneer matching the aesthetics of the existing wall.

Alternative C Option 2 consists of a sheet pile wall installed behind the existing wall. The sheet pile would extend 2-feet above the canal bed, and 13-feet below ground. A sloped bank, of either rip rap or vegetative berm, would then extend from the top of the sheet pile to the top of bank. A rip rap slope would require more excavation of soils than the vegetative berm option but would be more stable during flood events. The vegetative berm would require less excavation than a rip rap slope but would be less stable during and after flood events. Both the rip rap slope and vegetative berm options would provide additional flood storage.

6.3.1 Resilience

- Option 1 would increase flood storage by adding approximately 8.5 cu.ft./ft. of additional flood storage due to the removal of the existing stone masonry wall which increases the cross section of the channel.
- Option 2 would provide an additional 20-25 cu.ft./ft. additional flood storage due to the rip rap slope or vegetative berm.
- Height of wall can be increased in the future; however, the north wall height will also need to be increased to not cause increased flooding on the north side. Requires design and special detailing of the wall to accommodate future height addition (cost included in engineer's cost estimate).
- This option does not require compensatory storage for regulatory purposes since it provides greater storage capacity than currently available. If more flood storage is desired by City, then the land at 24 Caller Street can potentially be regraded to provide additional flood storage space.

6.3.2 Durability

- Steel sheet piling requires very minimal maintenance, such as monitoring for deviation from design alignment and corrosion. The concrete coping would need to be checked for minor cracks and spalls at multiple times during its design life.
- Steel sheet piling can provide a minimum design life of 75 years.
- Rip rap requires inspections to be performed after flood events and a minimum level of maintenance such as replacing any dislodged rocks after a flood event. The vegetative berm would be less stable than the rip rap during and after flood events. The vegetative berm would also require scheduled maintenance of vegetation to prevent overgrowth.
- With proper maintenance and routine inspection, a rip rap slope should provide a minimum life span of 50 years.

6.3.3 Environmental Impact

- Sheet pile installation will create more noise than the other alternatives. This may be able to be mitigated based on the installation methods needed.
- Option 1 requires the least amount of contaminated soil removal of all Alternatives considered.
- Option 2 requires no dredging of the stream bed.

6.3.4 Constructability & Construction Schedule

- This alternative will require specialized equipment for the installation of the sheet piling.
- Water control will be necessary for the removal of the existing stone masonry wall.
- Requires excavation of abandoned rail road east of Strongwater Brook.
- Minimizes the demolition of the abandoned building foundation east of Strongwater Brook for Option 1.
- Estimated construction duration is 4-5 months

6.3.5 Right-of-Way

- This alternative will require permanent easement that is approximately 15 feet wide from the face of the existing wall for Option 1 and up to 30 feet wide for Option 2.
- A 15-foot-wide temporary easement for construction will be required as well.

6.4 Alternative D – Cantilever Concrete Retaining Wall

Alternative D consists of removing the existing stone masonry wall and constructing a concrete cantilever retaining wall in the same location. The concrete retaining wall will have a footing constructed approximately 4 feet below the stream bed. The stem of the concrete wall will be approximately 14 inches wide at the top and about 30 inches wide at the base. A concrete form liner may be used to provide texture or the look of a stone veneer if desired.

6.4.1 Resilience

- This alternative would not provide any increase in flood storage.
- Height of wall can be increased in the future; however, the north wall height will also need to be increased to not cause increased flooding on the north side. Requires design and special detailing of the wall to accommodate future height addition (cost included in engineer's cost estimate).
- This option does not require compensatory storage for regulatory purposes since it provides equal storage capacity as currently available. If more flood storage is desired by City, then the land at 24 Caller Street can potentially be regraded to provide additional flood storage space.

6.4.2 Durability

- Requires minimal maintenance including minor spall or crack repairs; repairs will need to be completed multiple times during its design life.
- A concrete retaining wall, with proper maintenance, can provide a minimum design life of 75 years.

6.4.3 Environmental Impact

- Requires excavation of contaminated soils.
- Requires dredging of the streambed to construct the footing.
- Requires over-excavation of organic soils to prevent settlement.

6.4.4 Constructability & Construction Schedule

- This alternative does not require any specialized equipment or methods.
- Water control will be necessary for the removal of the existing stone masonry wall and construction of the new wall.
- Sheet piling should be permanently installed at the toe of the footing in areas of deep organic soils, such as at 24 Caller St and 166R Main St.

- Requires excavation of abandoned rail road east of Strongwater Brook.
- Requires demolition of the abandoned building foundation east of Strongwater Brook.
- Estimated construction duration is 6-8 months.

6.4.5 Right-of-Way

- This alternative will require permanent easement that is approximately 15 feet wide from the face of the existing wall.
- A 15-foot-wide temporary easement for construction will be required as well.

6.5 Alternative E – Stone Masonry Wall

Alternative E consists of removing the existing stone masonry wall and constructing a new stone masonry wall on a concrete footing in the same location. The stem of the wall will be approximately 20 inches wide at the top and 4 feet at the base. The concrete footing would be constructed approximately 4 feet below the stream bed. This alternative would provide no additional flood storage space.

6.5.1 Resilience

- This alternative would not provide any increase in flood storage.
- Height of wall can be increased in the future; however, the north wall height will also need to be increased to not cause increased flooding on the north side. Requires design and special detailing of the wall to accommodate future height addition (cost included in engineer's cost estimate).
- This option does not require compensatory storage for regulatory purposes since it provides greater storage capacity than currently available. If more flood storage is desired by the City then the land at 24 Caller Street can potentially be regraded to provide additional flood storage space.

6.5.2 Durability

- The stone masonry retaining wall requires a moderate amount of maintenance such as repointing of masonry. The majority of maintenance will be required above the waterline; however, some areas may require maintenance and repair below the water level. Maintenance done below water level will require sandbags to divert water away from location of repairs.
- A stone masonry retaining wall, with proper maintenance, can provide a minimum design life of 50 years.

6.5.3 Environmental Impact

- Requires excavation of contaminated soils.
- Requires dredging of the streambed to construct the footing.
- Requires over-excavation of organic soils to prevent settlement.

6.5.4 Constructability & Construction Schedule

- This alternative does not require any specialized equipment or methods.
- Water control will be necessary for the removal of the existing stone masonry wall and construction of the new wall.
- Sheet piling should be permanently installed at the toe of the footing in areas of deep organic soils, such as at 24 Caller St and 166R Main St.
- Requires excavation of abandoned rail road east of Strongwater Brook.
- Requires demolition of the abandoned building foundation east of Strongwater Brook.
- Estimated construction duration is 7-9 months.

6.5.5 Right-of-Way

- This alternative will require permanent easement that is approximately 15 feet wide from the face of the existing wall.
- A 15-foot-wide temporary easement for construction will be required as well.

7.0 REFERENCES INCREMENTAL APPROACH

Climate change projections indicate that, by 2100, mean sea level rise in Boston Harbor since 2000 is unlikely to exceed (83% probability) 4.0 feet although it could be as high as 10.2 feet (NECSC). Boston Harbor has seen a sea level rise of more than 11 inches between 1921 and 2018. Since the North River Canal is tidally influenced closer to Salem, it is possible the canal will experience an even higher likelihood of extreme flooding as the canal shoulder of the North River will likely become tidal. Since work is only being done to the south wall, a significant decrease in current riverine flooding is difficult without also working on the north wall. There are options and steps that can be taken to assure that the south wall of the North River Canal can be altered to accommodate larger flood events or to match future work done of the north wall.

Not all alternative options will be able to accommodate an added wall height in the future. The rip rap slope, vegetative berm and sheet pile walls could be altered to accommodate an increase wall height but may require additional land usage to do so. The stone masonry wall and concrete cantilever wall could be designed to accommodate future wall height increase. For it to be possible to increase the wall height in the future, the walls will need to be designed to have additional capacity than current conditions require.

Raising the South wall height in the future would only provide additional flood storage if the North wall height were also increased. If the South wall were to be raised in the future without raising the North wall as well, it would only increase flooding on the North side of the canal.

Additional investigations would still be required in the future to ensure the wall has available capacity and no deterioration or damage has occurred that would reduce the capacity of the walls.

8.0 PERMITTING STRATEGY

8.1 Introduction

Weston & Sampson has developed five (5) design repair / replacement alternatives, Alternative A through Alternative E. Alternatives A, B, and C each included two separate options (options 1 & 2) for the south canal wall in order to support the construction of a Riverwalk and improve the flood resilience along the North River Canal. Wall alternatives include options for repairing the wall in place to protect against future flooding as well as other options that provide additional flood storage. Weston & Sampson then conducted a preliminary analysis and evaluated the permitting strategy for each of the proposed five (5) wall alternatives.

The permitting evaluation which follows in this chapter, first reviews each alternative for the amount of impact to resource areas, the required environmental permits associated with those impacts, permitting timelines, and finally permitting costs. In addition, an evaluation of the different wall options and associated permitting was also conducted based on the anticipated ease or feasibility of implementation with regulatory agencies, and other additional studies or requirements, and their associated costs, that may be required as part of for each wall alternative.

The five (5) wall alternatives that are being considered for the repair of the south wall of the North River Canal are:

- Alternative A – Rip Rap Slope
  - Option 1, build out from Toe of existing wall
  - Option 2, build out from inside of existing wall
- Alternative B – Vegetative Berm Over Rip Rap Slope
  - Option 1, build out from Toe of existing wall
  - Option 2, build out from inside of existing wall
- Alternative C – Sheet Pile Wall
  - Option 1, Sheet Pile with Concrete Cap
  - Option 2, Sheet Pile with Sloped Bank (rip-rap or vegetated berm)
- Alternative D – Cantilever Concrete Retaining Wall
- Alternative E – Stone Masonry Wall

Currently, it is infeasible to modify the north wall of the river, so these alternatives are only relative to the south wall. Furthermore, since the north wall is at a lower elevation than the current south wall for about half of the river length, there would be no point to raise the wall height to accommodate future flood levels, as it would just force the flood water to the north. In order to obtain additional flood storage from these repairs the river would need to be widened.

There is known or suspected soil contamination along the proposed Riverwalk area that will also need to be addressed, as each alternative will require the handling of soils to some extent. The permitting strategy detailed in this chapter report does not include any MCP permitting associated with the contamination found. Easements or property acquisition will be required for each alternative to accommodate the Riverwalk, with some alternatives requiring more property than others.

A description of the typical permits and requirements that might be required for each alternative can be seen in Appendix K. Appendix L provides a summary table of estimated regulatory impacts and likely permits required for each of the five options, while Appendix M provides a permit approval schedule for

each alternative.

Information presented in the permitting matrix in Section 8.3 - Permitting Summary and Recommendations, is described in greater detail, below.

8.2 Environmental Permitting Strategy

8.2.1 Alternative A – Rip Rap Slope

A rip rap slope would require the removal of the existing south wall along the entire length in consideration. The rip rap would be placed with a slope of 1 vertical to 1.5 horizontal; the stone can be locally sourced or reused from the current south wall. The rip rap will extend 5-feet into the river bed and 3.5-feet below the river bed to maintain continuity with the slope. Two options are presented for the location of the slope.

- Option 1 will begin the 1:1.5 slope where the current wall exists, providing additional flood storage along the slope.
- Option 2 will begin the 1:1.5 slope roughly 3.5-feet north of the south wall (in the river) providing no additional flood storage but maintaining the storage the current river width provides.

8.2.1.1 Regulatory Impacts

Environmental resources that will be impacted with both Rip Rap Slope options include the following (all calculations are estimates based on current conceptual designs):

- Bank of perennial stream
    - For both rip rap options, an estimated 1,335 linear feet (lf) will be impacted due to the removal of the existing wall.
- Land under water associated with a perennial stream
    - Option 1 will result in Land Under Water (LUW) impacts of 6,700 sf and dredging of 24,800 cubic feet (cf) of material.
    - Option 2 will result in LUW impacts of 12,300 sf, 43,500 cf of dredge, and unknown amount of fill.
- 100-year flood zone
    - Option 1 would increase flood storage by adding approximately 24,000 CF of additional flood storage due to the removal of the existing stone masonry wall Option 2 will match existing storage volume
- Riverfront area
    - Option 1 will impact 26,000 sf
    - Option 2 will impact 21,000 sf

8.2.1.2 Potential Permits

Potential permits required for both the rip rap slope alternatives include the following:

- MA Wetlands Protection Act Notice of Intent
- MassDEP 401 Water Quality Certification
- MassDEP Chapter 91 submission
- MEPA Environmental Notification Form
- US Army Corps of Engineers Individual Permit

A description of these permits and typical required documents has been included in ***Appendix K***.

8.2.1.3 Permit Costs

Permit costs can vary depending on resource area impacts, project complexity, and reviewer comments. The typical range of costs per likely required permit is provided below.

Permit Costs for Rip Rap Slope Options 1 or 2

Permit	Minimum Cost	Maximum Cost
MassDEP Wetlands NOI	5,000	10,000
MassDEP 401 WQC	5,000	10,000
MassDEP Ch 91	5,000	10,000
MEPA ENF	5,000	10,000
ACOE IP	5,000	10,000
TOTAL	25,000	50,000

Option 2 would most likely incur an additional $10,000 -15,000 for additional studies related to mitigation/compensation design.

8.2.1.4 Permit Approval Schedule

To efficiently gain permit approvals, it is recommended that the ENF be submitted first. The ENF is forwarded to those reviewers who would have jurisdiction or an interest in the project. Comments from these reviewers are forwarded to the MEPA reviewer, who compiles the comments and forwards them on to the project proponent.

It is helpful to get these comments first and incorporate these comments into the remaining permit submissions to minimize the amount of back and forth with reviewers. Once submitted, the review time for the ENF is approximately 60 days. After incorporating the ENF comments into the remaining permits, all remaining permits can be submitted simultaneously. The ACOE IP can take up to 135 days before gaining approval. The joint 401 WQC / Chapter 91 submission can take from approximately 150 – 400 days for review, depending on if MassDEP determines there are administrative or technical deficiencies with the submission and requests additional information. Finally, assuming the NOI review requires two (2) public meetings, the review process can take approximately 45 days.

In all, the environmental permit review process could take between seven (7) and fifteen (15) months.

8.2.1.5 Alternative Favorability

When evaluating both options from a favorability standpoint, Option 1 presents a much more favorable approach from a wetland's perspective. Not only does it increase flood storage volume in the region, but it also requires no filling to LUW. Any fill within the river will be hard to permit through the various agencies, including DEP and ACOE. It will also require mitigation to replace lost wetland resource areas.

8.2.2 Alternative B – Vegetative Berm Over Rip Rap Slope

The vegetative berm option would be a combination of rip rap slope and vegetative berm. The rip rap would have the same stone size and slope as Alternative A but would stop approximately 3.5-feet above

the river bed with the vegetative berm extending to the top of the slope. The slope of the vegetative berm would be 1 vertical to 3 horizontal. As with the rip rap slope, two options are presented for the location of the slope.

- Option 1 is to begin the rip rap slope where the existing wall is located and provide additional flood storage in the sloped area.
- Option 2 is to begin the rip rap slope roughly 3.75-feet north of the south wall (in the river) which would provide no additional flood storage but would maintain the currently available flood storage.

8.2.2.1 Regulatory Impacts

Environmental resources that will be impacted with both vegetative berm options include the following (all calculations are estimates based on current conceptual designs):

- Bank of perennial stream
  - For both options, an estimated 1,335 linear feet (lf) of bank will be impacted
- Land under water
  - Option1 will result in LUW impacts of 6,000 sf and dredging of 21,400 cubic feet (cf)
  - Option 2 will result in LUW impacts of 10,600 sf, 41,400 cf of dredge, and unknown amount of fill
- 100-year flood zone
  - Option 1 would increase flood storage by adding approximately 26,000 CF of additional flood storage due to the removal of the existing stone masonry wall
  - Option 2 will have negligible impact to the flood zone
- Riverfront area
  - Option 1 will impact 28,500 sf
  - Option 2 will impact 21,800 sf

8.2.2.2 Potential Permits

Potential permits required for both vegetative berm alternatives include the following:

- MA Wetlands Protection Act Notice of Intent
- MassDEP 401 Water Quality Certification
- MassDEP Chapter 91 submission
- MEPA Environmental Notification Form
- US Army Corps of Engineers Individual Permit

A description of these permits and typical required documents has been included in Appendix J.

8.2.2.3 Permit Costs

Permit costs can vary depending on resource area impacts, project complexity, and reviewer comments. The typical range of costs per likely required permit is provided on the following page.

Permit Costs for Vegetative Berm Option

Permit	Minimum Cost	Maximum Cost
MassDEP Wetlands NOI	5,000	10,000
MassDEP 401 WQC	5,000	10,000
MassDEP Ch 91	5,000	10,000
MEPA ENF	5,000	10,000
ACOE IP	5,000	10,000
TOTAL	25,000	50,000

Option 2 would most likely incur an additional $10,000 -15,000 for additional studies related to mitigation/compensation design.

8.2.2.4 Permit Approval Schedule

Much like Alternative A the approach of Alternative B would be similar with a review through the MEPA ENF process followed by a simultaneous review by the other agencies. In all, the environmental permit review process could take between seven (7) and fifteen (15) months.

8.2.2.5 Alternative Favorability

Similar to Alternative A, Alternative B, Option 1 presents a much more favorable approach from a wetland's perspective. Not only does it increase flood storage volume in the region, but it also requires no filling to LUW. Any fill within the river will be hard to permit through the various agencies, including DEP and ACOE. It will also require mitigation to replace lost wetland resource areas.

The vegetative berm approach also has the added benefit of providing habitat to the stream. In many agencies minds this presents a greener solution than the rip rap slope does and could potentially be seen as the desired and preferred alternative from a regulatory perspective.

8.2.3 Alternative C – Sheet Pile Wall

A sheet pile wall would require the removal of the existing wall structure. The existing wall structure would be removed after the sheet piles were installed just behind the existing wall. The height of the sheet pile walls can vary along the length of the canal or maintain a constant height. By removing the existing wall after installation of the sheet piles, a small increase in the canal flood storage will be achieved.

- Option 1 consists of a sheet pile wall installed behind the existing wall to an approximate depth of 20 feet below the top of slope. The existing wall structure would be removed after the sheet piles are installed, providing a small increase in flood storage. A concrete cap would be constructed along the top of the sheet pile wall for a more aesthetic look and to cover the jagged top of the sheet piling. An available option for this alternative is architectural cladding, such as a stone veneer matching the aesthetics of the existing wall.

- Option 2 consists of a sheet pile wall installed behind the existing wall. The sheet pile would extend 2-feet above the canal bed, and 13-feet below ground. A rip rap or vegetative slope, much like Alternatives A and B, would then extend from the top of the sheet pile to the top of bank.

8.2.3.1 Regulatory Impacts

Environmental resources that will be impacted with this option include the following (all calculations are estimates based on current conceptual designs):

- Bank of perennial stream
  - An estimated 1,335 linear feet (lf) of bank will be impacted
- Land under water
  - Temporary LUW impacts associated with demolition of south wall
- 100-year flood zone
  - Option 1 would increase flood storage by adding approximately 10,700 CF of additional flood storage due to the removal of the existing stone masonry wall
  - Option 2 would provide approximately 37,000 CF of flood storage due to the removal of wall and addition of a rip rap slope. If the slope were constructed as a vegetative berm, the additional flood storage would be increased to 44,000 CF.
- Riverfront area
  - Option 1 will impact 17,200 sf
  - Option 2 will impact 20,000 sf

8.2.3.2 Potential Permits

Potential permits required for the sheet pile wall alternative include the following:

- MA Wetlands Protection Act Notice of Intent
- MEPA Environmental Notification Form
- US Army Corps of Engineers Individual Permit
- MassDEP 401 Water Quality Certification

A description of these permits and typical required documents has been included in Appendix K.

8.2.3.3 Permit Costs

Permit costs can vary depending on resource area impacts, project complexity, and reviewer comments. The typical range of costs per likely required permit is provided, below.

Permit Costs for Sheet Pile Option

Permit	Minimum Cost	Maximum Cost
MassDEP Wetlands NOI	5,000	10,000
MEPA ENF	5,000	10,000
ACOE IP	5,000	10,000
401 WQC	5,000	10,000
Add'l Cost Analysis	5,000	10,000
TOTAL	25,000	50,000

An additional cost analysis may be needed to prove this Alternative is the preferred Alternative. We estimate that additional cost to be $5,000 -10,000 as explained in Section 8.3.

8.2.3.4 Permit Approval Schedule

Much like Alternative A and B, the approach of Alternative C would be similar with a review through the MEPA ENF process followed by a simultaneous review by the other agencies. The only permit that most likely will not be necessary is the Chapter 91 permit, as there will be no jurisdictional work within the waterway. Although this is only 1 permit fewer then the first alternatives, the CH91 permit has a lengthy review timeframe and by avoiding it, the project could cut the permitting approval process in half. In all, the environmental permit review process could take up to seven (7) months.

8.2.3.5 Alternative Favorability

Although this Alternative C - Option 1 is a suitable alternative for repair of the existing south wall, it provides no extra environmental benefit from a regulatory standpoint, with the exception of a marginal flood storage benefit.

Because the current wall is a vertical wall, it would be permittable as a replacement of the existing conditions. However, with other more favorable alternatives present, the City would have to show how other options would be less practicable based on at least the following considerations:

- Costs and whether such costs are reasonable or prohibitive to the owner;
- Existing technology; and
- Logistics considering the overall project purposes

Alternative C- Option 2 presents a more favorable approach than Alternative C - Option 1 from a regulatory perspective as it provides additional flood storage. If combined with the greener solution of a vegetated berm, then it could even provide some habitat benefit, as well.

8.2.4 Alternative D – Cantilever Concrete Retaining Wall

A cantilever concrete retaining wall would replace the existing south wall. Excavation would be required for the placement of the footing. The stem of the concrete wall will be approximately 14 inches wide at the top and about 30 inches wide at the base. A concrete form liner may be used to provide texture or the look of a stone veneer if desired.

8.2.4.1 Regulatory Impacts

Environmental resources that will be impacted with this option include the following (all calculations are estimates based on current conceptual designs):

- Bank of perennial stream
  - An estimated 1,335 linear feet (lf) of bank will be impacted
- Land under water
  - Temporary LUW impacts associated with demolition of south wall
- 100-year flood zone
  - Marginal increase in flood storage from removal of wall
- Riverfront area
  - Will impact 14,800 sf

8.2.4.2 Potential Permits

Potential permits required for the cantilever retaining wall alternative include the following:

- MA Wetlands Protection Act Notice of Intent

- MEPA Environmental Notification Form
- US Army Corps of Engineers Individual Permit
- 401 Water Quality Certification

A description of these permits and typical required documents has been included in Appendix J.

8.2.4.3 Permit Costs

Permit costs can vary depending on resource area impacts, project complexity, and reviewer comments. The typical range of costs per likely required permit is provided on the following page.

Permit Costs for Cantilever Retaining Wall Option

Permit	Minimum Cost	Maximum Cost
MassDEP Wetlands NOI	5,000	10,000
MEPA ENF	5,000	10,000
ACOE IP	5,000	10,000
401 WQC	5,000	10,000
Add'l Cost Analysis	5,000	10,000
TOTAL	25,000	50,000

An additional cost analysis may be needed to prove this Alternative is the preferred Alternative. We estimate that additional cost to be $5,000 -10,000 as explained in Section 8.3.

8.2.4.4 Permit Approval Schedule

Alternative D would replicate the schedule of Alternative C, with a review through the MEPA ENF process followed by a simultaneous review by the other agencies. Again, no CH 91 permit review would be necessary and therefore permitting review timelines would be reduced.

In all, the environmental permit review process could take up to seven (7) months.

8.2.4.5 Alternative Favorability

Similar to Alternative C, this alternative is a suitable alternative for repair of the existing south wall, however it provides no extra environmental benefit from a regulatory standpoint. It only provides a marginal flood storage benefit and no habitat benefit to the resource area.

Because the current wall is a vertical wall, it would be permittable as a replacement of the existing conditions. However, with other more favorable alternatives present, the City would have to show how other options would be less practicable based on at least the following considerations:

- Costs and whether such costs are reasonable or prohibitive to the owner;
- Existing technology; and
- Logistics considering the overall project purposes

To make this alternative more favorable the wall could be pushed back farther south, and the river widened to allow for increased flood storage.

8.2.5 Alternative E – Stone Masonry Wall

The stone masonry wall would replace the existing stone masonry wall with a new concrete footing in the same location. The stem of the wall will be approximately 20 inches wide at the top and 4 feet at the base. The concrete footing would be constructed approximately 4 feet below the stream bed. This alternative would provide no additional flood storage space.

8.2.5.1 Regulatory Impacts

Environmental resources that will be impacted with this option include the following (all calculations are estimates based on current conceptual designs):

- Bank of perennial stream
  - An estimated 1,335 linear feet (lf) of bank will be impacted
- Land under water
  - Temporary LUW impacts associated with demolition of south wall
- 100-year flood zone
  - Marginal increase in flood storage from removal of wall
- Riverfront area
  - Will impact 15,900 sf

8.2.5.2 Potential Permits

Potential permits required for the stone masonry wall alternative include the following:

- MA Wetlands Protection Act Notice of Intent
- MEPA Environmental Notification Form
- US Army Corps of Engineers Individual Permit
- 401 Water Quality Certification

A description of these permits and typical required documents has been included in Appendix K.

8.2.5.3 Permit Costs

Permit costs can vary depending on resource area impacts, project complexity, and reviewer comments. The typical range of costs per likely required permit is provided below

Permit Costs for Stone Masonry Wall Option

Permit	Minimum Cost	Maximum Cost
MassDEP Wetlands NOI	5,000	10,000
MEPA ENF	5,000	10,000
ACOE IP	5,000	10,000
401 WQC	5,000	10,000
Add'l Cost Analysis	5,000	10,000
TOTAL	25,000	50,000

An additional cost analysis may be needed to prove this Alternative is the preferred Alternative. We estimate that additional cost to be $5,000 -10,000 as explained in Section 8.3.

8.2.5.4 Permit Approval Schedule

Alternative E would replicate the schedule of Alternative C and D, with a review through the MEPA ENF process followed by a simultaneous review by the other agencies. Again, no CH 91 permit review would be necessary and therefore permitting review timelines would be reduced.

In all, the environmental permit review process could take up to seven (7) months

8.2.5.5 Alternative Favorability

Similar to both Alternatives C and D, this alternative is a suitable alternative for repair of the existing south wall, however it provides no extra environmental benefit from a regulatory standpoint. It only provides a marginal flood storage benefit and no habitat benefit to the resource area.

Because the current wall is a vertical wall, it would be permittable as a replacement of the existing conditions. However, with other more favorable alternatives present, the City would have to show how other options would be less practicable based on at least the following considerations:

- Costs and whether such costs are reasonable or prohibitive to the owner;
- Existing technology; and
- Logistics considering the overall project purposes

To make this alternative more favorable the wall could be pushed back farther south, and the river widened to allow for increased flood storage.

8.3 Permitting Summary and Recommendations

Weston & Sampson has produced five (5) design alternatives (three with sub options for a total of eight total alternatives) for repair / replacement options for the south wall along the North River Canal in order to support the proposed construction of a Riverwalk and to improve the flood resilience along the North River Canal. Each of these designs has been evaluated for five (5) different variables, including impacts to protected environmental resources, required permits, permit costs, permit approval schedule and regulatory favorability. For each alternative, each variable was given a value, with lower values indicating lesser preferred alternative results. A summary table showing each alternative with five different variable results are provided in *Appendix K*.

In general, the more complicated the wall repair, the greater the number of environmental resources and impact areas, which results in a greater number of environmental permits being required along with increased costs and schedule duration. As a result of this analysis, it should be noted that the alternatives fall into one of two groups, those that require permanent work within land under water (Alternative A and B), and those that do not require permanent work within land under water (Alternative C, D and E). For those alternatives that impact land under water, an additional permit (MassDEP Chapter 91) will be required and result in additional project costs and permitting approval duration.

In general, the only difference between these two groups of alternatives from a permit cost and schedule context is approximately $5k-$10k in costs and 7-8 months in review. However, when providing additional overall project cost analysis study, the cost of C, D and E are comparable to Option 1 in both Alternatives A and B. Furthermore Option 2 in Alternatives A and B add even more costs associated with further design required for mitigation of lost resource areas. Therefore, Option 1 in Alternative A and B, Alternative C, Alternative D, and Alternated E all have roughly the same costs when factoring in the Permit costs and Additional Overall Cost Analysis. The additional studies required as part of Option

2 for Alternative A and B would make those choices more expensive. See table below:

Potential Permitting Costs

	Alt A, Opt. 1	Alt A, Opt. 2	Alt. B, Opt. 1	Alt. B, Opt. 2	Alt. C, Opt. 1	Alt. C. Opt. 2	Alt. D	Alt. E
Costs ($)	$25,000 - $50,000	$35,000 - $65,000	$25,000 - $50,000	$35,000 - $65,000	$25,000 - $50,000	$25,000 - $50,000	$25,000 - $50,000	$25,000 - $50,000

Given the relatively small difference in cost and timing of the permits required for each alternative, Weston & Sampson evaluated the anticipated favorability of each alternative from a regulatory perspective. Each permitting agency will be evaluating the potential impacts of resource areas that will be impacted by the proposed alternative; most notably bank and land under water. Although any repair alternative work will be performed within the flood plain, the intent of the overall project will be to increase flood storage and not fill the flood plain, which will also be looked at favorably by the regulatory agencies. Additionally, work will also be completed in the riverfront area, however the portion of the riverfront area that will be impacted is previously developed and any project of this magnitude that has a goal of cleaning up the riverfront is anticipated to be looked at favorably by the permitting agency reviewer.

The following is an excerpt of the performance standards for bank and land under water in the wetland's protection act:

"General Performance Standards (Land Under Water).

(a) Where the presumption set forth in 310 CMR 10.56(3) is not overcome, any proposed work within Land under Water Bodies and Waterways shall not impair the following:

1. *The water carrying capacity within the defined channel, which is provided by said land in conjunction with the banks;*
2. *Ground and surface water quality;*
3. *The capacity of said land to provide breeding habitat, escape cover and food for fisheries; and*
4. *The capacity of said land to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 5,000 square feet (whichever is less) of land in this resource area found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures established under 310 CMR 10.60."*

"General Performance Standard (BANK).

(a) Where the presumption set forth in 310 CMR 10.54(3) is not overcome, any proposed work on a Bank shall not impair the following:

1. *the physical stability of the Bank;*
2. *the water carrying capacity of the existing channel within the Bank;*
3. *groundwater and surface water quality;*
4. *the capacity of the Bank to provide breeding habitat, escape cover and food for fisheries;*
5. *the capacity of the Bank to provide important wildlife habitat functions. A project or projects on a single lot, for which Notice(s) of Intent is filed on or after November 1, 1987, that (cumulatively) alter(s) up to 10% or 50 feet (whichever is less) of the length of the bank found to be significant to the protection of wildlife habitat, shall not be deemed to impair its capacity to provide important wildlife habitat functions. Additional alterations beyond the above threshold may be permitted if they will have no adverse effects on wildlife habitat, as determined by procedures contained in 310 CMR 10.60."*

Although they are listed as two (2) different resource areas, the performance standards for both are very similar. Essentially LUW and Bank need to provide the following:

- Stability,
- Water carrying capacity,
- Ground water and surface water quality,
- Habitat for fisheries, and
- Capacity of land to provide other wildlife habitat functions

Although these are just performance standards under the Massachusetts Wetlands Protection Act, and both resource areas are also protected under the Army Corp Section 404 and Mass DEP Section 401 of the Clean Water Act, as well as Mass DEP Chapter 91 regulations, the intent of the protection remains the same throughout.

So, when evaluating each alternative, we must review them to these standards to see if they Meet (M), Improve (I) or Diminish (D) each standard.

Alternative Evaluation against Performance Standards

	Stability	Water Carrying	Water Quality	Habitat for Fisheries	Wildlife Habitat	Total
Alternative A Option 1	Improve	Improve	Improve	Improve	Meet	4 I, 1 M
Alternative A Option 2	Improve	Diminish	Diminish	Diminish	Meet	1 I, 1 M, 3 D
Alternative B Option 1	Improve	Improve	Improve	Improve	Improve	5 I
Alternative B Option 2	Improve	Diminish	Diminish	Diminish	Improve	2 I, 3 D
Alternative C Option 1	Improve	Improve	Meet	Meet	Meet	2 I, 3 M
Alternative C Option 2	Improve	Improve	Meet	Meet	Improve (if veg berm)	3 I, 2 M
Alternative D	Improve	Meet	Meet	Meet	Meet	1 I, 4 M
Alternative E	Improve	Meet	Meet	Meet	Meet	1 I, 4 M

As can be seen above, Option 2 for both Alternative A and B would diminish the quality of the resource areas impacted by the project. Based on the location of the wall in both scenarios, fill would need to be placed within the existing land under water. This would diminish the river's existing ability to carry water, treat the water and provide fish habitat. Because these alternatives would result in a diminished resource area, the agencies would more than likely require some type of mitigation to replicate the lost function of the resource area lost. This would require additional studies (hydraulic, water quality, habitat evaluations, etc.) and design of replication/restoration areas in order to determine exactly what functions were being lost and how to best replicate them on the same stretch of river.

Alternatives D, and E would meet the standards, but would provide no benefit or improvement, except for stabilizing the wall. Alternatives C - Option 1 rates slightly higher as it would improve on 1 standard by increasing water carrying capacity. Because the river is currently confined between two vertical walls

throughout this stretch, an argument could be made that all three alternatives should be allowable, as the work will not diminish what currently exists. Agencies would most likely require additional information to determine why these three alternatives were preferred over others that may provide more benefit to the site. Additional information could include an overall project cost analysis of each alternative and additional information on property rights along the river. For instance, acquisition of private land in order to complete Alternative B may be cost prohibitive and not preferred over another alternative that had a smaller footprint and required less acquisition of land. The proponent would be required to prove that the selected alternative, although possibly not the most environmentally preferred, was selected for other preferential reasons.

Alternative B - Option 1, Alternative A - Option 2, and Alternative C - Option 2provide the most favorable alternatives when compared to the standards. Because these options include the expansion of the width of the river, the creation of Land Under Water and the gradual sloping of the bank, all three options would improve upon various criteria within the standards.

Although not called out specifically in the performance standards there are still other environmental considerations that will factor into overall favorability. Special consideration should also be given to alternatives that provide other benefits, such as the creation of flood storage volume. When rating each alternative based on their potential long-term impact to increasing storage along the river, Alternative B - Option 1, Alternative A - Option 1 and Alternative C - Option 2 rate out the most favorable, in that order.

In summary, the evaluated alternatives ranked accordingly highest to lowest based on regulatory favorability:

- Alternative B - Option 1 (provides 5 improvements and provides flood storage)
- Alternative A -Option 1 (provides 4 improvements and provides flood storage)
- Alternative C - Option 2 (provides 3 improvement and provides flood storage)
- Alternative C - Option 1 (provides 2 improvement and meets others)
- Alternative D (provides 1 improvement, additional study required to show why selected)
- Alternative E (provides 1 improvement, additional study required to show why selected)
- Alternative B - Option 2 (will diminish resource area, additional studies for impact and replication)
- Alternative A - Option 2 (will diminish resource area, additional studies for impact and replication)

Utilizing the five standards and flood plain considerations mentioned above, we have included a Permitting Strategy Matrix on the following page for the project. Although the matrix rates out four alternatives relatively close, careful consideration should be taken to which variables are more important to the client.

Given the relatively small difference in cost and timing of the permits (when compared to the general wall repair costs, etc.) these factors are less likely to impact the City's decisions as to which alternative to choose. More important factors, such as favorability or the likelihood and ease of which approvals can be obtained from the agencies might be the governing factor. This would be evident in the favorability ranking of each alternative. Please see the Permitting Strategy Matrix Summary provided on the following page:

Permitting Strategy Matrix Summary

	A.1 - Rip Rap Slope	A.2 - Rip Rap Slope	B.1 - Vegetative Berm	B.2 - Vegetative Berm	C.1 - Sheet Pile Wall	C.2- Sheet Pile Wall w/ Sloped Bank	D - Cantilever Concrete Retaining Wall	E - Stone Masonry Wall
Impacts (1-7)	3	1	4	2	5	5	7	6
Permits (1-7)	5	1	5	1	6	6	6	6
Costs (1-7)	3	1	3	1	3	3	3	3
Favorability (1-8)	7	1	8	2	3	6	3	3
Schedule (1-7)	3	1	3	1	4	4	4	4
Total Average	4.2	1.0	4.6	1.4	4.2	4.8	4.6	4.4

lower number = less preferred alternative

higher number = more preferred alternative

9.0 COMPREHENSIVE COMPARATIVE MATRIX

The following is a comprehensive comparative matrix to assist the City when comparing each of the repair design alternatives outlined in this report. Please note that this is not a final construction cost estimate. The preliminary cost estimates provided for each conceptual alternative only include major items associated with each wall design and are to be used for comparative purposes only. These preliminary cost estimates are not representative of the final construction costs as they do not include minor items that will be required for the implementation of each alternatives such as site preparation work, clearing and grubbing, erosion controls, etc.

Please refer to the assumptions presented in *Appendix I – Wall Alternative Cost Estimates*. Please note that the cost estimates assume that only impacted soils associated with wall repair activities are removed from the site and are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the future construction of the proposed Riverwalk, etc., as the preliminary design of the Riverwalk has not been completed at this time.

	Resiliency & Flood Storage	Durability & Maintenance	Estimated Excavation	Construction & Easements	Permitting & Regulatory Favorability	Preliminary Cost Estimate *
Alt A - Rip Rap Option 1	- Approx. 18 cu.ft./ft additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 30%-55%	- Minimum design service life 50 years - Low maintenance (i.e. replace dislodged riprap after storm events)	- Requires excavating ~3000 CY of contaminated soils	- Requires 25-ft permanent easement from edge of river - Additional 15-ft temporary easement for construction - Approx. 5-month construction	-4th in Total Permitting Favorability (tie) - 2nd in Regulatory Favorability - 4 Improved Resources	$2,607,000 – $9,926,000
Alt A - Rip Rap Option 2	- Approx. 1 cu. ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 11%-17%	- Minimum design service life 50 years - Low maintenance (i.e. replace dislodged riprap after storm events)	- Requires excavating ~1500 CY of contaminated soils	- Requires 21-ft permanent easement from edge of river - Additional 15-ft temporary easement for construction - Approx. 5-month construction	- Lowest scoring (8th) alternative in Total Permitting Favorability - Lowest (8th) Regulatory Favorability -Diminishes Resources & Need for additional studies	$2,615,000 - $8,459,000
Alt B - Vegetative Berm Option 1	- Approx. 20 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 31%-60%	- Minimum design service life 50 years - Low to Moderate maintenance required (i.e. maintain vegetation, replace rip rap and/or soils, etc. after storm events)	- Requires excavating ~3000 CY of contaminated soils	- Requires 28-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Approx. 5-9-month construction (depends on growing season)	- 2rd in Total Permitting Favorability (tie) - Highest (1st) Regulatory Favorability -5 Improved Resources	$2,479,000 - $9,712,000

Alt B - Vegetative Berm Option 2	- Approx. 1 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 11%-17%	- Minimum design service life 50 years - Low to Moderate maintenance required (i.e. maintain vegetation, replace rip rap and/or soils, etc. after storm events)	- Requires excavating ~1400 CY of contaminated soils	- Requires 25-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Approx. 5-9-month construction (depends on growing season)	- 5th in Total Permitting Favorability - 7th (second to last) in Regulatory Favorability - Diminishes Resources & Need for additional studies	$2,421,000 - $8,103,000
Alt C – Sheet Pile Wall Option 1	- Approx. 8.5 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 20%-45%	- Minimum design service life 75 years - Low maintenance required (i.e. monitor sheet piles for corrosion, crack and spall repairs of concrete cap)	- Requires excavating ~400 CY of contaminated soils	- Requires 13-foot permanent easement from edge of river -Additional 15-foot temporary easement for construction - Specialized construction methods - Approx. 4-5-month construction	- 4th in Total Permitting Favorability (tie) - 4th in Regulatory Favorability - Limited Improvements & Need for additional studies	$2,678,000 - $3,422,000
Alt C – Sheet Pile Wall Option 2 w/ Sloped Bank	- Approx. 20-25 cu.ft./ft. additional flood storage - Future height increase possible - Max. % of parcels protected ranges from 31%-60%	- Minimum design service life 50 years - Low to Moderate maintenance required (i.e. monitor sheet piles for corrosion; replace dislodged rip rap after storm events; maintain vegetative berm which is less stable than rip rap during and after storm events and may require minor repair)	- Requires excavating: ~2600 CY of contaminated soils for Rip Rap option ~1500 CY of contaminated soils for Earthen Berm	- Requires 28-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Approx. 5-month construction	- Highest (1st) in Total Permitting Favorability - 3rd in Regulatory Favorability -3 Improved Resources but Meet all others	$2,332,000 - $5,060,000 (w/ Earthen Berm) $2,726,000 - $7,214,000 (w/ Rip Rap)

Alt D - Concrete Cantilever Retaining Wall	- No increased river flood storage - Future height increase possible - No % of parcels protected	- Minimum design service life 75 years - Moderate maintenance required (i.e. crack and spall repairs)	- Requires excavating ~1900 CY of contaminated soils	- Requires 13-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Requires removal of organic soils to prevent settlement - Approx. 6-8-month construction	- 2nd in Total Permitting Favorability (tie) - 5th in Regulatory Favorability - limited Improvement & need for additional studies	$4,832,000 - $9,834,000
Alt E - Stone Masonry Wall	- No additional river flood storage - Future height increase possible - No % of parcels protected	- Minimum design service life 50 years - Moderate maintenance required (i.e. repointing of mortar, replace dislodged stones)	- Requires excavating ~2100 CY of contaminated soils	- Requires 13-foot permanent easement from edge of river - Additional 15-foot temporary easement for construction - Requires removal of organic soils to prevent settlement - Approx. 7-9-month construction - Requires removal of organic soils to prevent settlement	- 3rd in Total Permitting Favorability - 6th in Regulatory Favorability - limited Improvement & need for additional studies	$4,328,000 - $9,702,000

* Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions

10.0 CONCLUSIONS

The comparative matrix in the previous section was used to determine the highest-ranking wall alternative option for this project. Factors with the most importance during this decision were: cost, quantity of impacted soils requiring excavation and off-site disposal, volume of dredged material, favorability by regulatory agencies in obtaining permits, feasibility of providing additional flood storage, and the ease of adding a Riverwalk behind the wall.

In general, the least expensive alternatives were: 1) Alternatives C – Sheet Pile options; 2) Alternatives B – Vegetative Berm options; and Alternatives A- Rip Rap options. The alternatives which require the least estimated amount of material to be dredged from the canal are: 1) Alternatives C – Sheet Pile options; 2) Alternative D - Cantilever Wall; and 3) Alternative E - Stone Masonry wall. Adding a Riverwalk behind the sheet pile wall option 1, concrete cantilever wall or stone masonry wall may prove difficult at certain locations where a cantilever walkway would become necessary. At those difficult locations, the two rip rap options, the two vegetative berm options, and sheet pile option 2 would allow for the use of piers to avoid a cantilever walkway and thus likely reduce costs.

Therefore, Alternative C – Sheet Pile Wall Option 2 with Sloped Bank is the highest scoring alternative. However, Alternative C- Option 2 may not be feasible along the entire length due to existing structures and grade, such as the parking lot at 21 Caller Street, and may require a limited length of one of the other wall alternatives to be considered. As an example, the Sheet Pile Wall Option 1 could be used for a short distance along the bank until a larger portion of land is available behind the wall to return to the Sheet Pile Wall Option 2. The feasibility in areas such as 21 Caller Street will need to be further evaluated during the preliminary design and may depend on other factors such as property easements or acquisition potential.

Other well-scoring options during the comparison evaluation were: Alternative C - Sheet Pile Wall - Option 1; Alternative B - Vegetative Berm - Option 1; and Alternative A - Rip Rap - Option 1. The highest-ranking wall option, Alternative C - Sheet Pile Wall - Option 2 with Sloped Bank, combines all the favorable qualities of Alternatives A and B with the favorable qualities of Sheet Pile Option 1 and provides the highest percentage of potential parcel protection for all six flood-climate change projection scenarios.

While Alternative C - Sheet Pile Wall options generally cost about the same as Alternative B - Vegetative Berm Option 1, the sheet pile walls' low maintenance, ease of construction and long lifespan make it a good option and this alternative also does not require any material to be dredged from the canal. Alternative A - Rip Rap Option 1 was ranked closely behind Alternative B because of its similar characteristics to the Vegetative Berm Option 1 but ranked slightly lower due to its greater construction costs and lower total permitting favorability. The estimated cost of Alternative C – Sheet Pile Wall – Option 2 is slightly lower than these other well-scoring options due to the limited excavation and channel dredging required. Alternatives A – Option 1, B – Option 1 and C – Option 2 require roughly the same easement widths.

11.0 REFERENCES

This report has prepared the report for the use by the City of Peabody and the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA), and the design and construction teams for this project and this site only. The information herein could be used for bidding or estimating purposes but should not be construed as a warranty of subsurface conditions. We have made observations only at the aforementioned locations and only to the stated depths. These observations do not reflect soil types, strata thicknesses, or water levels that may exist between observations. Weston & Sampson should be retained during final design to complete additional geotechnical analyses as necessary and review final design and specifications to ensure that our recommendations are suitably followed.

The findings provided by Weston & Sampson in this report are based solely on the information reported in this document. Future subsurface investigations, sampling, and/or other information that was not available to Weston & Sampson at the time of the study, may result in a modification of the findings stated in this report.

Should additional information become available concerning this project site or neighboring properties, which could directly impact the Site in the future, that information should be made available to Weston & Sampson for review so that, if necessary, conclusions presented in this report may be modified.

The preceding recommendations should be considered preliminary, as actual soil conditions may vary. In order for our recommendations to be final, Weston & Sampson should be retained to observe actual subsurface conditions encountered during construction. Our observations will allow us to interpret actual conditions and adapt our recommendations if needed.

The conclusions of this report are based on project site conditions observed by Weston & Sampson personnel at the time of the study, information provided by the City of Peabody, and samples collected and analyzed on the dates shown or stated in this report. Any modification of the report without written verification or adaptation by Weston & Sampson, as appropriate for the specific purpose intended, will be at the City and MassEEA's sole risk and without liability or legal exposure to Weston & Sampson or to Weston & Sampson's consultants. Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty, expressed or implied, is given.

FIGURES



Weston & Sampson
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Five Centennial Drive, Peabody, MA 01960
978.532.1900
800.SAMPSON
www.westonandsampson.com

No.	Date	Description	Dr.By	Ck.By	App.By
		APPROVED			

DATE

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 1 - Locus Plan

CADD NO.	SCALE:	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
	AS NOTED	1	2180658	-	-	-	-

S-1

FILE NO.

SHEET 1 OF 1

\\wse01cvol\WSE\Projects\MA\Peabody, MA\MVP Action Grant 2018\Task 2 – Engineering Services & Alternatives Analysis\Geotechnical\CAD\North River – South Well Exit .mxe.dwg

NOTES:

1. THIS DRAWING IS BASED ON JUNE 2017 SOUTH WALL EVALUATION PLANS PREPARED BY WESTON & SAMPSON.
2. BORING LOCATIONS SHOWN ON THIS PLAN ARE BASED ON FIELD MEASUREMENTS RELATIVE TO EXISTING SITE FEATURES.

LEGEND:

- B-# — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL ENGINEERING STAFF BETWEEN NOVEMBER 5 AND 9, 2018.
- TP-# — DESIGNATION AND APPROXIMATE LOCATION OF TEST PITS COMPLETED BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL AND STRUCTURAL ENGINEERING STAFF ON NOVEMBER 6 AND 7, 2018.
- WS-# — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY GEOLOGIC EARTH EXPLORATIONS, INC. OF NORFOLK, MA AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL ENGINEERING STAFF BETWEEN MARCH 21 AND 23, 2007.
- TP-# (2007) — DESIGNATION AND APPROXIMATE LOCATION OF TEST PIT OBSERVED BY WESTON & SAMPSON ON MARCH 8, 2007.
- B-# (GSI) — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY NEW HAMPSHIRE BORING AND OBSERVED BY GEOTECHNICAL SERVICES, INC. BETWEEN OCTOBER 31 AND NOVEMBER 4, 2002. (GSI) HAS BEEN TO THE BORING ID TO DIFFERENTIATE FROM RECENT BORINGS COMPLETED BY WESTON & SAMPSON.

85-38±
0

85-41
15 WALLIS ST

85-37
45 WALNUT ST

85-36
49 WALNUT ST

85-39A
0

85-39B
0 WALNUT

APPROXIMATE LOCATION OF 78 IN. SEWER

CONCRETE VAULT

SMH R=15.70

SMH R=15.84

SMH R=12.09

WALLIS STREET

NORTH RIVER CANAL

TP-5 (2007)

B-1 (GSI)

WS-1

APPROXIMATE EDGE OF WATER

B-2 (GSI)

B-3/MW-4 (GSI)

B-4 (GSI)

B-5 (GSI)

B-6 (GSI)

B-7/MW-1 (GSI)

B-8/MW-3 (GSI)

PROPANE TANK

GOOD | GOOD | POOR | FAIR | GOOD | POOR | POOR | POOR | FAIR

00-25 00-19 0+00 1+00 01+50 01+70 2+00 02+30 3+00 03+20 03+30 03+50 03+70 4+00 04+80

STONE WALL WITH MORTAR

CONCRETE WALL ON TOP OF STONE WITH MORTAR

13 WALLIS ST

24 CALLER ST

REINFORCED CONCRETE (BRIDGE ABUT+WING)

100 FT WETLAND BUFFER

200' RIVER FRONT PROTECTION AREA

20 10 0 20 40
SCALE: 1"=20'

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No.	Date	Description	Dr.By	Ck.By	App.By
A	P	P	R	O	V	E	D		

REGISTERED PROFESSIONAL ENGINEER

DATE

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 2 - Site Plan STA. 00-25 to 04+80

CADD NO.	SCALE: AS NOTED	CONTRACT: 1	JOB NO. 2180658	DR.BY -	DSN.BY -	CHK.BY -	APP.BY -

FILE NO. S-2

SHEET 1 OF 3

\\wse03.local\WSE\Projects\WA\Peabody MA\WP Action Grant 2018\Task 2 – Engineering Services & Alternatives Analysis\Geotechnical\CAD\North River – South Wall Eval new.dwg

NOTES:

1. THIS DRAWING IS BASED ON JUNE 2017 SOUTH WALL EVALUATION PLANS PREPARED BY WESTON & SAMPSON.
2. BORING LOCATIONS SHOWN ON THIS PLAN ARE BASED ON FIELD MEASUREMENTS RELATIVE TO EXISTING SITE FEATURES.

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85-39B
0 WALNUT ST

86-140
65 WALNUT ST

86-139
75 WALNUT ST

86-141
27 CALLER ST

APPROXIMATE LOCATION OF 78 IN. SEWER

SMH R=12.09

SMH R=11.97

SMH R=10.50

SMH R=10.68

SMH R=11.58

SMH R=12.60

SMH R=13.48

STA 505+7

STA 5+88

JZ120

SKZ24

NORTH RIVER CANAL

APPROXIMATE EDGE OF WATER

CALLER STREET

3'-0"

GRANITE BLOCK PILE

B-2 B-3 B-4

TP-1 TP-2 TP-3 TP-4 TP-5 TP-6

WS-3 WS-4

04+80	5+00	6+00	06+35	7+00	07+35	8+00	08+16	08+65	9+00	09+65	09+75	10+00	10+10	10+60
FAIR WITH ISOLATED POOR		FAIR		POOR		FAIR		FAIR	FAIR WITH ISOLATED POOR		POOR	FAIR WITH ISOLATED POOR	POOR	FAIR W
STONE WITH MORTAR				CONCRETE WALL ON TOP OF STONE WITH MORTAR				CONCRETE BRIDGE ABUTMENT ON GRANITE BLOCK WITH MORTAR	STONE WITH MORTAR			STACKED GRANITE BLOCK ON STONE RUBBLE (NO MORTAR)		STACKED GRA
24 CALLER ST												21 CALLER ST		18 H

20 10 0 20 40
SCALE: 1"=20'

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Weston & Sampson
Weston & Sampson Engineers, Inc.
Five Centennial Drive, Peabody, MA 01960
978.532.1900
800.SAMPSON
www.westonandsampson.com

No.	Date	Description	Dr.By	Ck.By	App.By
		APPROVED			

REGISTERED PROFESSIONAL ENGINEER

DATE

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 2 - Site Plan STA. 04-80 to 10+60

CADD NO.	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
	1	2180658	-	-	-	-

SCALE: AS NOTED

FILE NO.

S-3

SHEET 2 OF 3

\\wes03.local\WSE\Projects\MA\Peabody MA\WP Action Grant 2018\Task 2 - Engineering Services & Alternatives Analysis\Geotechnical\CAD\North River - South Wall Eval new.dwg

NOTES:

1. THIS DRAWING IS BASED ON JUNE 2017 SOUTH WALL EVALUATION PLANS PREPARED BY WESTON & SAMPSON.
2. BORING LOCATIONS SHOWN ON THIS PLAN ARE BASED ON FIELD MEASUREMENTS RELATIVE TO EXISTING SITE FEATURES.

LEGEND:

- B-# — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL ENGINEERING STAFF BETWEEN NOVEMBER 5 AND 9, 2018.
- TP-# — DESIGNATION AND APPROXIMATE LOCATION OF TEST PITS COMPLETED BY NEW ENGLAND BORING CONTRACTORS AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL AND STRUCTURAL ENGINEERING STAFF ON NOVEMBER 6 AND 7, 2018.
- WS-# — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY GEOLOGIC EARTH EXPLORATIONS, INC. OF NORFOLK, MA AND OBSERVED BY WESTON & SAMPSON GEOTECHNICAL ENGINEERING STAFF BETWEEN MARCH 21 AND 23, 2007.
- TP-# (2007) — DESIGNATION AND APPROXIMATE LOCATION OF TEST PIT OBSERVED BY WESTON & SAMPSON ON MARCH 8, 2007.
- B-# (GSI) — DESIGNATION AND APPROXIMATE LOCATION OF BORINGS COMPLETED BY NEW HAMPSHIRE BORING AND OBSERVED BY GEOTECHNICAL SERVICES, INC. BETWEEN OCTOBER 31 AND NOVEMBER 4, 2002. (GSI) HAS BEEN TO THE BORING ID TO DIFFERENTIATE FROM RECENT BORINGS COMPLETED BY WESTON & SAMPSON.

86-139
5 WALNUT ST

86-141
CALLER ST

86-138
77 WALNUT ST

86-150A
166 MAIN ST (R)

N/F
26 HOWLEY STREET TRUST
"FLEA MARKET"

1 STORY BRICK

3 STORY BRICK

CONNECTION FROM CATCH BASINS UNKNOWN

300mmCMP

TOP STEP

GRANITE BLOCK RET. WALL

PORTION OF CONC. FOUNDATION ON GRANITE WALL

1 STORY CONC. BLOCK ON CONC PIERS (RIVER BELOW)

0.6m sq. CONC. PIER (TYP.) EL=3.127

(EL. UNDER BLDG)

NORTH RIVER

FLOW

STONE BRIDGE

BITUMINOUS

"NO PARKING"

#8 W/TRANS

SESD DISK "B1125"

150mm INV=1.9

APPROX. L.O. LINE

RAILROAD TIE RET. WALL

GRANITE BRIDGE SUPPORTS

PK NAIL "HOW_C" EL=2.887

N/F
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

MASSACHUSE

TP-6

GRAINTE RIDGE PILE

WS-3

APPROXIMATE EDGE OF WATER

B-6

B-7

WS-2

BITUMINOUS

1 STORY WOOD FRAME

R=2.635
PIPE BLOCKED
H20 EL=1.66

R=2.708
PIPE BLOCKED
H20 EL=1.63

#22

BM#1

POSSIBLE END OF GAS LINE – SCALED FROM GAS PLANS

"RR CROSSING"

"STOP"

7' CLF

VAULT

"WEIGHT LIMIT"

CONST. B

GOOD

POOR

FAIR WITH ISOLATED POOR

POOR

POOR

POOR

POOR

POOR

POOR

FAIR WITH ISOLATED POOR

POOR

10+60 | 11+00 | 11+49 | 11+57 | 12+00 | 12+25 | 13+00 | 13+25 | 13+35 | 13+36 | 13+46 | 14+00 | 14+09 | 15+00 | 15+09 | 15+53 | 15+59

STACKED GRANITE BLOCK (NO MORTAR)

EARTH EMBANKMENT OR BURIED WALL

STACKED GRANITE BLOCK (NO MORTAR)

TIMBER TIE BEHIND EARTH EMBANKMENT

TIMBER TIE BEHIND CONCRETE COLUMN

EARTH EMBANKMENT OR BURIED WALL

CK ON
ORTAR)

18 HOWLEY ST

166 MAIN ST.

BRIDGE

COLLAPSED/MISSING WALL

STACKED GRANITE BLOCK WITH CONCRETE CAP

STACKED GRANITE BLOCK ON STONE RUBBLE

REINFORCED CONCRETE WITH RIPRAP PROTECTION

CONCRETE FOUNDATION

MAG NAIL SET

N/F
THE AZOREAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC.

1 STORY CONC. BLOCK

#20

APPROX. L.O. LINE

HOWLEY

#55-4 W/RISER SL & TRANS

APPROX. L.O. LINE

R=3.012
BOT. VAULT = 0.878

R=2.821
I=0.75(IN)
I=0.05(OUT)

R=2.870
I=1.62(IN)
I=1.59(OUT)

R=2.787
I=2.13(NE)
I=2.14(SE)
I=2.13(SW)

450mm RCP

100 mm HP FLOW

150mm PVC

VGC

VCC

CONCRETE

20 10 0 20 40
SCALE: 1"=20'

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No.	Date	Dr.By	Ck.By	App.By	Description	DATE
		A	P	P	R O V E D	

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

Figure 2 - Site Plan STA. 10-60 to 15+58

S-4

CADD NO.	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
	1	2180658	-	-	-	-

SCALE: AS NOTED

FILE NO.

SHEET 3 OF 3

\\wse03.local\WSE\Projects\MA\Peabody MA\WP Action Grant 2018\Task 2 – Engineering Services & Alternatives Analysis\Geotechnical\CAD\North River – South Wall Eval new.dwg

TABLES

TABLE 1 - SUMMARY OF EXISTING CONDITIONS

Property	Approximate Station Boundaries	Approximate Ground Surface Elevations at Back of Canal Wall (Feet NAVD88)	Surface Conditions
13 Wallis St	0+00 to 02+80	12 to 13	The property is currently a vacant lot with debris, gravel, and vegetation. The area adjacent to the canal is covered with trees and overgrown vegetation.
24 Caller St	02+80 to 08+16	11 to 12	The property is currently developed with several warehouse buildings, a gravel lot used for vehicle and drum storage, and an asphalt concrete paved driveway. Trees and vegetation line the edge of the canal wall.
Caller Street Bridge	08+16 to 08+65	12	Asphalt concrete paved roadway bridge with concrete sidewalks
21 Caller St	08+65 to 10+55	10 to 12	The property is currently developed with a three story commercial and residential building with a paved parking lot. The parking lot is retained by an approximately 3 to 6 foot high masonry retaining wall which runs parallel to the south wall of the canal. The area in between the retaining wall and the canal is about 10 feet wide, and is covered with trees, vegetation, and debris.
18 Howley St	10+55 to 11+49	8 to 9	The property is currently vacant. The area adjacent to the canal is covered with trees, vegetation, and debris including a granite rock pile.
166R Main St	11+49 to 14+25	7 to 9	The property is currently vacant. The Strongwater Brook canal meets the North River Canal at about Sta. 11+49 to 11+57. Asphalt pavement, rail ties, and old building foundations (raised slabs) exist close to the canal wall east of Strongwater Brook.

TABLE 2 - SUMMARY OF SUBSURFACE CONDITIONS

TABLE 2A - TEST BORINGS

Property	Exploration ID	Date of Exploration	Depth to Bottom of Fill (ft) [2]	Depth to Bottom of Organics (ft) [2]	Bottom of Exploration Depth (ft)	Approximate Groundwater Depth (ft)[3]
13 Wallis St	B-1 (GSI)[1]	11/4/2002	10	N/A	40	8
	B-2 (GSI)[1]	10/31/2002	10	N/A	25	8
	B-3 (GSI)[1]	10/31/2002	13	N/A	22	10.5
	B-4 (GSI)[1]	11/1/2002	14	N/A	32	8
	B-5 (GSI)[1]	10/31/2002	10	N/A	17	10
	B-6 (GSI)[1]	10/31/2002	10	N/A	22	8.5
	WS-1	3/21/2007	15	N/A	21	Not Reported
24 Caller St	WS-4	3/23/2007	10	N/A	41	Not Reported
	B-1	11/8/2018	8	14	22	Not Reported
	B-2	11/8/2018	8	N/A	21	Not Reported
	B-3	11/5/2018	7	8.5	21	Not Reported
21 Caller St	B-4	11/8/2018	6	8	21	Not Reported
18 Howley St	WS-3	3/22/2007	N/A	N/A	41	Not Reported
166R Main St	WS-2	3/22/2007	10	15	41	Not Reported
	B-5	11/9/2018	6.5	8.5	21	Not Reported
	B-6	11/9/2018	4	12	21	Not Reported

NOTES:

(1) Subsurface conditions reported herein are based on soil boring logs prepared by Geotechnical Services, Inc. Soil samples have not been reviewed by Weston & Sampson.

(2) N/A indicates stratum was not observed/encountered at the boring location

(3) Depth to groundwater is not reported for borings advanced using drive and wash method, which introduces water into the borehole during drilling.

TABLE 2 - SUMMARY OF SUBSURFACE CONDITIONS

TABLE 2B - TEST PITS					
Property	**Exploration ID**	**Date of Exploration**	**Bottom of Exploration Depth (ft)**	**Approximate Groundwater Depth (ft)**	**Comments**
13 Wallis St	TP-5 (2007)	3/8/2007	6.1	6	Vertical, mortared, granite block wall observed in the test pit.
24 Caller St	TP-1	11/7/2018	6.2	5.8	34-inch thick, boulder wall observed to bottom of test pit. Mortar observered at canal side, but no mortar visible at back of wall.
	TP-2	11/7/2018	6	5.3	17 to 21-inch thick CIP concrete vertical wall observed to 4 feet. Below 4 feet, wall consists of dry-stacked boulders up to 34-inch diameter.
	TP-3	11/6/2018	5.7	5.3	21-inch thick, vertical, CIP concrete wall encountered to bottom of test pit.
21 Caller St	TP-4	11/6/2018	6.8	5.7	16 to 21-inch thick, vertical, mortared, stone wall observed to bottom of test pit.
	TP-5	11/6/2018	5.6	4.6	20-inch thick vertical, dry-stacked, granite block wall observed to bottom of test pit.
	TP-6	11/6/2018	5.6	5.3	No wall structure visible in test pit.

Table 3
Summary of Soil Analytical Results - Disposal Characterization
North River Canal
21 Caller Street
Peabody, Massachusetts

Parameter	Unit	Reportable Concentrations (RCs) [1]	COMM 97 In-State Disposal/Reuse Levels		Sample Location and Date
		RCS-1	Unlined	Lined	TP-5 (5-6') 11/6/2018
Metals					
ARSENIC	mg/kg	20	40	40	**11**
BARIUM	mg/kg	1000	NS	NS	**31**
CADMIUM	mg/kg	70	30	80	**0.51**
CHROMIUM	mg/kg	100	1000	1000	**34**
HEXAVALENT CHROMIUM	mg/kg	100	1000	1000	<1.0
LEAD	mg/kg	200	1000	2000	**42**
SELENIUM	mg/kg	400	NS	NS	<4.3
SILVER	mg/kg	100	NS	NS	<0.43
MERCURY	mg/kg	20	10	10	**0.099**
Polychlorinated biphenyls (PCBs)					
Total PCBs	mg/kg	1	<2	<2	ND
Total Petroleum Hydrocarbons					
TPH	mg/kg	1000	2500	5000	**18**
Volatile Organic Compounds (VOCs)					
Total VOCs	mg/kg	NS	4	10	ND
Semivolatile Organic Compounds (SVOCs)					
Total SVOCs	mg/kg	NS	100	100	ND
General Chemistry					
SPECIFIC CONDUCTANCE	µmhos/cm	NS	4000	8000	**9.8**
IGNITABILITY	present/absent	NS	NS	NS	Absent
REACTIVE CYANIDE	mg/kg	NS	NS	NS	<0.0039
REACTIVE SULFIDE	mg/kg	NS	NS	NS	<20
FLASHPOINT	F	NS	NS	NS	>212 F
OXIDATION/REDUCTION POTENTIAL	mV	NS	NS	NS	**130**
pH	pH units	NS	NS	NS	**6.5**

QC by LEM 12/10/18

Notes:

mg/kg = milligrams per kilogram
µmhos/cm = micromhos per cm
F = degrees fahrenheit
mV = millivolts
NS = No Standard
NT = Not Tested

BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1 S-1 standard
< = indicates parameter not detected above laboratory method reporting limit, shown
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014.

Table 4
Summary of Soil Transportation Disposal Cost Estimates
North River Canal
Peabody, Massachusetts

Description	Unit Price ($/ton)	13 Wallis Street (*Meets Group B Soil Disposal Requirements*)[1]						
		Alternative A - Rip Rap Option 1 (yd^3)	Alternative A - Rip Rap Option 2 (yd^3)	Alternative B - Vegetative Berm Option 1 (yd^3)	Alternative B - Vegetaive Berm Option 2 (yd^3)	Alternative C - Sheet Pile Wall (yd^3)	Alternatie D - Cantilever Concrete Retaining Wall (yd^3)	Alternative E - Stone Masonry Wall (yd^3)
		276	38	368	115	92	230	368
Group A Soil Transport and Disposal - In State < RCS-1 Standards	$35.00	*	*	*	*	*	*	*
Group B1 Soil Transport and Disposal - In State Unlined Landfill	$45.00	$12,420.00	$1,710.00	$16,560.00	$5,175.00	$4,140.00	$10,350.00	$16,560.00
Group B2 Soil Transport and Disposal - In State Lined Landfill	$65.00	$17,940.00	$2,470.00	$23,920.00	$7,475.00	$5,980.00	$14,950.00	$23,920.00
Group C1 Soil Transport and Disposal - Out of State (Non-Haz) ESMI	$55.00	$15,180.00	$2,090.00	$20,240.00	$6,325.00	$5,060.00	$12,650.00	$20,240.00
Group C2 Soil Transport and Disposal - Out of State (Non-Haz) Turnkey	$125.00	$34,500.00	$4,750.00	$46,000.00	$14,375.00	$11,500.00	$28,750.00	$46,000.00

QC by

Notes:

* Disposal Option could not be considered based upon analytical results

** Costs prepared 1/15/2019. Future costs should be escalated appropriately.

1 - Based upon currently available disposal characterization analyatical data

Table 4
Summary of Soil Transportation Disposal Cost Estimates
North River Canal
Peabody, Massachusetts

Description	Unit Price ($/ton)	24 Caller Street (*Disposal Required at Out of State Landfill - Non Hazardous Waste*)[1]						
		Alternative A - Rip Rap Option 1 (yd^3)	Alternative A - Rip Rap Option 2 (yd^3)	Alternative B - Vegetative Berm Option 1 (yd^3)	Alternative B - Vegetaive Berm Option 2 (yd^3)	Alternative C - Sheet Pile Wall (yd^3)	Alternatie D - Cantilever Concrete Retaining Wall (yd^3)	Alternative E - Stone Masonry Wall (yd^3)
		442	221	589	184	147	368	589
Group A Soil Transport and Disposal - In State < RCS-1 Standards	$35.00	*	*	*	*	*	*	*
Group B1 Soil Transport and Disposal - In State Unlined Landfill	$45.00	*	*	*	*	*	*	*
Group B2 Soil Transport and Disposal - In State Lined Landfill	$65.00	*	*	*	*	*	*	*
Group C1 Soil Transport and Disposal - Out of State (Non-Haz) ESMI	$55.00	$24,310.00	$12,155.00	$32,395.00	$10,120.00	$8,085.00	$20,240.00	$32,395.00
Group C2 Soil Transport and Disposal - Out of State (Non-Haz) Turnkey	$125.00	$55,250.00	$27,625.00	$73,625.00	$23,000.00	$18,375.00	$46,000.00	$73,625.00

QC by

Notes:

* Disposal Option could not be considered based upon analytical results

** Costs prepared 1/15/2019. Future costs should be escalated appropriately.

1 - Based upon currently available disposal characterization analyatical data

Table 4
Summary of Soil Transportation Disposal Cost Estimates
North River Canal
Peabody, Massachusetts

Description	Unit Price ($/ton)	21 Caller Street *(Meets < RCS-1 and In State Landfill Requirements)* [1]						
		Alternative A - Rip Rap Option 1 (yd^3)	Alternative A - Rip Rap Option 2 (yd^3)	Alternative B - Vegetative Berm Option 1 (yd^3)	Alternative B - Vegetaive Berm Option 2 (yd^3)	Alternative C - Sheet Pile Wall (yd3)	Alternatie D - Cantilever Concrete Retaining Wall (yd^3)	Alternative E - Stone Masonry Wall (yd^3)
		182	91	242	76	61	151	242
Group A Soil Transport and Disposal - In State < RCS-1 Standards	$35.00	$6,370.00	$3,185.00	$8,470.00	$2,660.00	$2,135.00	$5,285.00	$8,470.00
Group B1 Soil Transport and Disposal - In State Unlined Landfill	$45.00	$8,190.00	$4,095.00	$10,890.00	$3,420.00	$2,745.00	$6,795.00	$10,890.00
Group B2 Soil Transport and Disposal - In State Lined Landfill	$65.00	$11,830.00	$5,915.00	$15,730.00	$4,940.00	$3,965.00	$9,815.00	$15,730.00
Group C1 Soil Transport and Disposal - Out of State (Non-Haz) ESMI	$55.00	$10,010.00	$5,005.00	$13,310.00	$4,180.00	$3,355.00	$8,305.00	$13,310.00
Group C2 Soil Transport and Disposal - Out of State (Non-Haz) Turnkey	$125.00	$22,750.00	$11,375.00	$30,250.00	$9,500.00	$7,625.00	$18,875.00	$30,250.00

QC by

Notes:

* Disposal Option could not be considered based upon analytical results

** Costs prepared 1/15/2019. Future costs should be escalated appropriately.

1 - Based upon currently available disposal characterization analyatical data

Table 4
Summary of Soil Transportation Disposal Cost Estimates
North River Canal
Peabody, Massachusetts

Description	Unit Price ($/ton)	18 Howley Street (Disposal Required at Out of State Landfill - Non Hazardous Waste) [1]						
		Alternative A - Rip Rap Option 1 (yd^3)	Alternative A - Rip Rap Option 2 (yd^3)	Alternative B - Vegetative Berm Option 1 (yd^3)	Alternative B - Vegetaive Berm Option 2 (yd^3)	Alternative C - Sheet Pile Wall (yd^3)	Alternatie D - Cantilever Concrete Retaining Wall (yd^3)	Alternative E - Stone Masonry Wall (yd^3)
		442	221	589	184	34	368	589
Group A Soil Transport and Disposal - In State < RCS-1 Standards	$35.00	*	*	*	*	*	*	*
Group B1 Soil Transport and Disposal - In State Unlined Landfill	$45.00	*	*	*	*	*	*	*
Group B2 Soil Transport and Disposal - In State Lined Landfill	$65.00	*	*	*	*	*	*	*
Group C1 Soil Transport and Disposal - Out of State (Non-Haz) ESMI	$55.00	$24,310.00	$12,155.00	$32,395.00	$10,120.00	$1,870.00	$20,240.00	$32,395.00
Group C2 Soil Transport and Disposal - Out of State (Non-Haz) Turnkey	$125.00	$55,250.00	$27,625.00	$73,625.00	$23,000.00	$4,250.00	$46,000.00	$73,625.00

QC by

Notes:

* Disposal Option could not be considered based upon analytical results

** Costs prepared 1/15/2019. Future costs should be escalated appropriately.

1 - Based upon currently available disposal characterization analyatical data

Table 4
Summary of Soil Transportation Disposal Cost Estimates
North River Canal
Peabody, Massachusetts

Description	Unit Price ($/ton)	166R Main Street (Assumed Disposal Required at Out of State Landfill - Non Hazardous Waste) [1]						
		Alternative A - Rip Rap Option 1 (yd^3)	Alternative A - Rip Rap Option 2 (yd^3)	Alternative B - Vegetative Berm Option 1 (yd^3)	Alternative B - Vegetaive Berm Option 2 (yd^3)	Alternative C - Sheet Pile Wall (yd^3)	Alternatie D - Cantilever Concrete Retaining Wall (yd^3)	Alternative E - Stone Masonry Wall (yd^3)
		197	99	263	82	66	164	263
Group A Soil Transport and Disposal - In State < RCS-1 Standards	$35.00	*	*	*	*	*	*	*
Group B1 Soil Transport and Disposal - In State Unlined Landfill	$45.00	*	*	*	*	*	*	*
Group B2 Soil Transport and Disposal - In State Lined Landfill	$65.00	*	*	*	*	*	*	*
Group C1 Soil Transport and Disposal - Out of State (Non-Haz) ESMI	$55.00	$10,835.00	$5,445.00	$14,465.00	$4,510.00	$3,630.00	$9,020.00	$14,465.00
Group C2 Soil Transport and Disposal - Out of State (Non-Haz) Turnkey	$125.00	$24,625.00	$12,375.00	$32,875.00	$10,250.00	$8,250.00	$20,500.00	$32,875.00

QC by

Notes:

* Disposal Option could not be considered based upon analytical results

** Costs prepared 1/15/2019. Future costs should be escalated appropriately.

1 - Based upon currently available disposal characterization analyatical data

APPENDIX A

2017 Riverwalk along North River Corridor – South Wall Evaluation

June 02, 2017

5 Centennial Drive, Peabody, MA 01960
Tel: 978.532.1900

Brendan Callahan
Planner
City of Peabody
24 Lowell Street
Peabody MA 01960-3111

Re: **Riverwalk along North River Corridor – South Wall Evaluation**

Dear Mr. Callahan:

Weston and Sampson has completed the inspection and evaluation of the South Wall of the North River Corridor. This report provides a description of the structure, a summary of the observed conditions, evaluation of the overall condition, and recommendations for future action.

Purpose of the Inspection and Evaluation

The City of Peabody is investigating the possibility of constructing a Riverwalk along the south side of the North River Corridor between Wallis Street and Howley Street (See Project Location Map below). In 2008, sections of the walls forming the north side of the channel were repaired. At that time, the walls forming the south side of the channel were not included in the improvements. The purpose of this inspection and evaluation is to determine the general condition of the south wall, note observations, and recommend future actions. Observations and evaluation are broken up into two sections; those pertaining to the wall in its existing state and future considerations if a Riverwalk is to be constructed.



Project Location Map

Existing Information and Method of Inspection

Weston and Sampson reviewed existing information including previous work performed on the north canal wall, existing survey information, and existing subsurface investigation data. Existing plans of the wall were not available at the time of inspection.

Weston & Sampson performed a visual inspection of the wall and surrounding area. Measurements were taken using a survey wheel, survey tape, and tape measure. The canal was accessed in isolated areas with hip waders. Light probing of isolated scoured areas was performed using a ½" diameter steel foundation probe and a piece of steel reinforcing bar.

Wall Description

To aid in description of the wall a project stationing was chosen and used throughout this report to help illustrate extents and relative locations of observations. The stationing chosen matches the stationing previously used for the north wall repairs. This will avoid confusion in the future if both projects are reviewed simultaneously. The portion of wall nearest Wallis St is located between station 00-25 and 00-19. The western edge of the Howley St bridge is located at station 15+58. The limits of inspection and observation contained in this report extend from stations 00-25 to 15+58. See attached plan sheets (Appendix C) for a graphic illustration of the plan view and stationing. Additionally, a series of photos (Appendix A) and a summary table (Appendix B) are included to further illustrate/describe conditions and extents.

Starting near Wallis St the canal is initially oriented North/South and extends from the property at 15 Wallis St. beneath a timber railroad bridge. In this location, the west wall was inspected since it transitions into what will be the south wall for most of the canal. The west wall for this portion of the canal (STA. 00-25 to STA. 00-19) is of reinforced concrete construction and doubles as the bridge abutment and wingwall (See photo 001). South of the bridge the canal makes a 90 degree turn and transitions into an East/West orientation. Around the bend (STA. 00-19) the wall transitions from reinforced concrete construction to stone with mortar construction (See photos 002 to 003). The stone with mortar construction wall continues for 349 feet (STA. 00-19 to STA. 03+30) (See photos 003 to 009). The next 40 feet of wall (STA. 03+30 to STA. 03+70) consist of concrete construction on top of stone with mortar construction (See photos 009 to 011). At the end of the concrete construction the stone with mortar portion continues for 330 feet (STA. 03+70 to STA. 07+00) (See photos 012 to 017). At this point in the structure another concrete wall begins on top of the stone with mortar construction. This concrete on top of stone with mortar construction extends for 116 feet (STA. 07+00 to STA. 08+16) until it reaches the Caller Street Bridge (See photos 018 to 021).

The Caller Street Bridge appears to be founded on the next portion of wall which extends to the eastern edge of the bridge (STA. 08+16 to STA. 08+65) and is of granite block and mortar construction (See photos 022 to 026). East of the Caller Street Bridge the wall is of stone with mortar construction which extends for 100 feet (STA. 08+65 to STA. 09+65) (See photos 027 to 029). The next 95 feet of wall (STA. 09+65 to STA. 10+60) consist of stacked granite blocks on top of stone rubble without mortar (See photos 030 to 033). This is followed by an 89-foot section (STA. 10+60 to STA. 11+49) of full height stacked granite block construction which extends to the west bank of the Strongwater Brook canal (See photos 034 to 036).

The Strongwater Brook canal which is approximately 6-8ft wide meets the North River canal at this point. There is an abandoned railroad bridge (STA. 11+49 to STA. 11+57) which crosses the Strongwater Brook which is centered about 6 feet behind the south wall of the North River canal (See photos 037 to 038). East of the Strongwater Brook is a 68-foot section (STA. 11+57 to STA. 12+25) of earth embankment or buried wall (See photos 039 to 040). The next 100 feet of wall (STA. 12+25 to STA. 13+25) consist of stacked granite blocks without mortar (See photo 041 to 043). The following section of wall (STA. 13+25 to 13+35) is collapsed or missing (See photos 044 to 045). This section leads up to and continues through a 90-degree bend in the canal which transitions the canal into a North/South orientation. Following the bend (STA 13+35 to STA 13+36), the Eastern canal wall is made up of stacked granite blocks on top of stone rubble which extends to a timber railroad bridge (See photos 046 to 047).

The railroad bridge appears to rest on a granite slab which sits on top of the next section of wall which consists of a concrete cap on top of stacked granite blocks (See photo 048). This section of wall extends northward (STA. 13+40 to STA. 13+46) until the canal makes another 90-degree bend which transitions the canal back into an East/West orientation. East of the bend, the south canal wall is made up of a timber tie structure behind earth embankment (See photos 049 to 050). This section of wall extends until it meets the building located at 26 Howley St. which extends over the canal (STA. 13+46 to STA. 14+09). The timber tie structure continues behind the building's concrete columns for approximately 100 feet (STA. 14+09 to STA. 15+09) (See photos 051 to 052). East of the building is a section of earth embankment or buried wall which extends until it meets the Southwest wingwall for the Howley St. Bridge (STA. 15+09 to STA. 15+53) (See photo 053). The Howley St. Bridge Southwest wingwall which is of reinforced concrete construction protected by riprap slope extends approximately 5 feet until it meets the Howley St. Bridge (See photo 054).

Observations

See condition table in appendix for observations pertaining to both the existing condition and to future Riverwalk considerations.

Evaluation - Existing State

The wall condition varies drastically over the length of the structure ranging from good to poor. Wall conditions specific to each section along the length are noted in the photos in Appendix A, in the summary table in Appendix B, and in the plan sheets in Appendix C. Sections labeled as good are assumed to require minor or no repair to continue functioning acceptably. Sections labeled as fair are assumed to require more substantial repairs to continue functioning acceptably. Sections labeled as poor are assumed to require either full or partial reconstruction in order to function in an acceptable manor. The above assumed conditions are based on review of available existing materials and limited visual observation of the wall only. In general, most of the noted issues with the wall appear to be driven/exacerbated by waterflow, overgrown vegetation (such as trees with invasive roots), and changes in the surrounding conditions. In addition to addressing the issues it is recommended that addressing the cause of the issues be considered where possible.

Evaluation – Future Considerations for Riverwalk

In addition to the items mentioned above in the existing state evaluation, a number of additional items should be considered for the future Riverwalk. The proposed Riverwalk directly behind the south canal wall would apply additional loading to the wall beyond what it is currently subject to. Analysis of the wall for additional proposed loading would be required. As a result, modifications to sections noted as fair or good above may be required. Near Wallis street the proposed Riverwalk location appears to be close to the existing railroad line. A buffer or fencing may be required for safety. The land directly south of the wall is heavily vegetated containing plants, bushes, and trees. The vegetation would need to be cleared to install a walkway. The existing grading is not adequate for an ADA compliant walkway. The walkway would need to be relatively level both along the width and along the length of the walkway. To achieve ADA compliant grading sections of wall would need to be constructed or demolished and existing soil grades would need to be lowered or raised. Lowering and raising of grades is problematic with the existing grade occupying a flood zone. Adjusting the existing grades may require construction of new sections of wall south of the Riverwalk. Majority of the walkway adjacent to the canal would require railing. Some of the adjacent property lines appear to be very close to the south canal wall and property acquisition may be required to construct a Riverwalk. Caller Street Bridge railing termination extends beyond the bridge limits and appears to extend into the proposed Riverwalk location. Additionally, utilities and what appears to be a storm drain both appear to conflict with the proposed Riverwalk location. Any modifications to the Caller Street Bridge or it's railing may be subject to MassDOT Chapter 85 review. East of the Caller Street Bridge there is a large wall behind the south canal wall. Analysis of this wall would be required if the grades are modified or the loading condition is changed. At the Strongwater brook canal location the existing abandoned bridge structure does not appear to be adequate to carry a Riverwalk over Strongwater brook. A new bridge structure or extensive modifications to the existing structure may be required. East of the Strongwater brook canal it appears that existing railroad ties and

possibly rail may be abandoned in place and covered with asphalt. If present this could add difficultly to excavation or construction. An abandoned building foundation exists close to the south canal wall east of the Strongwater Brook Canal. Land may need to be acquired and this foundation would need to be partially demolished and a retaining structure may be required south of the Riverwalk to ensure any remaining portion is stable. Near Howley street the proposed Riverwalk location appears to be close to an active railroad line operated by Pan Am. A buffer or fencing may be required for safety.

Recommended Actions

1) Delineate the corridor to determine wetlands extents, and identify bordering vegetated wetlands.
2) Conduct additional field survey to supplement and update the existing survey.
3) Perform additional subsurface investigation to explore wall type and possible repair options. Recommended additional investigation measures and locations as shown on the attached plan sheets S-01 through S-03. Additional subsurface investigation may be necessary as design progresses.
4) Following the additional investigation mentioned in action items 1-3 above, create an alternative analysis report evaluating repair options which take into account the information gained in the above investigations to determine the correct course of action for wall repairs. The alternative analysis report would take into account structural, geotechnical, and environmental permitting considerations for each repair alternative and compare them based on anticipated durability, environmental impact, construction schedule, and cost.
5) Develop contract documents including detailed plans, specifications, and estimate to perform chosen wall repairs from report generated in action item 4.

If you have any questions regarding the above evaluation, please contact me at (978) 977-0110, ext 7402.

Sincerely,

WESTON & SAMPSON

Richard A. Campbell, PE
Senior Associate

Nathan L. Rosencranz, PE
Project Engineer

APPENDIX A

(PHOTOS)



Photo 001: STA 00-25 to STA 00-19 (Bridge Abutment – Good Condition)



Photo 002: STA 00-25 to STA 00-19 (Bridge Wing – Separating from Abutment)



Photo 003: STA 00-19 to 01+50 (Stone with Mortar – Good Condition)



Photo 004: STA 00-19 to 01+50 (Stone with Mortar – Good Condition)



Photo 005: STA 00-19 to 01+50 (Stone with Mortar – Good Condition)



Photo 006: STA 01+50 to 01+70 (Stone with Mortar – Poor Condition - Tree Growing Through Wall)



Photo 007: STA 01+70 to 02+30 (Stone with Mortar – Fair Condition)



Photo 008: STA 02+30 to 03+20 (Stone with Mortar – Good Condition)



Photo 009: STA 03+20 to 03+30 (Stone with Mortar – Poor Condition – Cap Stones Displaced by Tree)



Photo 010: STA 03+30 to 03+50 (Concrete over Stone with Mortar – Poor Condition – Rotation)



Photo 011: STA 03+50 to 03+70 (Concrete over Stone with Mortar – Poor Condition – Crack)



Photo 012: STA 03+70 to 04+80 (Stone with Mortar – Fair Condition)



Photo 013: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 014: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition – Example of Poor Area)



Photo 015: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 016: STA 04+80 to 06+35 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 017: STA 06+35 to 07+00 (Stone with Mortar – Fair Condition – Aggressive Slope Behind)



Photo 018: STA 07+00 to 07+35 (Concrete over Stone with Mortar – Poor Condition – Broken up with Voids)



Photo 019: STA 07+35 to 08+16 (Concrete on top of Stone with Mortar – Fair Condition – Rotating)



Photo 020: STA 07+35 to 08+16 (Concrete on top of Stone with Mortar – Fair Condition – Middle Joint)



Photo 021: STA 07+35 to 08+16 (Concrete on top of Stone with Mortar – Fair Condition – Joint at Bridge)



Photo 022: STA 08+16 to 08+35 (Concrete Abutment on Granite Block with Mortar – Fair Condition)



Photo 023: STA 08+16 to 08+35 (Concrete Abutment on Granite Block with Mortar – Fair Condition)



Photo 024: STA 08+16 to 08+35 (Concrete Abutment on Granite Block with Mortar – Fair Condition)



Photo 025: STA 08+16 to 08+35 (Caller St. Bridge – Bridge Rail)



Photo 026: STA 08+16 to 08+35 (Caller St. Bridge – Utilities)



Photo 027: STA 08+65 to 09+65 (Stone with Mortar – Fair with Isolated Poor Condition)



Photo 028: STA 08+65 to 09+65 (Stone with Mortar – Closeup of Isolated Poor Condition)



Photo 029: STA 08+65 to 09+65 (Stone with Mortar – Closeup of Isolated Poor Condition)



Photo 030: STA 09+65 to 09+75 (Stacked Granite Block on Stone Rubble – Poor Condition)



Photo 031: STA 09+75 to 10+10 (Stacked Granite Block on Stone Rubble – Fair with Isolated Poor Condition)



Photo 032: STA 10+10 to 10+60 (Stacked Granite Block on Stone Rubble – Poor Condition)



Photo 033: STA 10+10 to 10+60 (Stacked Granite Block on Stone Rubble – Condition Behind Wall)



Photo 034: STA 10+60 to 11+49 (Stacked Granite Block – Fair with Isolated Poor Condition)



Photo 035: STA 10+60 to 11+49 (Stacked Granite Block – Fair with Isolated Poor Condition)



Photo 036: STA 10+60 to 11+49 (Stacked Granite Block – Fair with Isolated Poor Condition)



Photo 037: STA 11+49 to 11+57 (Strongwater Brook – Abandoned RR Bridge)



Photo 038: STA 11+49 to 11+57 (Strongwater Brook – Abandoned RR Bridge)



Photo 039: STA 11+57 to 12+25 (Earth Embankment or Buried Wall – Poor Condition)



Photo 040: STA 11+57 to 12+25 (Earth Embankment or Buried Wall – Poor Condition)



Photo 041: STA 12+25 to 13+25 (Stacked Granite Block – Poor Condition)



Photo 042: STA 12+25 to 13+25 (Stacked Granite Block – Abandoned Timber Ties)



Photo 043: STA 12+25 to 13+25 (Stacked Granite Block – Condition Behind Wall)



Photo 044: STA 13+25 to 13+35 (Collapsed or Missing Wall – Poor Condition)



Photo 045: STA 13+25 to 13+35 (Collapsed or Missing Wall – Condition Behind Wall)



Photo 046: STA 13+35 to 13+40 (Stacked Granite Block on Stone Rubble – Poor Condition)



Photo 047: STA 13+35 to 13+40 (Stacked Granite Block on Stone Rubble – Condition Behind Wall)



Photo 048: STA 13+40 to 13+46 (Stacked Granite with Concrete Cap – Fair with Isolated Poor Condition)



Photo 049: STA 13+46 to 14+09 (Timber Tie Behind Earth Embankment – Poor Condition)



Photo 050: STA 13+46 to 14+09 (Timber Tie Behind Earth Embankment – Poor Condition)



Photo 051: STA 14+09 to 15+09 (Timber Tie Behind Concrete Columns – Poor Condition)



Photo 052: STA 14+09 to 15+09 (Timber Tie Behind Concrete Columns – Poor Condition)



Photo 053: STA 15+09 to 15+53 (Earth Embankment or Buried Wall – Poor Condition)



Photo 054: STA 15+09 to 15+53 (Reinforced Concrete with Riprap Protection – Good Condition)

APPENDIX B

(SUMMARY TABLE)

STATION	WALL TYPE	Observations - Existing Condition	Observations - Riverwalk Considerations	PHOTOS
00-25				
	Reinforced Concrete	Bridge Abutment - Good Condition Bridge Wing - Seperating from Abutment w/ minor vegetation growth in seperation		001 - 002
00-19				
	Stone w/ Mortar	Good Condition w/ isolated scour locations below the water line	Heavy vegetation behind. Ground behind wall slopes down to top of wall	003 - 005
01+50				
	Stone w/ Mortar	Poor Condition - Tree growing through wall - breaking joints and dislodging stones	Heavy vegetation behind. Ground behind wall slopes down to top of wall	006
01+70				
	Stone w/ Mortar	Fair Condition - Failing mortar joints and dislodged stones	Heavy vegetation behind. Ground behind wall slopes down to top of wall	007
02+30				
	Stone w/ Mortar	Good Condition w/ isolated scour locations below the water line	Heavy vegetation behind. Ground behind wall approximately level	008
03+20				
	Stone w/ Mortar	Poor Condition - Cap stones displaced by tree	Heavy vegetation behind. Ground behind wall approximately level	009
03+30				
	Concrete Wall on top of Stone wall w/ Mortar	Poor Condition - Concrete section rotating due to tree	Heavy vegetation behind. Ground behind wall approximately level	010
03+50				
	Concrete Wall on top of Stone wall w/ Mortar	Poor Condition - Concrete section cracked	Heavy vegetation behind. Ground behind wall approximately level	011
03+70				
	Stone w/ Mortar	Fair Condition - Failing mortar joints and dislodged stones	Heavy vegetation behind. Ground behind wall slopes down to top of wall	012
04+80				
	Stone w/ Mortar	Fair Condition with Isolated Poor Areas Failing mortar joints and dislodged stones stones displaced by trees in poor areas abandoned foundation behind appears to be forcing tree roots into wall	Abandonded Foundation behind wall appears to conflict with proposed riverwalk Removing the abandoned foundation may require additional wall south of riverwalk It appears that property acquisition would likely be requred at this location Heavy vegetation behind wall Ground behind wall slopes down to top of wall	013 - 016
06+35				
	Stone w/ Mortar	Fair Condition - failing mortar joints and dislodged stones	Aggressive slope behind wall. About a 3 ft drop over a 3 ft width Slope retained by loose granite blocks, some appear to have slid into the water May need to cut slope and add wall or retain with riprap Heavy vegetation on slope	017
07+00				
	Concrete Wall on top of Stone wall w/ Mortar	Poor Condition - Concrete section broken up w/ large voids	Heavy vegetation behind. Ground behind sloped down to wall.	018
07+35				
	Concrete Wall on top of Stone wall w/ Mortar	Fair Condition - Concrete Wall looks to be in good shape, but appears to be rotating	Heavy vegetation behind. Ground behind wall approximately level	019 - 021

STATION	WALL TYPE	Observations - Existing Condition	Observations - Riverwalk Considerations	PHOTOS
08+16				
	Caller Street Bridge Concrete Bridge abutment on top of granite block w/ mortar	Fair Condition - Concrete Abutment appears to be in good shape, Failing mortar joints and dislodged blocks in granite below Repairing joints may be subject to MassDOT Chapter 85 review process	Approach guardrail is damaged and appears to conflict with proposed riverwalk location Modifying guardrail may be subject to MassDOT Chapter 85 review process	022 - 026
08+65				
	Stone w/ Mortar	Fair Condition with Isolated Poor Areas Local Poor area around 08+90 Local Poor area about 09+35 to 09+45	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	027 - 029
09+65				
	Stacked Granite Block on Stone Rubble (No Mortar)	Poor Condition - Top section of wall missing or collapsed Tree growing through wall.	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	030
09+75				
	Stacked Granite Block on Stone Rubble (No Mortar)	Fair Condition with Isolated Poor Areas Trees disrupting/Growing through wall Irregular spaces between blocks / blocks misaligned	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	031
10+10				
	Stacked Granite Block on Stone Rubble (No Mortar)	Poor Condition - Granite Blocks missing or collapsed Blocks/Stones in canal adjacent to wall Trees disrupting/Growing through wall	Heavy vegetation behind. Ground behind sloped down to wall. Tall wall south of canal wall may require analysis for changed conditions	032-033
10+60				
	Stacked Granite Block (No Mortar)	Fair Condition with Isolated Poor Areas Trees disrupting/Growing through wall Irregular spaces between blocks / blocks misaligned	Heavy vegetation behind. Ground behind sloped down to wall. Pile of granite behind wall would need to be moved or removed	034 - 036
11+49				
	Strongwater Brook Abandoned RR Bridge	No Wall in this region	Existing bridge consists of Rolled Steel beams encased in concrete at each end Beam spacing is about 5~ which does not appear adequate for proposed riverwalk Beam webs are heavily deteriorated and bridge has no deck Bridge would require repair and additional beams and deck to support walkway New bridge may be a better option	037 - 038
11+57				
	Earth Embankment or Buried Wall	Poor Condition - Wall is missing or buried	Heavy vegetation behind. Ground sloped down to wall. Ground behind is paved over existing railroad ties and possibly rails	039 - 040
12+25				
	Stacked Granite Block (No Mortar)	Poor Condition Irregular spacing between blocks. Blocks misaligned. Some blocks appear to be missing.	Heavy vegetation behind. Ground sloped down to wall. Ground behind is paved over existing railroad ties and possibly rails Abandoned foundation close behind canal wall Abandoned foundation would require demolition and possibly new wall construction It appears that property acquisition would likely be requred at this location	041 - 043

STATION	WALL TYPE	Observations - Existing Condition	Observations - Riverwalk Considerations	PHOTOS
13+25				
	Collapsed or missing wall	Poor Condition - Wall is collapsed or missing	Heavy vegetation behind. Ground sloped down to wall. Ground behind is paved over existing railroad ties and possibly rails Abandoned foundation close behind canal wall Abandoned foundation would require demolition and possibly new wall construction It appears that property acquisition would likely be requred at this location	044 - 045
13+35				
	Stacked Granite Block on Stone Rubble	Poor Condition Irregular joint spacing Misaligned Blocks	Heavy vegetation behind. Abandoned foundation close behind canal wall Abandoned foundation would require demolition and possibly new wall construction It appears that property acquisition would likely be requred at this location	046 - 047
13+40				
	Stacked Granite Block with Concrete Cap	Fair Condition with Isolated Poor Areas Irregular joint spacing Large crack with apparent differential settlement	Proposed riverwalk is not anticipated to impact this section of wall	048
13+46				
	Timber Tie behind Earth Embankment	Poor Condition Timber ties appear to be heavily deteriorated and rotated Earth Embankment is overgrown	Proposed riverwalk is not anticipated to impact this section of wall	049 - 050
14+09				
	Timber Tie behind Concrete Columns	Fair Condition Timber ties appear deteriorated Concrete columns exhibit cracking	Proposed riverwalk is not anticipated to impact this section of wall	051 - 052
15+09				
	Earth Embankment or Buried Wall	Poor Condition - Wall is missing or buried	Proposed riverwalk is not anticipated to impact this section of wall	053
15+53				
	Reinforced Concrete with Riprap Protection	Good Condition	Proposed riverwalk is not anticipated to impact this section of wall	054
15+58				

APPENDIX C

(PLANS)

N

Current Wall Condition
Good
Fair
Poor

E (P–#) EXISTING PROBE
E (B–#) EXISTING SOIL BORING
P (B–#) PROPOSED SOIL BORING
E (TP–#) EXISTING TEST PIT
P (TP–#) PROPOSED TEST PIT
WF–# WETLANDS FLAG FROM NORTH WALL REPAIR PROJECT

85–38±
0

85–41
15 WALLIS ST

85–37
45 WALNUT ST

85–36
49 WALNUT ST

85–39
0

85–39A
0

85–39B
0 WALNUT

APPROXIMATE LOCATION OF 78 IN. SEWER

CONCRETE VAULT

SMH R=15.70

SMH R=15.84

SMH R=12.09

WALLIS STREET

NORTH RIVER CANAL

WF1 WF2 WF3 WF4 WF5 WF6 WF7 WF8 WF9 WF10 WF11 WF12 WF13 WF14 WF15 WF16 WF17 WF18 WF19 WF20 WF21 WF22 WF23 WF24 WF25 WF26 WF27 WF28 WF29 WF30 WF31 WF32 WF33 WF34 WF35 WF36 WF37 WF38 WF39 WF40 WF41 WF42 WF43 WF44 WF45 WF46 WF47 WF48 WF49 WF50 WF51 WF52 WF53 WF54 WF55 WF56 WF57 WF58 WF59

E (TP5)
E (B–1)
E (BWS–1)
E (B–2)
E (B–3 (MW–4))
E (B–4)
E (B–5 (MW–2))
E (B–6)
E (B–7 (MW–1))
E (B–8 (MW–3))
E (B–84)
E (B–89)
E (P1–2)
E (P2–2)

APPROXIMATE EDGE OF WATER

PROPANE TANK

86–142A
24 CALLER ST

86–142B
0 CALLER ST

85–41B
9 WALLIS ST

85–72A
17 WALLIS ST

85–72
82 MAIN ST

GOOD | GOOD | POOR | FAIR | GOOD | POOR | POOR | POOR | FAIR

00–25 00–19 0+00 1+00 01+50 01+70 2+00 02+30 3+00 03+20 03+30 03+50 03+70 4+00 04+80

STONE WALL WITH MORTAR

CONCRETE WALL ON TOP OF STONE WITH MORTAR

REINFORCED CONCRETE (BRIDGE ABUT+WING)

100 FT WETLAND BUFFER

200' RIVER FRONT PROTECTION AREA

20 10 0 20 40
SCALE: 1"=20'

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No.	Date	Description	Dr.By	Ck.By	App.By	DATE
A		PROVED				

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

South Wall Evaluation STA. 00-25 to 04+80

CADD NO.	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
	1	21770345	-	-	-	-

SCALE: AS NOTED

S-1

FILE NO.

SHEET 1 OF 3

\\wes03.local\WSE\Projects\MA\Peabody MA\21770345 North River Wall Eval\CAD\WORKING\North River – South Wall Eval.dwg

N

E (P-#) EXISTING PROBE

E (B-#) EXISTING SOIL BORING

P (B-#) PROPOSED SOIL BORING

E (TP-#) EXISTING TEST PIT

P (TP-#) PROPOSED TEST PIT

WF-# WETLANDS FLAG FROM NORTH WALL REPAIR PROJECT

Current Wall Condition
Good
Fair
Poor

85-39B
0 WALNUT ST

86-140
65 WALNUT ST

86-140
65 WALNUT ST

86-139
75 WALNUT ST

86-139
75 WALNUT ST

86-141
27 CALLER ST

86-141
27 CALLER ST

APPROXIMATE LOCATION OF 78 IN. SEWER

APPROXIMATE LOCATION OF 78 IN. SEWER

SMH R=12.08

SMH R=11.97

SMH R=10.50

SMH R=10.68

SMH R=11.58

SMH R=12.60

SMH R=13.48

STA 5057

STA 5+88

JZ120

JZ120

SKZ24

SKZ24

E (P2-1)

E (P3-2)

E (P4-2)

E (TP4)

E (TP3)

E (TP2)

E (B-82)

E (B-81)

E (BWS-4)

E (BWS-3)

WF45 WF44 WF43 WF42 WF41 WF40 WF39 WF38 WF37 WF36 WF35 WF34 WF33 WF32 WF31 WF30 WF29 WF28 WF27 WF26 WF25 WF24 WF23 WF22 WF21 WF20 WF19 WF18 WF17

NORTH RIVER CANAL

NORTH RIVER CANAL

3'-0"

P (TP1)

P (TP2)

P (TP3)

P (TP4)

P (TP5)

GRANITE BLOCK PILE

APPROXIMATE EDGE OF WATER

CALLER STREET

FAIR WITH ISOLATED POOR | FAIR | POOR | FAIR | FAIR | FAIR WITH ISOLATED POOR | POOR | FAIR WITH ISOLATED POOR | POOR | FAIR

04+80 | 5+00 | 6+00 | 06+35 | 7+00 | 07+35 | 8+00 | 08+16 | 08+65 | 9+00 | 09+65 | 09+75 | 10+00 | 10+10 | 10+60

STONE WITH MORTAR | CONCRETE WALL ON TOP OF STONE WITH MORTAR | CONCRETE BRIDGE ABUTMENT ON GRANITE BLOCK WITH MORTAR | STONE WITH MORTAR | STACKED GRANITE BLOCK ON STONE RUBBLE (NO MORTAR) | STACKED GRA

86-142B
0 CALLER ST

86-142B
0 CALLER ST

86-143
24 CALLER ST

86-144
22 CALLER ST

86-150B
0

86-151
0

20 10 0 20 40
SCALE: 1"=20'

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\\weo3.local\WSE\Projects\MA\Peabody MA\21703345 North River Wall Eval\CAD\WORKING\North River - South Wall Eval.dwg

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No.	Date	Description	Dr.By	Ck.By	App.By	DATE
		APPROVED				

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

South Wall Evaluation STA. 04-80 to 10+60

CADD NO.	SCALE: AS NOTED	CONTRACT: 1	JOB NO. 21703345	DR.BY -	DSN.BY -	CHK.BY -	APP.BY -

S-2

FILE NO.

SHEET 2 OF 3

N

E (P-#) EXISTING PROBE

E (B-#) EXISTING SOIL BORING

P (B-#) PROPOSED SOIL BORING

E (TP-#) EXISTING TEST PIT

P (TP-#) PROPOSED TEST PIT

WF-# WETLANDS FLAG FROM NORTH WALL REPAIR PROJECT

Current Wall Condition

Good

Fair

Poor

86–139
5 WALNUT ST

86–141
CALLER ST

86–138
77 WALNUT ST

86–150
166 MAIN ST

86–150A
166 MAIN ST (R)

N/F
26 HOWLEY STREET TRUST
"FLEA MARKET"

1 STORY BRICK

3 STORY BRICK

1 STORY CONC. BLOCK ON CONC PIERS (RIVER BELOW)

(EL. UNDER BLDG)

N/F
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

N/F
THE AZOREAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC.

1 STORY CONC. BLOCK

1 STORY WOOD FRAME

STREET

HOWLEY

APPROX. L.O. LINE

CONSTRUCTION BASELINE (SEE NOTE 3)

N18°47'42"E 112.00'

CONNECTION FROM CATCH BASINS UNKNOWN

300mmCMP

300mm PVC

TOP STEP EL=

RAMP

FF EL.=3.716

FF EL.=4.171

FF EL.=3.457 (CONC. THRESH)

FF EL.=3.443 (CONC. THRESH)

CLOSED PIPE STRAIGHT THRU MANHOLE DOWN 1.3m

BITUMINOUS

CONCRETE

"RR CROSSING"

"NO PARKING"

"STOP"

"WEIGHT LIMIT"

CONST. B

GRANITE BLOCK RET. WALL

PORTION OF CONC. FOUNDATION ON GRANITE WALL

0.6m sq. CONC. PIER (TYP.) EL=3.127

RAILROAD TIE RET. WALL

GRANITE BRIDGE SUPPORTS

PK NAIL "HOW 1" EL=2.887

STONE BRIDGE

SESD DISK "B1125"

150mm INV=1.9

FLOW

NORTH RIVER

-0+55 -0+50 -0+40 -0+30 -0+20 -0+10 0+00 0+10 0+20

10+60 11+00 11+49 11+57 12+00 12+25 13+00 13+25 13+35 13+36 13+46 14+00 14+09 15+00 15+09 15+53 15+58

POOR

FAIR WITH ISOLATED POOR

STACKED GRANITE BLOCK (NO MORTAR)

EARTH EMBANKMENT OR BURIED WALL

STACKED GRANITE BLOCK (NO MORTAR)

TIMBER TIE BEHIND EARTH EMBANKMENT

TIMBER TIE BEHIND CONCRETE COLUMN

EARTH EMBANKMENT OR BURIED WALL

GOOD

BRIDGE

COLLAPSED/MISSING WALL

STACKED GRANITE BLOCK WITH CONCRETE CAP

STACKED GRANITE BLOCK ON STONE RUBBLE

REINFORCED CONCRETE WITH RIPRAP PROTECTION

CONCRETE FOUNDATION

MAG NAIL SET

APPROXIMATE EDGE OF WATER

RAINES DOCK PILE

P (TP5)

E (TP1)

E (BWS-1)

E (BWS-2)

P (B-1)

P (B-2)

P (B-3)

WF25 WF26 WF27 WF28 WF29 WF30 WF31 WF32 WF33 WF34 WF35

R=3.348 I=2.49(IN) I=2.45(OUT)

R=3.116 I=2.51

R=3.076 I=2.46

R=2.936 I=2.22

R=2.733 STONE SHELF EL=1.93 NPO

R=2.995 I=0.19(IN) I=0.92(OUT)

R=2.810 NPO

R=3.012 BOT. VAULT = 0.878

R=2.821 I=0.75(IN) I=0.05(OUT)

R=2.635 PIPE BLOCKED H2O EL=1.66

R=2.708 PIPE BLOCKED H2O EL=1.63

R=2.870 I=1.62(N) I=1.59(OUT)

R=2.787 I=2.13(NE) I=2.14(SE) I=2.13(SW)

VAULT

POSSIBLE END OF GAS LINE – SCALED FROM GAS PLANS

#8 W/TRANS

#55–4 W/RISER SL & TRANS

#55–5 W/RISER

#26

#22

#20

BM#1

BM#3

BM#4

20 10 0 20 40
SCALE: 1"=20'

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Weston & Sampson Engineers, Inc.
Five Centennial Drive, Peabody, MA 01960
978.532.1900 800.SAMPSON
www.westonandsampson.com

No.	Date	Dr.By	Ck.By	App.By	Description	DATE
A					APPROVED	

REGISTERED PROFESSIONAL ENGINEER

CITY OF PEABODY

RIVERWALK ALONG NORTH RIVER CANAL

South Wall Evaluation STA. 10-60 to 15+58

CADD NO.	SCALE: AS NOTED	CONTRACT: 1	JOB NO. 21703345	DR.BY -	DSN.BY -	CHK.BY -	APP.BY -

FILE NO.

S-3

SHEET 3 OF 3

\\wes03.local\WSE\Projects\MA\Peabody MA\21703345 North River Wall Eval\CAD\WORKING\North River - South Wall Eval.dwg

APPENDIX B

Previous Subsurface Explorations – Soil Borings & Test Pit Photographs

- 2002 Explorations by GSI
- 2007 Explorations by Weston and Sampson

13 Wallis St

TEST BORING LOG

B-1(GSI)

PROJECT: 9 Wallis Street
LOCATION: Peabody, MA
PROJECT NO.: 202367

BORING CONTRACTOR: New Hampshire Boring, Inc.
FOREMAN: Sam Shaw
RIG: Mobile B-59

GEOTECHNICAL SERVICES, INC.
18 Cote Avenue
Goffstown, NH 03045

BORING NO: B-1
SHEET: 1 of 2
START: November 4, 2002
FINISH: November 4, 2002
PREPARED BY: B. Levesque
CHECKED BY: H. Wetherbee, PE

EQUIPMENT	AUGER	CASING	SAMPLER	CORE BAR
TYPE	HAS		SS	
SIZE ID (IN)	2 3/4		2.0	
HAMMER WT (LB)			140	BIT
HAMMER FALL (IN)			30	

GROUNDWATER OBSERVATIONS
DATE November 4, 2002
DEPTH (FT) 8 ft
CASING AT (FT) 40 ft
TIME (HR) Upon Completion
☐ NO GROUNDWATER ENCOUNTERED
☐ LIQUID INTRODUCED DURING DRILLING

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ INSTRUMENTATION

DEPTH	SAMPLE NUMBER	DEPTH (ft)	RECOVERY (IN)	SPT (BLOWS/ 6 IN.)	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)
0	S-1	0-2	17	6-3	Black-brown, loose to med. dense f-m SAND, little Silt, Organics (roots, odor), little-trace f-c Gravel. (TOPSOIL/FILL)
1				2-2	
2					
3					
4					
5	S-2	5-7	13	1-1	Black to dk.gray, very loose f-c SAND, little Silt, little Organics, trace Debris (glass) (FILL)
6				1-1	
7					
8					
9					*fill*
10	S-3	10-12	13	2-1	Dk. brown, loose f-c SAND, little-trace Silt, trace f Gravel. *natural*
11				2-1	
12					
13					
14					
15	S-4	15-17	11	1-3	Lt. brown, loose f SAND, little Silt, trace f Gravel. (OUTWASH)
16				1-2	
17					
18					
19					
20	S-5	20-22	19	3-5	Orange-brown, f SAND, little Silt, trace f. Gravel (OUTWASH)
21				7-9	
22					
23					
24					
25	S-6	25-27	11	5-9	Lt brown f SAND, little Silt, trace f Gravel. (OUTWASH)
26				12-13	

SAMPLE IDENTIFICATION
S SPLIT SPOON
U UNDISTURBED
OR OPEN END ROD
C ROCK CORE

COHESIVE SOILS (Blows per ft.)	GRANULAR SOILS (Blows per ft.)	PROPORTIONS USED	COHESIVE SOIL THREAD
0 to 2: Very Soft	0 to 4: Very Loose	trace (0-10%)	1/4 = Clayey Silt
2 to 4: Soft	4 to 10: Loose	little (10-20%)	1/8 = Silt & Clay
4 to 8: Medium Stiff	10 to 30: Medium Dense	some (20-35%)	1/16 = Clay & Silt
8 to 15: Stiff	30 to 50: Dense	and (35-50%)	1/32 = Silty Clay
15 to 30: Very Stiff	Over 50: Very Dense		1/64 = Clay
Over 30: Hard			

Standard Penetration Test (SPT) = 140# hammer falling 30", Blows are per 6" taken with an 18" long x 2" I.D. split spoon sampler in accordance with ASTM D 1586, unless otherwise noted.

REMARKS: The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated on the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

NOTES:

13 Wallis St

TEST BORING LOG

B-1(GSI)

PROJECT: 9 Wallis Street
LOCATION: Peabody, MA
PROJECT NO.: 202367

BORING CONTRACTOR: New Hampshire Boring, Inc.
FOREMAN: Sam Shaw
RIG: Mobile B-59

GEOTECHNICAL SERVICES, INC.
18 Cote Avenue
Goffstown, NH 03045

BORING NO: B-1
SHEET: 2 of 2
START: November 4, 2002
FINISH: November 4, 2002

PREPARED BY: B. Levesque
CHECKED BY: H. Wetherbee, PE

EQUIPMENT	AUGER	CASING	SAMPLER	CORE BAR
TYPE	HAS		SS	
SIZE ID (IN)	2 3/4		2.0	
HAMMER WT (LB)			140	BIT
HAMMER FALL (IN)			30	

GROUNDWATER OBSERVATIONS
DATE November 4, 2002
DEPTH (FT) 8 ft
CASING AT (FT) 40 ft
TIME (HR) Upon Completion
☐ NO GROUNDWATER ENCOUNTERED
☐ LIQUID INTRODUCED DURING DRILLING

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ INSTRUMENTATION

DEPTH	SAMPLE NUMBER	DEPTH (ft)	RECOVERY (IN)	SPT (BLOWS/ 6 IN.)	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)
27					
28					
29					
30	S-7	30-32	7	17-28	
31				32-33	
32					— Continued augering to find refusal.
33					
34					
35					
36					
37					
38					
39					
40					— Auger refusal. B.O.E. @ 40 ft
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					

SAMPLE IDENTIFICATION
S SPLIT SPOON
U UNDISTURBED OR OPEN END ROD
C ROCK CORE

COHESIVE SOILS (Blows per ft.)
0 to 2: Very Soft
2 to 4: Soft
4 to 8: Medium Stiff
8 to 15: Stiff
15 to 30: Very Stiff
Over 30: Hard

GRANULAR SOILS (Blows per ft.)
0 to 4: Very Loose
4 to 10: Loose
10 to 30: Medium Dense
30 to 50: Dense
Over 50: Very Dense

PROPORTIONS USED
trace (0-10%)
little (10-20%)
some (20-35%)
and (35-50%)

COHESIVE SOIL THREAD
1/4 = Clayey Silt
1/8 = Silt & Clay
1/16 = Clay & Silt
1/32 = Silty Clay
1/64 = Clay

Standard Penetration Test (SPT) = 140# hammer falling 30", Blows are per 6" taken with an 18" long x 2" I.D. split spoon sampler in accordance with ASTM D 1586, unless otherwise noted.

REMARKS: The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated on the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

NOTES:

13 Wallis St

PROJECT: 9 Wallis Street
LOCATION: Peabody, MA
PROJECT NO.: 202367

BORING CONTRACTOR: New Hampshire Boring, Inc.
FOREMAN: Sam Shaw
RIG: Mobile B-59

TEST BORING LOG

GEOTECHNICAL SERVICES, INC.
18 Cote Avenue
Goffstown, NH 03045

BORING NO: B-2 B-2(GSI)
SHEET: 1 of 1
START: October 31, 2002
FINISH: October 31, 2002
PREPARED BY: B. Levesque
CHECKED BY: H. Wetherbee, PE

EQUIPMENT	AUGER	CASING	SAMPLER	CORE BAR
TYPE	HAS		SS	
SIZE ID (IN)	2 3/4		2.0	
HAMMER WT (LB)			140	BIT
HAMMER FALL (IN)			30	

GROUNDWATER OBSERVATIONS
DATE October 31, 2002
DEPTH (FT) 9 ft
CASING AT (FT) 20 ft
TIME (HR) Upon Completion
☐ NO GROUNDWATER ENCOUNTERED
☐ LIQUID INTRODUCED DURING DRILLING

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ INSTRUMENTATION

DEPTH	SAMPLE NUMBER	DEPTH (ft)	RECOVERY (IN)	SPT (BLOWS/ 6 IN.)	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)
0	S-1	0-2	5	3-4	Brown, med. dense f-m SAND, little Silt, little to trace Organics (roots, odor), trace f-c Gravel. (TOPSOIL/FILL)
1				7-7	
2					
3					
4					
5	S-2	5-7	8	2-2	Brown, loose f-m SAND, little Silt, trace Organcis, trace Debris (concrete, ash). (FILL)
6				3-4	
7					
8					
9					*fill*
10	S-3	10-12	9	5-5	Black-brown, med. dense f-c SAND, little-trace Silt, little-trace f-c Gravel, trace Organics (peat fibers, silt). *natural*
11				6-6	
12					(OUTWASH)
13					
14					
15	S-4	15-17	8.5	3-4	Black-brown, loose f-c SAND, little Silt, little f Gravel.
16				3-2	
17					(OUTWASH)
18					
19					— 2 ft of blow-in @ 20 ft. Drove spoon an additional 2 ft. —
20	S-5	20-22	17	6-8	Tan-orange, med. dense f-m SAND, trace Silt, trace f Gravel.
21				13-15	
22					— Attempted to continue drilling and sampling. —
23					— Cuttings same as for S-5 —
24					Driller reports 5 to 7 ft of blow –in at 25 ft. Boring terminated.—
25					B.O.E. @ 25 ft.
26					

SAMPLE IDENTIFICATION	COHESIVE SOILS (Blows per ft.)	GRANULAR SOILS (Blows per ft.)	PROPORTIONS USED	COHESIVE SOIL THREAD
S SPLIT SPOON	0 to 2: Very Soft	0 to 4: Very Loose	trace (0-10%)	1/4 = Clayey Silt
U UNDISTURBED	2 to 4: Soft	4 to 10: Loose	little (10-20%)	1/8 = Silt & Clay
OR OPEN END ROD	4 to 8: Medium Stiff	10 to 30: Medium Dense	some (20-35%)	1/16 = Clay & Silt
C ROCK CORE	8 to 15: Stiff	30 to 50: Dense	and (35-50%)	1/32 = Silty Clay
	15 to 30: Very Stiff	Over 50: Very Dense		1/64 = Clay
	Over 30: Hard			

Standard Penetration Test (SPT) = 140# hammer falling 30", Blows are per 6" taken with an 18" long x 2" I.D. split spoon sampler in accordance with ASTM D 1586, unless otherwise noted.

REMARKS: The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated on the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

NOTES:

13 Wallis St

PROJECT: 9 Wallis Street
LOCATION: Peabody, MA
PROJECT NO.: 202367

BORING CONTRACTOR: New Hampshire Boring, Inc.
FOREMAN: Sam Shaw
RIG: Mobile B-59

TEST BORING LOG

GEOTECHNICAL SERVICES, INC.
18 Cote Avenue
Goffstown, NH 03045

BORING NO: B-3 B-3(GSI)
SHEET: 1 of 1
START: October 31, 2002
FINISH: November 1, 2002
PREPARED BY: B. Levesque
CHECKED BY: H. Wetherbee, PE

EQUIPMENT	AUGER	CASING	SAMPLER	CORE BAR
TYPE	HAS		SS	
SIZE ID (IN)	2 3/4		2.0	
HAMMER WT (LB)			140	BIT
HAMMER FALL (IN)			30	

GROUNDWATER OBSERVATIONS
DATE November 1, 2002
DEPTH (FT) 10.5 ft
CASING AT (FT) 20 ft
TIME (HR) Upon Completion
☐ NO GROUNDWATER ENCOUNTERED
☐ LIQUID INTRODUCED DURING DRILLING

☐ FIELD TESTING
☐ LABORATORY TESTING
X MONITORING WELL INSTALLED
☐ INSTRUMENTATION

DEPTH	SAMPLE NUMBER	DEPTH (ft)	RECOVERY (IN)	SPT (BLOWS/6 IN.)	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)
0	S-1	0-2	5	3-5	Black-brown, loose f-m SAND, little Silt, little Organics (roots, odor), little trace f-c Gravel. (TOPSOIL/FILL)
1				2-2	
2					
3					
4					
5	S-2	5-7	4	1-3	Black, very loose ORGANICS (peat fibers, silt) little f-m Sand, little-trace Silt, trace Debris (brick). (FILL)
6				1-1	
7					
8					
9					
10	S-3A	10-11	6	2-3	Dk. red-brown, very loose f-c SAND, little Silt, trace Debris (brick, glass). (FILL)
11	S-3B	11-12	5	5-6	Black, loose ORGANICS (peat fibers, silt) little f-m Sand, little-trace Silt, trace Debris (brick). (FILL)
12					
13					*fill*
14					*natural*
15	S-4	15-17	19	3-5	Brown to orange-brown, loose f-c SAND, little Silt, trace f Gravel. (OUTWASH)
16				5-3	
17					
18					
19					
20	S-5	20-22	11	2-3	Orange-brown, loose f-c SAND, little Silt, trace f Gravel. (OUTWASH)
21				3-3	
22					B.O.E. @ 22 ft.
23					
24					
25					
26					

SAMPLE IDENTIFICATION
S-SPLIT SPOON
U-UNDISTURBED OR OPEN END ROD
C-ROCK CORE

COHESIVE SOILS (Blows per ft.)
0 to 2: Very Soft
2 to 4: Soft
4 to 8: Medium Stiff
8 to 15: Stiff
15 to 30: Very Stiff
Over 30: Hard

GRANULAR SOILS (Blows per ft.)
0 to 4: Very Loose
4 to 10: Loose
10 to 30: Medium Dense
30 to 50: Dense
Over 50: Very Dense

PROPORTIONS USED
trace (0-10%)
little (10-20%)
some (20-35%)
and (35-50%)

COHESIVE SOIL THREAD
1/4 = Clayey Silt
1/8 = Silt & Clay
1/16 = Clay & Silt
1/32 = Silty Clay
1/64 = Clay

Standard Penetration Test (SPT) = 140# hammer falling 30", Blows are per 6" taken with an 18" long x 2" I.D. split spoon sampler in accordance with ASTM D 1586, unless otherwise noted.

REMARKS: The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated on the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

NOTES:

13 Wallis St

PROJECT: 9 Wallis Street
LOCATION: Peabody, MA
PROJECT NO.: 202367

BORING CONTRACTOR: New Hampshire Boring, Inc.
FOREMAN: Sam Shaw
RIG: Mobile B-59

TEST BORING LOG

GEOTECHNICAL SERVICES, INC.
18 Cote Avenue
Goffstown, NH 03045

BORING NO: B-4 B-4(GSI)
SHEET: 1 of 1
START: November 1, 2002
FINISH: November 4, 2002
PREPARED BY: B. Levesque
CHECKED BY: H. Wetherbee, PE

EQUIPMENT	AUGER	CASING	SAMPLER	CORE BAR
TYPE	HAS		SS	
SIZE ID (IN)	2 3/4		2.0	
HAMMER WT (LB)			140	BIT
HAMMER FALL (IN)			30	

GROUNDWATER OBSERVATIONS
DATE November 4, 2002
DEPTH (FT) 8 ft
CASING AT (FT) 20 ft
TIME (HR) Upon Completion
☐ NO GROUNDWATER ENCOUNTERED
☐ LIQUID INTRODUCED DURING DRILLING

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ INSTRUMENTATION

DEPTH	SAMPLE NUMBER	DEPTH (ft)	RECOVERY (IN)	SPT (BLOWS/ 6 IN.)	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	
0	S-1	0-2	5	2-5	Black-brown, med. dense f-m SAND, little Silt, little Organics (roots, odor), little trace f-c Gravel.	(TOPSOIL/FILL)
1				2-2		
2						
3						
4						
5	S-2	5-7	11	2-1	Black, very loose ORGANICS (peat fibers, silt) little f-m Sand, little-trace Silt, trace Debris (brick).	(FILL)
6				1-3		
7						
8						
9						
10	S-3	10-12	6	2-2	Black, loose f SAND, some Silt, little Organics (peat fibers, silt), trace Debris (brick, concrete).	(FILL)
11				5-2		
12						
13						
						fill
14						*natural*
15	S-4	15-17	20	6-10	Tan, med. dense f-c SAND, little Silt, little f Gravel.	(OUTWASH)
16				13-6		
17						
18						
19						
20	S-5	20-22	19	10-7	Tan, med. dense f-m SAND, little Silt, trace f Gravel.	(OUTWASH)
21				6-11		
22						
23						
24						
25	S-6	25-27	12	6-8	Tan, med. dense f-c SAND, little-trace Silt, trace f Gravel.	(OUTWASH)
26				9-7	— Auger probed to find bedrock. Auger refusal at 32 ft. B.O.E. @ 32 ft.	

SAMPLE IDENTIFICATION
S SPLIT SPOON
U UNDISTURBED
OR OPEN END ROD
C ROCK CORE

COHESIVE SOILS (Blows per ft.)
0 to 2: Very Soft
2 to 4: Soft
4 to 8: Medium Stiff
8 to 15: Stiff
15 to 30: Very Stiff
Over 30: Hard

GRANULAR SOILS (Blows per ft.)
0 to 4: Very Loose
4 to 10: Loose
10 to 30: Medium Dense
30 to 50: Dense
Over 50: Very Dense

PROPORTIONS USED
trace (0-10%)
little (10-20%)
some (20-35%)
and (35-50%)

COHESIVE SOIL THREAD
1/4 = Clayey Silt
1/8 = Silt & Clay
1/16 = Clay & Silt
1/32 = Silty Clay
1/64 = Clay

Standard Penetration Test (SPT) = 140# hammer falling 30", Blows are per 6" taken with an 18" long x 2" I.D. split spoon sampler in accordance with ASTM D 1586, unless otherwise noted.

REMARKS: The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated on the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

NOTES:

13 Wallis St

PROJECT: 9 Wallis Street
LOCATION: Peabody, MA
PROJECT NO.: 202367

BORING CONTRACTOR: New Hampshire Boring, Inc.
FOREMAN: Sam Shaw
RIG: Mobile B-59

TEST BORING LOG

GEOTECHNICAL SERVICES, INC.
18 Cote Avenue
Goffstown, NH 03045

BORING NO: B-5 (MW-2) B-5(GSI)
SHEET: 1 of 1
START: October 31, 2002
FINISH: October 31, 2002
PREPARED BY: B. Levesque
CHECKED BY: H. Wetherbee, PE

EQUIPMENT	AUGER	CASING	SAMPLER	CORE BAR
TYPE	HAS		SS	
SIZE ID (IN)	2 3/4		2.0	
HAMMER WT (LB)			140	BIT
HAMMER FALL (IN)			30	

GROUNDWATER OBSERVATIONS
DATE October 31, 2002
DEPTH (FT) 10 ft
CASING AT (FT) 20 ft
TIME (HR) Upon Completion
☐ NO GROUNDWATER ENCOUNTERED
☐ LIQUID INTRODUCED DURING DRILLING

☐ FIELD TESTING
☐ LABORATORY TESTING
X MONITORING WELL INSTALLED
☐ INSTRUMENTATION

DEPTH	SAMPLE NUMBER	SAMPLE DEPTH (ft)	RECOVERY (IN)	SPT (BLOWS/6 IN.)	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)
0	S-1	0-2	3	1-2	Black-brown, loose f-m SAND, little Silt, little Organics (roots, odor), little trace f-c Gravel. (TOPSOIL/FILL)
1				1-2	
2					
3					
4					
5	S-2	5-7	7	5-7	Black to dk.gray f-c SAND, little Silt, trace Organics, trace Debris (glass) (FILL)
6				2-2	
7					
8					
9					*fill*
10	S-3	10-12	17	7-7	Brown, med. dense f-c SAND, trace Silt, trace f Gravel. *natural*
11				3-2	(OUTWASH)
12					
13					
14					
15	S-4	15-17	22	3-5	Orange-brown, loose f-m SAND, little Silt, trace f Gravel. (OUTWASH)
16				3-3	
17					B.O.E. @ 17 ft.
18					
19					
20					
21					
22					
23					
24					
25					
26					

SAMPLE IDENTIFICATION	COHESIVE SOILS (Blows per ft.)	GRANULAR SOILS (Blows per ft.)	PROPORTIONS USED	COHESIVE SOIL THREAD
S SPLIT SPOON	0 to 2: Very Soft	0 to 4: Very Loose	trace (0-10%)	1/4 = Clayey Silt
U UNDISTURBED OR OPEN END ROD	2 to 4: Soft	4 to 10: Loose	little (10-20%)	1/8 = Silt & Clay
C ROCK CORE	4 to 8: Medium Stiff	10 to 30: Medium Dense	some (20-35%)	1/16 = Clay & Silt
	8 to 15: Stiff	30 to 50: Dense	and (35-50%)	1/32 = Silty Clay
	15 to 30: Very Stiff	Over 50: Very Dense		1/64 = Clay
	Over 30: Hard			

Standard Penetration Test (SPT) = 140# hammer falling 30", Blows are per 6" taken with an 18" long x 2" I.D. split spoon sampler in accordance with ASTM D 1586, unless otherwise noted.

REMARKS: The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated on the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

NOTES:

13 Wallis St

PROJECT: 9 Wallis Street
LOCATION: Peabody, MA
PROJECT NO.: 202367

BORING CONTRACTOR: New Hampshire Boring, Inc.
FOREMAN: Sam Shaw
RIG: Mobile B-59

TEST BORING LOG

GEOTECHNICAL SERVICES, INC.
18 Cote Avenue
Goffstown, NH 03045

BORING NO: B-6 B-6(GSI)
SHEET: 1 of 1
START: October 31, 2002
FINISH: October 31, 2002
PREPARED BY: B. Levesque
CHECKED BY: H. Wetherbee, PE

EQUIPMENT	AUGER	CASING	SAMPLER	CORE BAR
TYPE	HAS		SS	
SIZE ID (IN)	2 3/4		2.0	
HAMMER WT (LB)			140	BIT
HAMMER FALL (IN)			30	

GROUNDWATER OBSERVATIONS
DATE October 31, 2002
DEPTH (FT) 8.5 ft
CASING AT (FT) 20 ft
TIME (HR) Upon Completion
☐ NO GROUNDWATER ENCOUNTERED
☐ LIQUID INTRODUCED DURING DRILLING

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ INSTRUMENTATION

DEPTH	SAMPLE NUMBER	SAMPLE DEPTH (ft)	RECOVERY (IN)	SPT (BLOWS/6 IN.)	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)
0	S-1	0-2	15	3-7	Black-brown, loose to med. dense f-m SAND, little Silt, Organics (roots, odor), little-trace f-c Gravel. (TOPSOIL/FILL)
1				3-2	
2					
3					
4					
5	S-2	5-7	NR	1-1	Black to dk.gray, very loose f-c SAND, little Silt, trace Organics, trace Debris (glass) (FILL)
6				1-1	
7					
8					
9					*fill*
10	S-3	10-12	17	3-5	Dk. brown, loose f-c SAND, little-trace Silt, trace f Gravel. *natural*
11				4-5	
12					
13					
14					
15	S-4	15-17	14	3-5	Lt. brown, loose f SAND, little Silt, trace f Gravel. (OUTWASH)
16				3-3	
17					
18					
19					
20	S-5	20-22	11	3-3	Orange-brown, f SAND, little Silt, trace f. Gravel. (OUTWASH)
21				4-3	
22					B.O.E. @ 22 ft
23					
24					
25					
26					

SAMPLE IDENTIFICATION
S SPLIT SPOON
U UNDISTURBED
OR OPEN END ROD
C ROCK CORE

COHESIVE SOILS (Blows per ft.)
0 to 2: Very Soft
2 to 4: Soft
4 to 8: Medium Stiff
8 to 15: Stiff
15 to 30: Very Stiff
Over 30: Hard

GRANULAR SOILS (Blows per ft.)
0 to 4: Very Loose
4 to 10: Loose
10 to 30: Medium Dense
30 to 50: Dense
Over 50: Very Dense

PROPORTIONS USED
trace (0-10%)
little (10-20%)
some (20-35%)
and (35-50%)

COHESIVE SOIL THREAD
1/4 = Clayey Silt
1/8 = Silt & Clay
1/16 = Clay & Silt
1/32 = Silty Clay
1/64 = Clay

Standard Penetration Test (SPT) = 140# hammer falling 30", Blows are per 6" taken with an 18" long x 2" I.D. split spoon sampler in accordance with ASTM D 1586, unless otherwise noted.

REMARKS: The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Water level readings have been made in the test borings at times and under conditions stated on the test boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

NOTES:

Weston & Sampson

PROJECT: Peabody - North River Canal Rehabilitation Project

REPORT OF BORING No. WS-1

SHEET 1 OF 1

Project No. 2070047.B

CHKD BY B. Green

BORING Co. Geologic Earth Exploration, Inc.

FOREMAN Ray / John

WSE GEOLOGIST: April Prezioso

BORING LOCATION See attached plan

GROUND SURFACE ELEV. El. 14.0 +/- DATUM NAVD 1988

DATE START 3/21/07 DATE END 3/21/07

SAMPLER: Sampler consists of 2 in. Spilt Spoon Sampler driven using a140-LB Hammer falling 30-inches

CASING: 4 in. casing driven using a 300-LB Hammer falling 24 in.

CASING SIZE: I.D. 4.00 in. Method Drive and Wash

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
3/21/07	-	~3.5 ft.	-	Water introduced during drilling, may not represent stable groundwater condition

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	PEN/REC (in)	DEPTH (ft)	BLOWS/6"	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
		S-1	24/16	0.0-2.0	2-8	NA	M.dense, dark brown, coarse to fine SAND, some coarse to fine gravel and organics, trace silt.	(1)	Fill
					16-2				
5		S-2	24/24	4.0-6.0	1 for 24 in.		V.soft, beige, CLAY, trace dark brown organics.	(2)	
10		S-3	24/6	9.0-11.0	1-1		Loose, dark brown, medium to fine SAND, trace fine gravel, wood.		
					6-8				
15		S-4	24/16	14.0-16.0	2-3		Loose, light brown, fine SAND, trace silt.		Sand
					3-4				
20		S-5	24/12	19.0-21.0	2-3		Loose, light brown, fine SAND, trace silt.	(3)	
					4-6				EOB - 21.0 ft.

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

(1) Sample frozen

(2) Strong odor; appears to be decomposed ash.

(3) Grain size analysis conducted.

EOB at 21.0 ft. due to the availability of boring logs in the area.

NOTES:

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.

2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. WS-1

Weston & Sampson

PROJECT: Peabody - North River Canal Rehabilitation Project

REPORT OF BORING No. WS-2

SHEET 1 OF 2

Project No. 2070047.B

CHKD BY B. Green

BORING Co. Geologic Earth Exploration, Inc.

FOREMAN Ray / Chip

WSE GEOLOGIST: April Prezioso

BORING LOCATION See attached plan

GROUND SURFACE ELEV. El. 10.0 +/- DATUM NAVD 1988

DATE START 3/22/07 3/22/07

SAMPLER: Sampler consists of 2 in. Spilt Spoon Sampler driven using a140-LB Hammer falling 30-inches

CASING: 4 in. casing driven using a 300-LB Hammer falling 24 in.

CASING SIZE: I.D. 4.00 in. Method Drive and Wash

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
3/22/07	-	~3.0 ft.	-	Water introduced during drilling, may not represent stable groundwater condition

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	PEN/REC (in)	DEPTH (ft)	BLOWS/6"	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
		S-1	24/6	0.0-2.0	43-29	NA	V.dense, light brown, coarse to fine SAND, some fine gravel.	(1)	Concrete, 0 to 4 in.
					116 - ref				
5		S-2	24/0	4.0-6.0	32-6		No recovery, cobble was lodged in spoon. (Stratum Loose)	(2)	Probable Fill
					2-1				
10		S-3	24/6	9.0-11.0	25-8		M. dense, dark grey, medium to fine SAND, some organics, little fine gravel. Cobbles observed.		Organic Soils
					16-24				
15		S-4	24/6	14.0-16.0	35-34		Dense, dark grey, coarse to fine SAND, some coarse to fine gravel. Cobbles observed.		Sand
					10-6				
20		S-5	24/22	19.0-21.0	13-9		M. stiff, light grey SILT, some Clay, little fine sand		Silt
					5-7				
25		S-6	24/24	24.0-26.0	9-12		Hard, light grey SILT, some clay, little fine sand		
					20-30				
30		S-7	24/24	29.0-31.0	8-12		V. stiff, light grey SILT, some clay, little fine sand		
					3-10				
35									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

(1) 4 in. of concrete

(2) While washing, organics were observed with coarse to fine gravel

(3) Grain size analysis conducted.

NOTES:

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.

2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. WS-2

Weston & Sampson

PROJECT: Peabody - North River Canal Rehabilitation Project

REPORT OF BORING No. WS-2

SHEET 2 OF 2

Project No. 2070047.B

CHKD BY B. Green

BORING Co. Geologic Earth Exploration, Inc.

FOREMAN Ray / Chip

WSE GEOLOGIST: April Prezioso

BORING LOCATION See attached plan

GROUND SURFACE ELEV. El. 10.0 +/- DATUM NAVD 1988

DATE START 3/22/07 DATE END 3/22/07

SAMPLER: Sampler consists of 2 in. Spilt Spoon Sampler driven using a140-LB Hammer falling 30-inches

CASING: 4 in. casing driven using a 300-LB Hammer falling 24 in.

CASING SIZE: I.D. 4.00 in. Method Drive and Wash

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
3/22/07	-	~3.0 ft.	-	Water introduced during drilling, may not represent stable groundwater condition

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	PEN/REC (in)	DEPTH (ft)	BLOWS/6"	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
35		S-8	24/24	34.0-36.0	4-4	NA	M. stiff, light grey SILT, some clay, little fine sand		Silt
					3-7				
40		S-9	24/24	39.0-41.0	5-7		Stiff, light grey SILT, some clay, little fine sand	(3)	EOB - 41.0 ft.
					9-26				

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

(3) Grain size analysis conducted.

NOTES:

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. WS-2

Weston & Sampson

PROJECT: Peabody - North River Canal Rehabilitation Project

REPORT OF BORING No. WS-3

SHEET 1 OF 2

Project No. 2070047.B

CHKD BY B. Green

BORING Co. Geologic Earth Exploration, Inc.
FOREMAN Ray / Chip
WSE GEOLOGIST: April Prezioso

BORING LOCATION See attached plan
GROUND SURFACE ELEV. El. 10.5 +/- DATUM NAVD 1988
DATE START 3/22/07 DATE END 3/22/07

SAMPLER: Sampler consists of 2 in. Spilt Spoon Sampler driven using a140-LB Hammer falling 30-inches
CASING: 4 in. casing driven using a 300-LB Hammer falling 24 in.
CASING SIZE: I.D. 4.00 in. Method Drive and Wash

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
3/22/07	-	~4.0 ft.	-	Water introduced during drilling, may not represent stable groundwater condition

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	PEN/REC (in)	DEPTH (ft)	BLOWS/6"	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
		S-1	24/10	0.0-2.0	11-30	NA	V.dense, dark brown, coarse to fine SAND, little coarse to fine gravel, trace silt.	(1)	Topsoil, 0 to 2.0 ft.
					33-36				
5		S-2	24/6	4.0-6.0	28-4		Loose, dark brown, coarse to fine SAND, some coarse to fine gravel, trace silt.		Sand
					6-10				
10		S-3	24/8	9.0-11.0	20-5		Loose, dark brown, SILTY coarse to fine SAND, trace fine gravel.		
					5-6				
15		S-4	24/12	14.0-16.0	28-40		V.dense, tan, coarse to fine SAND, trace silt.		
					54-47				
20		S-5	24/16	19.0-21.0	14-14		Dense, grey, fine SAND, trace silt.		
					20-25				
25		S-6	24/6	24.0-26.0	24-30		V. dense, gray, fine SAND, trace silt.		
					22-26				
30		S-7	24/22	29.0-31.0	8-10		V stiff, grey SILT, some clay, trace fine sand.		Silt
					27-25				
35									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

(1) Ground frozen
(2) Grain size analysis conducted.

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. WS-3

Weston & Sampson

PROJECT: Peabody - North River Canal Rehabilitation Project

REPORT OF BORING No. WS-3

SHEET 2 OF 2

Project No. 2070047.B

CHKD BY B. Green

BORING Co. Geologic Earth Exploration, Inc.

FOREMAN Ray / Chip

WSE GEOLOGIST: April Prezioso

BORING LOCATION See attached plan

GROUND SURFACE ELEV. El. 10.5 +/- DATUM NAVD 1988

DATE START 3/22/07 DATE END 3/22/07

SAMPLER: Sampler consists of 2 in. Spilt Spoon Sampler driven using a140-LB Hammer falling 30-inches

CASING: 4 in. casing driven using a 300-LB Hammer falling 24 in.

CASING SIZE: I.D. 4.00 in. Method Drive and Wash

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
3/22/07	-	~4.0 ft.	-	Water introduced during drilling, may not represent stable groundwater condition

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	PEN/REC (in)	DEPTH (ft)	BLOWS/6"	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
35		S-8	24/24	34.0-36.0	8-15	NA	V. stiff, grey SILT, some clay, trace fine sand.	(2)	Silt
					23-13				
40		S-9	24/24	39.0-41.0	13-18		V. stiff, grey SILT, some clay, trace fine sand.		EOB - 41.0 ft.
					30-29				

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

(2) Grain size analysis conducted.

NOTES:

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. WS-3

Weston & Sampson

PROJECT: Peabody - North River Canal Rehabilitation Project

REPORT OF BORING No. WS-4

SHEET 1 OF 2

Project No. 2070047.B

CHKD BY B. Green

BORING Co. Geologic Earth Exploration, Inc.

FOREMAN Ray / Chris

WSE GEOLOGIST: April Prezioso

BORING LOCATION See attached plan

GROUND SURFACE ELEV. El. 12.5 +/- DATUM NAVD 1988

DATE START 3/23/07 DATE END 3/23/07

SAMPLER: Sampler consists of 2 in. Spilt Spoon Sampler driven using a140-LB Hammer falling 30-inches

CASING: 4 in. casing driven using a 300-LB Hammer falling 24 in.

CASING SIZE: I.D. 4.00 in. Method Drive and Wash

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
3/23/07	-	~4.0 ft.	-	Water introduced during drilling, may not represent stable groundwater condition

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	PEN/REC (in)	DEPTH (ft)	BLOWS/6"	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
		S-1	24/18	0.0-2.0	70-40	NA	V.dense, dark brown, coarse to fine SAND, trace silt.	(1)	Asphalt, 0 to 3.0 in.
					23-13				
5		S-2	24/12	4.0-6.0	8-7		M. dense, tan, coarse to fine SAND, wood.	(2)	Probably Fill
					6-12				
10		S-3	24/16	9.0-11.0	24-41		V.dense, orange/brown, coarse to fine SAND, little coarse to fine gravel. Cobbles observed.		
					74-70				
15		S-4	24/10	14.0-16.0	40-24		Dense, tan, fine SAND.	(3)	Sand
					22-31				
20		S-5	24/24	19.0-21.0	15-11		V. stiff, light grey SILT, some clay, trace fine sand.		
					19-18				Silt
25		S-6	24/20	24.0-26.0	8-15		Dense, tan, fine SAND, trace silt.	(4)	
					16-16				
30		S-7	24/18	29.0-31.0	15-20		Dense, tan, fine SAND, trace silt.	(5)	Sand
					24-29			(6)	
35									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

(1) Ground frozen
(2) Organics observed from 7 to 9 ft. while washing
(3) Iron stained Seam at 8 in. (14.8 ft.) ~ 1/4 in. thick
(4) Iron stained Seam throughout ~ 1/8 in. thick
(5) Iron stained Seam throughout ~ 1/4 in. thick
(6) Grain size analysis conducted.

NOTES:

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. WS-4

Weston & Sampson

PROJECT: Peabody - North River Canal Rehabilitation Project

REPORT OF BORING No. WS-4

SHEET 2 OF 2

Project No. 2070047.B

CHKD BY B. Green

BORING Co. Geologic Earth Exploration, Inc.

FOREMAN Ray / Chip

WSE GEOLOGIST: April Prezioso

BORING LOCATION See attached plan

GROUND SURFACE ELEV. El. 12.5 +/- DATUM NAVD 1988

DATE START 3/22/07 DATE END 3/22/07

SAMPLER: Sampler consists of 2 in. Spilt Spoon Sampler driven using a140-LB Hammer falling 30-inches

CASING: 4 in. casing driven using a 300-LB Hammer falling 24 in.

CASING SIZE: I.D. 4.00 in. Method Drive and Wash

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
3/22/07	-	~3.0 ft.	-	Water introduced during drilling, may not represent stable groundwater condition

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	PEN/REC (in)	DEPTH (ft)	BLOWS/6"	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
35		S-8	24/22	34.0-36.0	10-17	NA	Dense, tan, fine SAND, trace silt.		Sand
					20-22				
40		S-9	24/22	39.0-41.0	10-21		Hard, greenish grey SILT, some clay, little fine sand.		EOB - 41.0 ft.
					33-41				

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

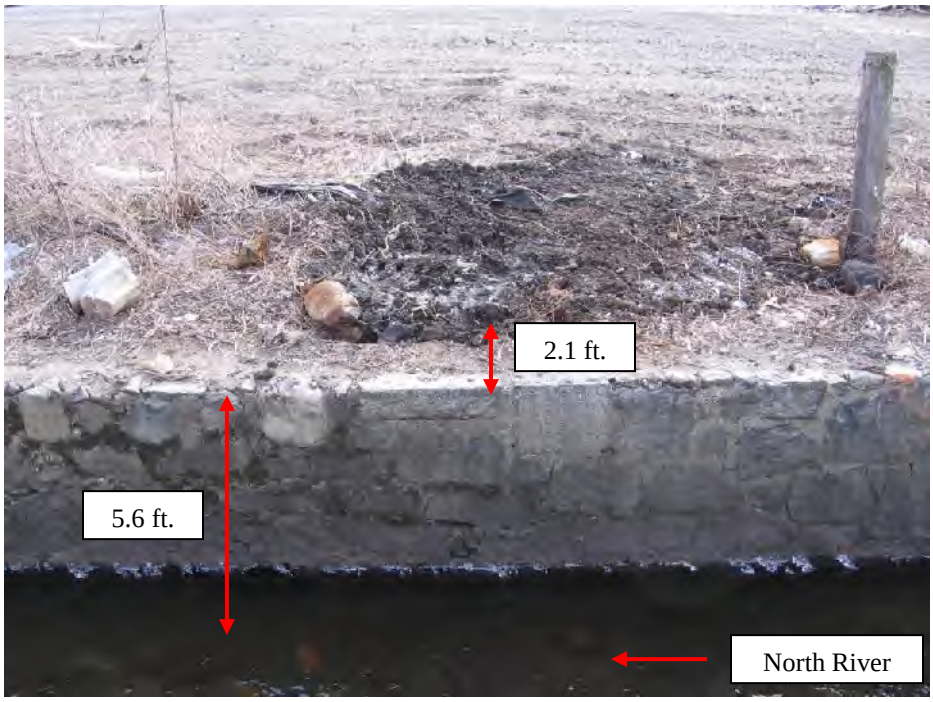
NOTES:

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. WS-4

Test Pit Photographs (March 8, 2007)

TEST PIT #5



The face of the mortared granite wall at this location (1 of 3)



The mortared, vertical back of the granite wall looking towards the North River (2 of 3)



The vertical backside of the mortared granite wall looking upstream (3 of 3)

APPENDIX C

2017 Limited Subsurface Environmental Investigations – Proposed Riverwalk Area

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

June 30, 2017

Mr. Brendan Callahan
Department of Community Development and Planning
24 Lowell Street
Peabody, Massachusetts 01960

Re: Limited Subsurface Site Investigation
North River Corridor Riverwalk
13 Wallis Street
Peabody, Massachusetts

Dear Mr. Callahan:

Weston & Sampson is pleased to submit this Limited Subsurface Site Investigation Letter Report for the portion of 13 Wallis Street located adjacent to the North River Canal in Peabody, Massachusetts. Specifically, this assessment evaluated an approximate 10-foot wide strip of land abutting the south side of the North River in Peabody, Massachusetts (the Site). The assessment was performed as part of a multi-parcel limited assessment in support of the proposed Riverwalk project along the North River Corridor. Weston & Sampson performed the following tasks as part of the Limited Subsurface Site Investigation:

- Site reconnaissance and review of previous investigations conducted at the Site;
- Soil boring advancement; and,
- Soil sampling and analysis.

See attached Figures 1 and 2 for a Site Locus Map and a Site Plan (with soil sampling locations), respectively.

SITE BACKGROUND

In support of the City of Peabody's (the City's) desire to construct a Riverwalk along the North River Corridor, the City is evaluating potential property acquisition and/or easement takings at selected properties along the corridor. Specifically, the City is interested in purchasing a portion of the property located at 13 Wallis Street (Parcel ID 085-041A). 13 Wallis Street is **not** listed as Disposal Site by MassDEP; however, it has a long, industrial history primarily in tannery operations. Currently, a US Post Office occupies the northwestern corner of the property and the remainder of the property is used to store miscellaneous construction equipment.

A subsurface investigation conducted in 2009 indicated the presence of fill material containing arsenic, chromium, and lead at concentrations in excess of the MassDEP Reportable Concentrations (RCs) for S-1 soil (RCS-1) at a depths of 0-5 feet below ground surface. Several additional metals and PCBs were detected at concentrations below the applicable MassDEP RCS-1 thresholds in shallow soil. PAHs were detected below the RCS-1 thresholds in deeper soil (5-10 feet below ground surface); however, PAHs were not analyzed in the 0-5 foot depth interval. Data collected during the 2009 sampling event is insufficient in that only two (2) boring locations were investigated, and no shallow soil was analyzed for PAHs. The concentrations of arsenic, chromium, and lead detected during the 2009 subsurface investigation above the RCS-1 thresholds were not reported to the MassDEP by the property owner.

SUBSURFACE INVESTIGATION

Weston & Sampson performed a subsurface investigation at the Site on April 26, 2017. The investigation included the advancement of four (4) soil borings and the collection and analysis of nine (9) soil samples. A detailed summary of the investigation is provided below. See Figure 2 for sampling locations. A summary of laboratory analytical results is provided in Tables 1 and 2.

Soil Boring Advancement

On April 26, 2017, Weston & Sampson oversaw the advancement of four (4) soil borings (SP-1 through SP-4) at

the Site. The borings were advanced by New England Geotech, LLC, of Jamestown, Rhode Island, to depths of 5 feet below ground surface (bgs) using direct-push methods. Boring locations were selected by Weston & Sampson based on documented historical Site use and a review of previous Site investigations, and were spatially distributed to obtain a representative evaluation of the conditions of the proposed Riverwalk area.

Soil Sampling and Analysis

A Weston & Sampson geologist screened each soil boring at continuous depth intervals and logged soil descriptions using a modified Burmeister Soil Classification System. Each sample was field-screened for visual and olfactory evidence of impacts, as well as volatile organic compounds (VOCs) using a photoionization detector (PID) in accordance with the MassDEP jar headspace screening method. Field screening results are included in the soil boring logs attached.

Two (2) soil samples from each boring, one at the 0-1 foot interval, and one at the 2-5 foot interval, were submitted to Con-Test Analytical Laboratory of East Longmeadow, Massachusetts (Con-Test) analysis of hexavalent chromium, selenium, silver, and PAHs. Analysis of additional metals and PCBs was not required because those analytes were included in previous investigations.

Weston & Sampson also composited soil from all four (4) soil boring locations, and submitted the composite sample (Comp-1) for analysis of typical disposal characterization parameters. The disposal characterization was conducted in accordance with the Massachusetts Department of Environmental Protection (DEP) Policy # COMM-97-001: Reuse and Disposal of Contaminated Soil in Massachusetts and included the following analyses: total petroleum hydrocarbons (TPH); Resource Conservation and Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver); VOCs; semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); pH; ignitability; specific conductivity; and reactivity. The sample was also analyzed for Toxicity Characteristic Leaching Procedure (TCLP) lead analysis because the concentration of that analyte was above the RCRA "Rule of 20."

SUBSURFACE INVESTIGATION RESULTS

In general, the following shallow geologic conditions were encountered during the subsurface soil investigation program:

Fill Material: Light brown to dark brown fine to coarse sand matrix containing variable amounts of coal and wood fragments, ash, brick, concrete, suspected lime, and metal.

Note the borings were not advanced deeper than five (5) feet below ground surface. Bedrock was not encountered during the investigation.

Field Screening Results

As shown in the attached boring logs, PID field screening of soil samples collected from soil borings SP-1, SP-2, SP-3, and SP-4 did not identify detectable VOCs. Soil boring logs are included in Attachment A.

Soil Analytical Results

As shown in Table 1, analysis of soil samples identified concentrations of PAHs above applicable Massachusetts Contingency Plan (MCP) RCS-1 thresholds and Method 1 S-1/GW-2 and S-1/GW-3 standards. The following is a summary of the exceedances identified:

- Benzo(a)anthracene was identified at concentrations exceeding the applicable RCS-1 thresholds and Method 1 standards in sample SP-1 (2-5).
- Benzo(a)pyrene was identified at concentrations exceeding the applicable RCS-1 thresholds and Method 1 standards in samples SP-1 (2-5) and SP-3 (2-5).
- Benzo(b)fluoranthene was identified at concentrations exceeding the applicable RCS-1 thresholds and Method 1 standards in sample SP-1 (2-5).

- Dibenz(a,h)anthracene was identified at concentrations exceeding the applicable RCS-1 thresholds and Method 1 standards in sample SP-1 (2-5).

- Phenanthrene was identified at concentrations exceeding the applicable RCS-1 thresholds and Method 1 standards in sample SP-1 (2-5).

No other analytes were detected in excess of the applicable the applicable RCS-1 thresholds and Method 1 standards in SP-1 through SP-4. The results of historical investigations completed by others are included in Table 3. As shown in Table 3, arsenic, chromium, and lead are present at the Site above the applicable MCP RCS-1 thresholds and Method 1 standards.

The results of the disposal characterization analyses are presented in Table 2. The results were compared to the COMM-97-001 requirements for reuse at Massachusetts lined and unlined landfills. As shown in Table 2, soil analytical results indicate that while lead is present at a concentration exceeding the RCS-1 thresholds, the concentration does not exceed the COMM-97-001 Reuse level for In-State Lined and Unlined Landfills.

CONCLUSIONS

In summary, the contaminant concentrations reported during for this limited subsurface investigation indicate that:

- A reportable condition exists at the Site due to the presence of arsenic, chromium, lead, and PAHs at concentrations above the RCS-1;
- The City is not currently obligated to report the RCS-1 exceedances to MassDEP;
- In general, contaminants in the 0-2 feet bgs depth interval tend to be similar to the concentrations of contaminants in soils in the 2-5 ft bgs depth interval;
- Excavation will require soil management under the MCP;
- The contaminated media (soil) will require disposal at an appropriate facility and documentation by a Licensed Site Professional (LSP); and
- The soil did not fail the leachability test and does not require disposal at a RCRA facility.

Prior to the start of construction at the Site, the detected release of PAHs, lead, and arsenic (detected during a previous investigation) will require reporting to the MassDEP, and construction will require management under a Release Abatement Measure (RAM). It is important to reiterate, having completed this assessment for the purpose of due diligence in advance of a potential property transaction, the City is not currently obligated to report the RCS-1 exceedances to MassDEP; however, If the City takes ownership of the Site, the City will be responsible for reporting the release to MassDEP within 120 days of the property transfer. During construction soils will likely be excavated and disposed of at a licensed facility. Following removal of impacted fill, soil sampling will be required to evaluate remaining conditions and associated risk. Clean fill will be used to construct the Riverwalk pathways. A geotextile membrane barrier may also be required to separate impacted fill as part of the risk management strategy. A Permanent Solution Statement will be required for the Riverwalk area once complete.

Assuming only the Riverwalk portion of the property were to be obtained through an easement, potential obligations to the City to construct a river walk along the corridor at the 13 Wallis Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $25,000
    - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
    - RAM Status Report
    - Method 3 Risk Assessment for Riverwalk Area
    - Revised PSS (assumes no AUL based on existing data)
    - RAM Completion Report
    - Soil Management & Bills of Lading (BOLs)
- Construction Specifications ~ $5,000

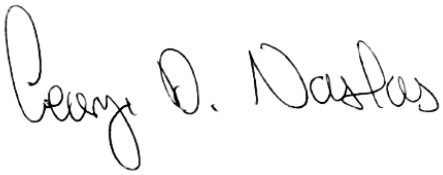
- Construction Administration, Coordination & Oversight ~ $5,000
- Soil removal and out-of-state disposal of approximately 500 tons (assumed to be an area measuring 430 feet long by 10 feet wide and a depth of 2 feet) of impacted soil from the Riverwalk ~ $50,000

Estimated TOTAL = $85,000* (not including permitting or associated Riverwalk construction costs).
*Note: Given the existing condition of the canal wall along the 13 Wallis Street property, further structural evaluations may conclude that additional soils require removal as part of wall repair alternatives.

We look forward to discussing these findings with you in greater detail and working with the City to make your visions for the Riverwalk a reality. If you have any comments or questions, please contact us at 978-532-1900.

Very truly yours,

WESTON & SAMPSON ENGINEERS, INC.



George D. Naslas, PG, LSP
Vice President

Attachments: Figures
Tables
Attachment A

O:\Peabody MA\North River Corridor Due Diligence\13 Wallis St\Subsurface Investigation\Summary Letter\13 Wallis St Site Investigation Summary.docx

FIGURES



FIGURE 1
13 WALLIS STREET
PEABODY, MASSACHUSETTS

LOCUS MAP

0 2,000 4,000 **Feet**

Weston & Sampson

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Legend

- SOIL BORING LOCATION
- PROPERTY BOUNDARY

50 0 50

Scale In Feet

FIGURE 2

13 WALLIS STREET
PEABODY, MASSACHUSETTS

SITE PLAN

JUNE 2017 SCALE: NOTED

Weston & Sampson SM

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TABLES

Table 1
Summary of Laboratory Analytical Results - Soil Borings
13 Wallis Street
Peabody, Massachusetts
April 26, 2017

Parameter	Units	Reportable Concentrations	Method 1 Cleanup Standards (1)		Sample Location and Depth							
		RCS-1	S-1/GW-2	S-1/GW-3	SP-1 (0-1)	SP-1 (2-5)	SP-2 (0-1)	SP-2 (2-5)	SP-3 (0-1)	SP-3 (2-5)	SP-4 (0-1)	SP-4 (2-5)
					0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet
Metals												
HEXAVALENT CHROMIUM	mg/kg	100	100	100	<1.2	<1.1	<1.2	<1.5	<0.93	<2.7	<0.93	<0.97
SELENIUM	mg/kg	400	400	400	<7.0	<6.8	<7.1	<8.9	<3.9	<7.8	<5.7	<6.1
SILVER	mg/kg	100	100	100	<0.70	<0.68	<0.71	<0.89	<0.39	<0.78	<0.57	**5.7**
PAHs												
ACENAPHTHENE	mg/kg	4	1000	1000	<0.25	**0.76**	<0.25	<0.31	<0.20	**0.53**	<0.21	<0.21
ACENAPHTHYLENE	mg/kg	1	600	10	<0.25	**0.89**	<0.25	<0.31	<0.20	**0.73**	<0.21	<0.21
ANTHRACENE	mg/kg	1000	1000	1000	**0.26**	**3.5**	<0.25	<0.31	<0.20	**2.3**	<0.21	<0.21
BENZO(A)ANTHRACENE	mg/kg	7	7	7	**0.97**	**8.4**	**0.27**	<0.31	**0.22**	**5.5**	**0.58**	**0.81**
BENZO(A)PYRENE	mg/kg	2	2	2	**0.97**	**7.3**	**0.29**	**0.37**	**0.22**	**4.5**	**0.56**	**0.86**
BENZO(B)FLUORANTHENE	mg/kg	7	7	7	**1.3**	**8**	**0.39**	**0.39**	**0.28**	**5.3**	**0.68**	**1**
BENZO(G,H,I)PERYLENE	mg/kg	1000	1000	1000	**0.74**	**4.7**	<0.25	<0.31	<0.20	**2.7**	**0.37**	**0.59**
BENZO(K)FLUORANTHENE	mg/kg	70	70	70	**0.46**	**3.4**	<0.25	<0.31	<0.20	**1.8**	**0.27**	**0.4**
CHRYSENE	mg/kg	70	70	70	**1.1**	**7.9**	**0.3**	**0.32**	**0.25**	**5.2**	**0.58**	**0.82**
DIBENZ(A,H)ANTHRACENE	mg/kg	0.7	0.7	0.7	<0.25	**1.4**	<0.25	<0.31	<0.20	**0.4**	<0.21	<0.21
FLUORANTHENE	mg/kg	1000	1000	1000	**2**	**17**	**0.55**	**0.52**	**0.56**	**11**	**1.2**	**1.5**
FLUORENE	mg/kg	1000	1000	1000	<0.25	**1.5**	<0.25	<0.31	<0.20	**0.91**	<0.21	<0.21
INDENO(1,2,3-CD)PYRENE	mg/kg	7	7	7	**0.81**	**4.8**	<0.25	<0.31	<0.20	**3.2**	**0.41**	**0.69**
2-METHYLNAPHTHALENE	mg/kg	0.7	80	300	<0.25	**0.34**	<0.25	<0.31	<0.20	<0.29	<0.21	<0.21
NAPHTHALENE	mg/kg	4	20	500	<0.25	**0.46**	<0.25	<0.31	<0.20	**0.44**	<0.21	<0.21
PHENANTHRENE	mg/kg	10	500	500	**1.4**	**16**	**0.3**	<0.31	**0.54**	**9.1**	**0.83**	**0.99**
PYRENE	mg/kg	1000	1000	1000	**2.2**	**19**	**0.58**	**0.65**	**0.59**	**9.9**	**1.3**	**1.8**

QC by JRS 6/22/2017

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard
MCP = Massachusetts Contingency Plan
mg/kg = milligram per killiogram

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP RCS-1 Threshold and/or Method 1, S-1 standard
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

Table 2
Summary of Laboratory Analytical Results - Disposal Characterization
13 Wallis Street
Peabody, Massachusetts
April 26, 2017

Parameter	Units	Reportable Concentrations[1]	COMM-97-001 In-State Disposal/Reuse Levels		Sample Location, Depth, and Date
		RCS-1	Unlined	Lined	Comp-1
Metals					
ARSENIC	mg/kg	20	40	40	**16**
BARIUM	mg/kg	1000	NS	NS	**98**
CADMIUM	mg/kg	70	30	80	**1.3**
TRIVALENT CHROMIUM	mg/kg	100	1000	1000	**36**
LEAD	mg/kg	200	1000	2000	**860**
TCLP LEAD	mg/L	NS	5	5	**0.26**
MERCURY	mg/kg	20	10	10	**0.46**
SELENIUM	mg/kg	400	NS	NS	<5.5
SILVER	mg/kg	100	NS	NS	**3.3**
PCBs					
Total PCBs	mg/kg	1	<2	<2	ND
TPH					
TPH	mg/kg	1000	2500	5000	**130**
VOCs					
Total VOCs	mg/kg	NS	4	10	ND
SVOCs					
BENZO(A)ANTHRACENE	mg/kg	7	NS	NS	**0.33**
BENZO(A)PYRENE	mg/kg	2	NS	NS	**0.38**
BENZO(B)FLUORANTHENE	mg/kg	7	NS	NS	**0.51**
BENZO(G,H,I)PERYLENE	mg/kg	1000	NS	NS	**0.24**
BENZO(K)FLUORANTHENE	mg/kg	70	NS	NS	**0.21**
CHRYSENE	mg/kg	70	NS	NS	**0.38**
FLUORANTHENE	mg/kg	1000	NS	NS	**0.63**
INDENO(1,2,3-CD)PYRENE	mg/kg	7	NS	NS	**0.25**
PHENANTHRENE	mg/kg	10	NS	NS	**0.52**
PYRENE	mg/kg	1000	NS	NS	**0.64**
Total SVOCs	mg/kg	NS	100	100	**4.09**
General Chemistry					
% Solids	%Wt	NS	NS	NS	**86.1**
SPECIFIC CONDUCTANCE	(µmhos/cm)	NS	4000	8000	**42**
IGNITABILITY	(present/absent)	NS	Absent	Absent	Absent
REACTIVE CYANIDE	mg/kg	NS	ND	ND	<4.0
REACTIVE SULFIDE	mg/kg	NS	ND	ND	<20
PH	pH Units	NS	>2 and <12	>2 and <12	**7.0**

QC by JRS 6/22/2017

O:\Peabody MA\North River Corridor Due Diligence\13 Wallis St\Subsurface Investigation\Table\[Table 1 - 13 Wallis Street.xls]Soil Borings

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
BOLD Parameter exceeds the COMM-97-001 standard for reuse at In-State landfills
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

Table 3
Summary of Laboratory Analytical Results - Historical Data
13 Wallis Street
Peabody, Massachusetts

Parameter	Units	Reportable Concentrations	Method 1 Cleanup Standards (1)		Sample Location, Depth, and Date			
		RCS-1	S-1/GW-2	S-1/GW-3	P-6 (0-5)	P-6 (5-10)	P-7 (0-5)	P-7 (5-10)
					5/24/2009	5/24/2009	5/24/2009	5/24/2009
Metals								
ANTIMONY	mg/kg	20	20	20	<7.03	<5.74	<6.62	<6.22
ARSENIC	mg/kg	20	20	20	**43.4**	**14.3**	**24.1**	**16.3**
TCLP ARSENIC	mg/L	NS	NS	NS	NA	NA	NA	NA
BARIUM	mg/kg	1000	1000	1000	**415**	**76.4**	**73.6**	**33.2**
BERYLLIUM	mg/kg	90	90	90	<0.44	**1.2**	**0.499**	**0.439**
CADMIUM	mg/kg	70	70	70	**1.25**	<0.718	<0.828	<0.778
TRIVALENT CHROMIUM	mg/kg	1000	1000	1000	**1160**	**85.4**	**64.6**	**32.9**
HEXAVALENT CHROMIUM[2]	mg/kg	100	100	100	<2.8	<2.6	<2.7	<2.7
TCLP TOTAL CHROMIUM	mg/L	NS	NS	NS	<0.1	NA	NA	NA
LEAD	mg/kg	200	200	200	**314**	**89.2**	**93.6**	**19.7**
TCLP LEAD	mg/L	NS	NS	NS	<0.25	NA	NA	NA
MERCURY	mg/kg	20	20	20	**0.477**	**0.105**	**0.158**	<0.0653
NICKEL	mg/kg	600	600	600	**26.4**	**30.6**	**23.7**	**18.6**
THALLIUM	mg/kg	8	8	8	<8.79	<7.18	<8.28	<7.78
VANADIUM	mg/kg	400	400	400	**48**	**54**	**24.7**	**24.4**
ZINC	mg/kg	1000	1000	1000	**620**	**116**	**363**	**136**
VOCs								
ACETONE	mg/kg	6	50	400	<0.026	**0.078**	<0.027	<0.024
BENZENE	mg/kg	2	40	40	<0.0064	<0.0067	<0.0068	<0.0061
CHLOROMETHANE	mg/kg	100	NS	NS	<0.0064	<0.0067	<0.0068	<0.0061
ETHYLBENZENE	mg/kg	40	500	500	<0.0064	<0.0067	<0.0068	<0.0061
METHYLENE CHLORIDE	mg/kg	0.1	20	200	<0.026	<0.0067	<0.027	<0.024
NAPHTHALENE	mg/kg	4	20	500	<0.0064	<0.0067	<0.0068	<0.0061
TETRACHLOROETHYLENE	mg/kg	1	10	30	<0.0064	<0.0067	<0.0068	<0.0061
TOLUENE	mg/kg	30	500	500	<0.0064	<0.0067	<0.0068	<0.0061
M/P-XYLENE	mg/kg	100	100	500	<0.0064	<0.0067	<0.0068	<0.0061
O-XYLENE	mg/kg	100	100	500	<0.0064	<0.0067	<0.0068	<0.0061
SVOCs								
ACENAPHTHYLENE	mg/kg	1	600	10	NA	<0.320	NA	<0.320
ANTHRACENE	mg/kg	1000	1000	1000	NA	<0.320	NA	<0.320
BENZO(A)ANTHRACENE	mg/kg	7	7	7	NA	<0.320	NA	<0.320
BENZO(A)PYRENE	mg/kg	2	2	2	NA	<0.320	NA	<0.320
BENZO(B)FLUORANTHENE	mg/kg	7	7	7	NA	<0.320	NA	<0.320
BENZO(G,H,I)PERYLENE	mg/kg	1000	1000	1000	NA	<0.320	NA	<0.320
BENZO(K)FLUORANTHENE	mg/kg	70	70	70	NA	<0.320	NA	<0.320
CHRYSENE	mg/kg	70	70	70	NA	<0.320	NA	<0.320
DIBENZ(A,H)ANTHRACENE	mg/kg	0.7	0.7	0.7	NA	<0.320	NA	<0.320
FLUORANTHENE	mg/kg	1000	1000	1000	NA	**0.42**	NA	<0.320
INDENO(1,2,3-CD)PYRENE	mg/kg	7	7	7	NA	<0.320	NA	<0.320
NAPHTHALENE	mg/kg	4	20	500	NA	<0.320	NA	<0.320
PHENANTHRENE	mg/kg	10	500	500	NA	**0.33**	NA	<0.320
PYRENE	mg/kg	1000	1000	1000	NA	**0.32**	NA	<0.320
PCBs								
AROCLOR 1268	mg/kg	1	1	1	**0.14**	<0.032	<0.033	<0.032
AROCLOR 1016	mg/kg	1	1	1	<0.035	<0.032	<0.033	<0.032
AROCLOR 1232	mg/kg	1	1	1	**0.084**	<0.032	<0.033	<0.032
TPH								
Diesel Range Organics	mg/kg	1000	1000	1000	**150**	<65	<68	<66

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Notes:
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BOLD Parameter exceeds the applicable MCP RCS-1 Threshold and Method 1, S-1 standard
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated Janurary 2015).
2 = Assumed to be the hexavalent form in the absence of speciation analysis

ATTACHEMNT A
Soil Boring Logs

Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-1
13 Wallis St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	Joseph Spencer

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2		
FOREMAN	Keith	GROUND SURFACE ELEV.		DATUM	
WSE REP	Taylor Smith	DATE START	4/26/17	DATE END	4/26/17

SAMPLER:	ATS track mounted rig
	DT 22 Sampler 2.25 inch
CASING:	DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE:	2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (in)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			6/12	0-2	0-2	0	Brown fine to coarse SAND, silt		SAND FILL
			18/36	2-5	2-5	0.1	Dark brown fine to coarse SAND, silt, trace wood, organic odor		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-1

Weston & Sampson

PROJECT	REPORT OF BORING No.	SB-2
13 Wallis St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	Joseph Spencer

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2		
FOREMAN	Keith	GROUND SURFACE ELEV.		DATUM	
WSE REP	Taylor Smith	DATE START	4/26/17	DATE END	4/26/17

SAMPLER:	ATS track mounted rig
	DT 22 Sampler 2.25 inch
CASING:	DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE:	2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (in)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			8/12	0-2	0-2	0	Dark brown to light brown fine to coarse SAND, silt, some brick fragments		SAND FILL
			24/36	2-5	2-5	0	Dark brown to brown fine to coarse SAND, some orange organics, some silt		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-2

Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-3
13 Wallis St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	Joseph Spencer

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2		
FOREMAN	Keith	GROUND SURFACE ELEV.		DATUM	
WSE REP	Taylor Smith	DATE START	4/26/17	DATE END	4/26/17

SAMPLER:	ATS track mounted rig
	DT 22 Sampler 2.25 inch
CASING:	DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE:	2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (in)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			10/12	0-2	0-2	0	Brown fine to coarse SAND, silt, trace brick fragments		SAND FILL
			20/36	2-5	2-5	0	Dark brown to light brown fine to coarse SAND, silt, trace brick		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-3

Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-4
13 Wallis St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	Joseph Spencer

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2		
FOREMAN	Keith	GROUND SURFACE ELEV.		DATUM	
WSE REP	Taylor Smith	DATE START	4/26/17	DATE END	4/26/17

SAMPLER:	ATS track mounted rig
	DT 22 Sampler 2.25 inch
CASING:	DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE:	2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (in)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			8/12	0-2	0-2	0	Brown fine to coarse SAND, silt, trace wood fragments		SAND FILL
			26/36	2-5	2-5	0	Brown to light brown fine to coarse SAND, silt		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-4

ATTACHMENT B
Laboratory Analytical Reports

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

May 4, 2017

Joe Spencer
Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960

Project Location: 13 Wallis St.
Client Job Number:
Project Number: [none]
Laboratory Work Order Number: 17D1259

Enclosed are results of analyses for samples received by the laboratory on April 26, 2017. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Meghan E. Kelley
Project Manager

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con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 5/4/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: [none]

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17D1259

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 13 Wallis St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
SP-1 (0-1)	17D1259-01	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-1 (2-5)	17D1259-02	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (0-1)	17D1259-03	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (2-5)	17D1259-04	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-3 (0-1)	17D1259-05	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-3 (2-5)	17D1259-06	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 5/4/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: [none]

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17D1259

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 13 Wallis St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
SP-4 (0-1)	17D1259-07	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-4 (2-5)	17D1259-08	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
Comp-1	17D1259-09	Soil		SM 2540G	
				SM21-22 2510B Modified	
				SW-846 1030	
				SW-846 6010C-D	
				SW-846 7471B	
				SW-846 8082A	
				SW-846 8100 Modified	
				SW-846 8260C	
				SW-846 8270D	
				SW-846 9014	
				SW-846 9030A	
				SW-846 9045C	

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

CASE NARRATIVE SUMMARY

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

For method 6010, only a select list of metals were requested and reported.

For method 8270, only PAHs were requested and reported.

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

SW-846 6010C-D

Qualifications:

MS-07

Matrix spike recovery is outside of control limits. Analysis is in control based on laboratory fortified blank recovery. Possiblity of sample matrix effects that lead to low bias for reported result or non-homogeneous sample aliquot cannot be eliminated.

Analyte & Samples(s) Qualified:

Chromium
B175645-MS1

MS-19

Sample to spike ratio is greater than or equal to 4:1. Spiked amount is not representative of the native amount in the sample. Appropriate or meaningful recoveries cannot be calculated.

Analyte & Samples(s) Qualified:

Lead
B175645-MS1

SW-846 7196A

Qualifications:

W-06

Elevated method reporting limit due to intense color of sample

Analyte & Samples(s) Qualified:

Hexavalent Chromium
17D1259-01[SP-1 (0-1)], 17D1259-02[SP-1 (2-5)], 17D1259-03[SP-2 (0-1)], 17D1259-04[SP-2 (2-5)], 17D1259-05[SP-3 (0-1)], 17D1259-06[SP-3 (2-5)], 17D1259-07[SP-4 (0-1)], 17D1259-08[SP-4 (2-5)]

SW-846 8082A

Qualifications:

O-32

A dilution was performed as part of the standard analytical procedure.

Analyte & Samples(s) Qualified:

17D1259-09[Comp-1]

SW-846 8260C

Qualifications:

L-07

Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.

Analyte & Samples(s) Qualified:

Hexachlorobutadiene
B175532-BSD1

V-16

Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.

Analyte & Samples(s) Qualified:

1,4-Dioxane
17D1259-09[Comp-1], B175532-BLK1, B175532-BS1, B175532-BSD1

V-20

Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.

Analyte & Samples(s) Qualified:

1,2-Dichloroethane
B175532-BS1, B175532-BSD1

1,4-Dioxane
B175532-BS1, B175532-BSD1

Dichlorodifluoromethane (Freon 12
B175532-BS1, B175532-BSD1

SW-846 8270D

Qualifications:

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

L-04

Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

Aniline

17D1259-09[Comp-1], B175467-BLK1, B175467-BS1, B175467-BSD1

V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

2,4-Dinitrophenol

17D1259-09[Comp-1], B175467-BLK1, B175467-BS1, B175467-BSD1

Aniline

17D1259-09[Comp-1]

Pentachlorophenol

17D1259-09[Comp-1], B175467-BLK1, B175467-BS1, B175467-BSD1

V-20

Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.

Analyte & Samples(s) Qualified:

Hexachlorobutadiene

17D1259-09[Comp-1], B175467-BLK1, B175467-BS1, B175467-BSD1

SW-846 6010C/D SW-846 6020A/B

For NC, Metals methods SW-846 6010D and SW-846 6020B are followed, and for all other states methods SW-846 6010C and SW-846 6020A are followed.

SW-846 8100 Modified

TPH (C9-C36) is quantitated against a calibration made with a diesel standard.

SW-846 8260C

Laboratory control sample recoveries for required MCP Data Enhancement 8260 compounds were all within limits specified by the method except for “difficult analytes” where recovery control limits of 40-160% are used and/or unless otherwise listed in this narrative. Difficult analytes: MIBK, MEK, acetone, 1,4-dioxane, chloromethane, dichlorodifluoromethane, 2-hexanone, and bromomethane.

SW-846 8270D

Laboratory control sample recoveries for required MCP Data Enhancement 8270 compounds were all within control limits specified by the method, 40-140% for base/neutrals and 30-130% for acids except for “difficult analytes” listed below and/or otherwise listed in this narrative. Difficult analytes limits are 15 and 140%: 2,4-dinitrophenol, 4-chloroaniline, 4-nitrophenol, and phenol.

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Lisa A. Worthington
Project Manager

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-1 (0-1) Sampled: 4/26/2017 10:25

Sample ID: 17D1259-01

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Acenaphthylene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Anthracene	0.26	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Benzo(a)anthracene	0.97	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Benzo(a)pyrene	0.97	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Benzo(b)fluoranthene	1.3	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Benzo(g,h,i)perylene	0.74	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Benzo(k)fluoranthene	0.46	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Chrysene	1.1	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Dibenz(a,h)anthracene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Fluoranthene	2.0	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Fluorene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Indeno(1,2,3-cd)pyrene	0.81	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
2-Methylnaphthalene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Naphthalene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Phenanthrene	1.4	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL
Pyrene	2.2	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:16	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	63.5	30-130		5/2/17 20:16
2-Fluorobiphenyl	63.6	30-130		5/2/17 20:16
p-Terphenyl-d14	76.2	30-130		5/2/17 20:16

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-1 (0-1) Sampled: 4/26/2017 10:25

Sample ID: 17D1259-01

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	7.0	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:34	SHN
Silver	ND	0.70	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:34	SHN

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-1 (0-1) Sampled: 4/26/2017 10:25

Sample ID: 17D1259-01

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.2	mg/Kg dry	5	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	140		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.9°C	5.9		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	67.2		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-1 (2-5) Sampled: 4/26/2017 10:30

Sample ID: 17D1259-02

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	0.76	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Acenaphthylene	0.89	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Anthracene	3.5	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Benzo(a)anthracene	8.4	2.3	mg/Kg dry	10		SW-846 8270D	4/27/17	5/3/17 12:02	BGL
Benzo(a)pyrene	7.3	2.3	mg/Kg dry	10		SW-846 8270D	4/27/17	5/3/17 12:02	BGL
Benzo(b)fluoranthene	8.0	2.3	mg/Kg dry	10		SW-846 8270D	4/27/17	5/3/17 12:02	BGL
Benzo(g,h,i)perylene	4.7	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Benzo(k)fluoranthene	3.4	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Chrysene	7.9	2.3	mg/Kg dry	10		SW-846 8270D	4/27/17	5/3/17 12:02	BGL
Dibenz(a,h)anthracene	1.4	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Fluoranthene	17	2.3	mg/Kg dry	10		SW-846 8270D	4/27/17	5/3/17 12:02	BGL
Fluorene	1.5	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Indeno(1,2,3-cd)pyrene	4.8	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
2-Methylnaphthalene	0.34	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Naphthalene	0.46	0.23	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 20:44	BGL
Phenanthrene	16	2.3	mg/Kg dry	10		SW-846 8270D	4/27/17	5/3/17 12:02	BGL
Pyrene	19	2.3	mg/Kg dry	10		SW-846 8270D	4/27/17	5/3/17 12:02	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	62.3	30-130		5/2/17 20:44
Nitrobenzene-d5	59.5	30-130		5/3/17 12:02
2-Fluorobiphenyl	57.5	30-130		5/2/17 20:44
2-Fluorobiphenyl	52.7	30-130		5/3/17 12:02
p-Terphenyl-d14	48.4	30-130		5/2/17 20:44
p-Terphenyl-d14	52.4	30-130		5/3/17 12:02

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-1 (2-5) Sampled: 4/26/2017 10:30

Sample ID: 17D1259-02

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	6.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:39	SHN
Silver	ND	0.68	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:39	SHN

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-1 (2-5) Sampled: 4/26/2017 10:30

Sample ID: 17D1259-02

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.1	mg/Kg dry	5	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	68		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.7°C	7.3		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	72.9		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-2 (0-1) Sampled: 4/26/2017 11:00

Sample ID: 17D1259-03

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Acenaphthylene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Anthracene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Benzo(a)anthracene	0.27	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Benzo(a)pyrene	0.29	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Benzo(b)fluoranthene	0.39	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Benzo(g,h,i)perylene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Benzo(k)fluoranthene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Chrysene	0.30	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Dibenz(a,h)anthracene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Fluoranthene	0.55	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Fluorene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Indeno(1,2,3-cd)pyrene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
2-Methylnaphthalene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Naphthalene	ND	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Phenanthrene	0.30	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL
Pyrene	0.58	0.25	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:12	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	68.9	30-130		5/2/17 21:12
2-Fluorobiphenyl	66.5	30-130		5/2/17 21:12
p-Terphenyl-d14	75.5	30-130		5/2/17 21:12

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-2 (0-1) Sampled: 4/26/2017 11:00

Sample ID: 17D1259-03

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	7.1	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:44	SHN
Silver	ND	0.71	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:44	SHN

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-2 (0-1) Sampled: 4/26/2017 11:00

Sample ID: 17D1259-03

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.2	mg/Kg dry	5	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	83		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.6°C	7.5		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	66.8		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-2 (2-5) Sampled: 4/26/2017 11:05

Sample ID: 17D1259-04

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Acenaphthylene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Anthracene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Benzo(a)anthracene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Benzo(a)pyrene	0.37	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Benzo(b)fluoranthene	0.39	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Benzo(g,h,i)perylene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Benzo(k)fluoranthene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Chrysene	0.32	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Dibenz(a,h)anthracene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Fluoranthene	0.52	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Fluorene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Indeno(1,2,3-cd)pyrene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
2-Methylnaphthalene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Naphthalene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Phenanthrene	ND	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL
Pyrene	0.65	0.31	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 21:39	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	67.3	30-130		5/2/17 21:39
2-Fluorobiphenyl	65.8	30-130		5/2/17 21:39
p-Terphenyl-d14	81.4	30-130		5/2/17 21:39

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-2 (2-5) Sampled: 4/26/2017 11:05

Sample ID: 17D1259-04

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	8.9	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:49	SHN
Silver	ND	0.89	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:49	SHN

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-2 (2-5) Sampled: 4/26/2017 11:05

Sample ID: 17D1259-04

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.5	mg/Kg dry	5	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	99		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.3°C	7.0		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	54.4		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-3 (0-1) Sampled: 4/26/2017 11:50

Sample ID: 17D1259-05

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Acenaphthylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Benzo(a)anthracene	0.22	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Benzo(a)pyrene	0.22	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Benzo(b)fluoranthene	0.28	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Benzo(g,h,i)perylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Benzo(k)fluoranthene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Chrysene	0.25	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Dibenz(a,h)anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Fluoranthene	0.56	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Fluorene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Indeno(1,2,3-cd)pyrene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
2-Methylnaphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Naphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Phenanthrene	0.54	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL
Pyrene	0.59	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:07	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	68.1	30-130		5/2/17 22:07
2-Fluorobiphenyl	69.9	30-130		5/2/17 22:07
p-Terphenyl-d14	89.9	30-130		5/2/17 22:07

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-3 (0-1) Sampled: 4/26/2017 11:50

Sample ID: 17D1259-05

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	3.9	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:54	SHN
Silver	ND	0.39	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:54	SHN

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-3 (0-1) Sampled: 4/26/2017 11:50

Sample ID: 17D1259-05

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.93	mg/Kg dry	5	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	130		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.5°C	6.3		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	84.5		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-3 (2-5) Sampled: 4/26/2017 12:00

Sample ID: 17D1259-06

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	0.53	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Acenaphthylene	0.73	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Anthracene	2.3	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Benzo(a)anthracene	5.5	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Benzo(a)pyrene	4.5	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Benzo(b)fluoranthene	5.3	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Benzo(g,h,i)perylene	2.7	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Benzo(k)fluoranthene	1.8	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Chrysene	5.2	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Dibenz(a,h)anthracene	0.40	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Fluoranthene	11	1.4	mg/Kg dry	5		SW-846 8270D	4/27/17	5/3/17 12:29	BGL
Fluorene	0.91	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Indeno(1,2,3-cd)pyrene	3.2	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
2-Methylnaphthalene	ND	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Naphthalene	0.44	0.29	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 22:37	BGL
Phenanthrene	9.1	1.4	mg/Kg dry	5		SW-846 8270D	4/27/17	5/3/17 12:29	BGL
Pyrene	9.9	1.4	mg/Kg dry	5		SW-846 8270D	4/27/17	5/3/17 12:29	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	65.0	30-130		5/2/17 22:37
Nitrobenzene-d5	61.4	30-130		5/3/17 12:29
2-Fluorobiphenyl	63.0	30-130		5/2/17 22:37
2-Fluorobiphenyl	57.2	30-130		5/3/17 12:29
p-Terphenyl-d14	70.3	30-130		5/2/17 22:37
p-Terphenyl-d14	55.3	30-130		5/3/17 12:29

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-3 (2-5) Sampled: 4/26/2017 12:00

Sample ID: 17D1259-06

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	7.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:59	SHN
Silver	ND	0.78	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 1:59	SHN

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-3 (2-5) Sampled: 4/26/2017 12:00

Sample ID: 17D1259-06

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	2.7	mg/Kg dry	10	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	120		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.3°C	7.0		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	58.9		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-4 (0-1) Sampled: 4/26/2017 12:15

Sample ID: 17D1259-07

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Acenaphthylene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Benzo(a)anthracene	0.58	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Benzo(a)pyrene	0.56	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Benzo(b)fluoranthene	0.68	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Benzo(g,h,i)perylene	0.37	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Benzo(k)fluoranthene	0.27	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Chrysene	0.58	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Dibenz(a,h)anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Fluoranthene	1.2	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Fluorene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Indeno(1,2,3-cd)pyrene	0.41	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
2-Methylnaphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Naphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Phenanthrene	0.83	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL
Pyrene	1.3	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:05	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	55.3	30-130		5/2/17 23:05
2-Fluorobiphenyl	54.4	30-130		5/2/17 23:05
p-Terphenyl-d14	66.8	30-130		5/2/17 23:05

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-4 (0-1) Sampled: 4/26/2017 12:15

Sample ID: 17D1259-07

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	5.7	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:20	SHN
Silver	ND	0.57	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:20	SHN

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-4 (0-1) Sampled: 4/26/2017 12:15

Sample ID: 17D1259-07

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.93	mg/Kg dry	5	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	120		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.8°C	7.3		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	82.9		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 13 Wallis St. | Sample Description: | Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-4 (2-5) | Sampled: 4/26/2017 12:20

Sample ID: 17D1259-08

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Acenaphthylene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Benzo(a)anthracene	0.81	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Benzo(a)pyrene	0.86	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Benzo(b)fluoranthene	1.0	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Benzo(g,h,i)perylene	0.59	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Benzo(k)fluoranthene	0.40	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Chrysene	0.82	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Dibenz(a,h)anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Fluoranthene	1.5	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Fluorene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Indeno(1,2,3-cd)pyrene	0.69	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
2-Methylnaphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Naphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Phenanthrene	0.99	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL
Pyrene	1.8	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/2/17 23:34	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	69.2	30-130		5/2/17 23:34
2-Fluorobiphenyl	70.0	30-130		5/2/17 23:34
p-Terphenyl-d14	88.8	30-130		5/2/17 23:34

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-4 (2-5) Sampled: 4/26/2017 12:20

Sample ID: 17D1259-08

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	6.1	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:25	SHN
Silver	5.7	0.61	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:25	SHN

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: SP-4 (2-5) Sampled: 4/26/2017 12:20

Sample ID: 17D1259-08

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.97	mg/Kg dry	5	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	160		mV	1		SM2580 A	4/26/17	4/26/17 21:00	IS
pH @20.6°C	7.1		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
% Solids	81.6		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acetone	ND	0.11	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
tert-Amyl Methyl Ether (TAME)	ND	0.0011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Benzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Bromobenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Bromochloromethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Bromodichloromethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Bromoform	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Bromomethane	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
2-Butanone (MEK)	ND	0.045	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
n-Butylbenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
sec-Butylbenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
tert-Butylbenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
tert-Butyl Ethyl Ether (TBEE)	ND	0.0011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Carbon Disulfide	ND	0.0068	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Carbon Tetrachloride	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Chlorobenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Chlorodibromomethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Chloroethane	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Chloroform	ND	0.0045	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Chloromethane	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
2-Chlorotoluene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
4-Chlorotoluene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0045	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2-Dibromoethane (EDB)	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Dibromomethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2-Dichlorobenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,3-Dichlorobenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,4-Dichlorobenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Dichlorodifluoromethane (Freon 12)	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,1-Dichloroethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2-Dichloroethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,1-Dichloroethylene	ND	0.0045	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
cis-1,2-Dichloroethylene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
trans-1,2-Dichloroethylene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2-Dichloropropane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,3-Dichloropropane	ND	0.0011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
2,2-Dichloropropane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,1-Dichloropropene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
cis-1,3-Dichloropropene	ND	0.0011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
trans-1,3-Dichloropropene	ND	0.0011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Diethyl Ether	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Diisopropyl Ether (DIPE)	ND	0.0011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,4-Dioxane	ND	0.23	mg/Kg dry	1	V-16	SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Ethylbenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF

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Project Location: 13 Wallis St. | Sample Description: | Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 | Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexachlorobutadiene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
2-Hexanone (MBK)	ND	0.023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Isopropylbenzene (Cumene)	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
p-Isopropyltoluene (p-Cymene)	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Methyl tert-Butyl Ether (MTBE)	ND	0.0045	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Methylene Chloride	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
4-Methyl-2-pentanone (MIBK)	ND	0.023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Naphthalene	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
n-Propylbenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Styrene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,1,1,2-Tetrachloroethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,1,2,2-Tetrachloroethane	ND	0.0011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Tetrachloroethylene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Tetrahydrofuran	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Toluene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2,3-Trichlorobenzene	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2,4-Trichlorobenzene	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,1,1-Trichloroethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,1,2-Trichloroethane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Trichloroethylene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Trichlorofluoromethane (Freon 11)	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2,3-Trichloropropane	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,2,4-Trimethylbenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
1,3,5-Trimethylbenzene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
Vinyl Chloride	ND	0.011	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
m+p Xylene	ND	0.0045	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF
o-Xylene	ND	0.0023	mg/Kg dry	1		SW-846 8260C	4/27/17	4/28/17 8:06	MFF

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
1,2-Dichloroethane-d4	106	70-130		4/28/17 8:06
Toluene-d8	98.2	70-130		4/28/17 8:06
4-Bromofluorobenzene	91.9	70-130		4/28/17 8:06

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Acenaphthylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Acetophenone	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Aniline	ND	0.39	mg/Kg dry	1	L-04, V-05	SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Benzo(a)anthracene	0.33	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Benzo(a)pyrene	0.38	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Benzo(b)fluoranthene	0.51	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Benzo(g,h,i)perylene	0.24	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Benzo(k)fluoranthene	0.21	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Bis(2-chloroethoxy)methane	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Bis(2-chloroethyl)ether	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Bis(2-chloroisopropyl)ether	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Bis(2-Ethylhexyl)phthalate	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
4-Bromophenylphenylether	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Butylbenzylphthalate	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
4-Chloroaniline	ND	0.77	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2-Chloronaphthalene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2-Chlorophenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Chrysene	0.38	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Dibenz(a,h)anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Dibenzofuran	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Di-n-butylphthalate	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
1,2-Dichlorobenzene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
1,3-Dichlorobenzene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
1,4-Dichlorobenzene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
3,3-Dichlorobenzidine	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2,4-Dichlorophenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Diethylphthalate	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2,4-Dimethylphenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Dimethylphthalate	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2,4-Dinitrophenol	ND	0.77	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2,4-Dinitrotoluene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2,6-Dinitrotoluene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Di-n-octylphthalate	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Fluoranthene	0.63	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Fluorene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Hexachlorobenzene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Hexachlorobutadiene	ND	0.39	mg/Kg dry	1	V-20	SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Hexachloroethane	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Indeno(1,2,3-cd)pyrene	0.25	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Isophorone	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2-Methylnaphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. | Sample Description: | Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 | Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
2-Methylphenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
3/4-Methylphenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Naphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Nitrobenzene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2-Nitrophenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
4-Nitrophenol	ND	0.77	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Pentachlorophenol	ND	0.39	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Phenanthrene	0.52	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Phenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
Pyrene	0.64	0.20	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
1,2,4-Trichlorobenzene	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2,4,5-Trichlorophenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL
2,4,6-Trichlorophenol	ND	0.39	mg/Kg dry	1		SW-846 8270D	4/27/17	5/3/17 9:50	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
2-Fluorophenol	58.6	30-130		5/3/17 9:50
Phenol-d6	62.6	30-130		5/3/17 9:50
Nitrobenzene-d5	66.7	30-130		5/3/17 9:50
2-Fluorobiphenyl	66.8	30-130		5/3/17 9:50
2,4,6-Tribromophenol	72.6	30-130		5/3/17 9:50
p-Terphenyl-d14	66.2	30-130		5/3/17 9:50

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Sample Flags: O-32

Polychlorinated Biphenyls By GC/ECD

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1221 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1232 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1242 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1248 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1254 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1260 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1262 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL
Aroclor-1268 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:46	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	102	30-150		5/1/17 10:46
Decachlorobiphenyl [2]	104	30-150		5/1/17 10:46
Tetrachloro-m-xylene [1]	102	30-150		5/1/17 10:46
Tetrachloro-m-xylene [2]	102	30-150		5/1/17 10:46

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Petroleum Hydrocarbons Analyses

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
TPH (C9-C36)	130	9.7	mg/Kg dry	1		SW-846 8100 Modified	4/27/17	4/29/17 9:50	PJG

Surrogates	% Recovery	Recovery Limits	Flag/Qual				
o-Terphenyl	62.6	40-140					4/29/17 9:50

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Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Arsenic	16	2.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:31	SHN
Barium	98	2.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:31	SHN
Cadmium	1.3	0.28	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:31	SHN
Chromium	36	0.55	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:31	SHN
Lead	860	0.83	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:31	SHN
Mercury	0.46	0.028	mg/Kg dry	1		SW-846 7471B	5/1/17	5/1/17 15:34	TJK
Selenium	ND	5.5	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:31	SHN
Silver	3.3	0.55	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/3/17 2:31	SHN

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17D1259

Date Received: 4/26/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17D1259-09

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Ignitability	Absent		present/absent	1		SW-846 1030	4/28/17	4/28/17 15:00	DCF
pH @20.7°C	7.0		pH Units	1		SW-846 9045C	4/26/17	4/26/17 21:00	IS
Reactive Cyanide	ND	4.0	mg/Kg	1		SW-846 9014	5/1/17	5/2/17 10:05	LL
Reactive Sulfide	ND	20	mg/Kg	1		SW-846 9030A	5/1/17	5/2/17 9:35	LL
Specific conductance	42	2.0	µmhos/cm	1		SM21-22 2510B Modified	5/2/17	5/2/17 10:15	EC
% Solids	86.1		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Sample Extraction Data

Prep Method: % Solids-SM 2540G

Lab Number [Field ID]	Batch	Date
17D1259-01 [SP-1 (0-1)]	B175514	04/27/17
17D1259-02 [SP-1 (2-5)]	B175514	04/27/17
17D1259-03 [SP-2 (0-1)]	B175514	04/27/17
17D1259-04 [SP-2 (2-5)]	B175514	04/27/17
17D1259-05 [SP-3 (0-1)]	B175514	04/27/17
17D1259-06 [SP-3 (2-5)]	B175514	04/27/17
17D1259-07 [SP-4 (0-1)]	B175514	04/27/17
17D1259-08 [SP-4 (2-5)]	B175514	04/27/17
17D1259-09 [Comp-1]	B175514	04/27/17

SM21-22 2510B Modified

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1259-09 [Comp-1]	B175829	1.00	05/02/17

SM2580 A

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1259-01 [SP-1 (0-1)]	B175444	20.0	04/26/17
17D1259-02 [SP-1 (2-5)]	B175444	20.0	04/26/17
17D1259-03 [SP-2 (0-1)]	B175444	20.0	04/26/17
17D1259-04 [SP-2 (2-5)]	B175444	20.0	04/26/17
17D1259-05 [SP-3 (0-1)]	B175444	20.0	04/26/17
17D1259-06 [SP-3 (2-5)]	B175444	20.0	04/26/17
17D1259-07 [SP-4 (0-1)]	B175444	20.0	04/26/17
17D1259-08 [SP-4 (2-5)]	B175444	20.0	04/26/17

SW-846 1030

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1259-09 [Comp-1]	B175669	50.0	04/28/17

Prep Method: SW-846 3050B-SW-846 6010C-D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-01 [SP-1 (0-1)]	B175645	1.06	50.0	04/28/17
17D1259-02 [SP-1 (2-5)]	B175645	1.01	50.0	04/28/17
17D1259-03 [SP-2 (0-1)]	B175645	1.05	50.0	04/28/17
17D1259-04 [SP-2 (2-5)]	B175645	1.04	50.0	04/28/17
17D1259-05 [SP-3 (0-1)]	B175645	1.51	50.0	04/28/17
17D1259-06 [SP-3 (2-5)]	B175645	1.09	50.0	04/28/17
17D1259-07 [SP-4 (0-1)]	B175645	1.05	50.0	04/28/17
17D1259-08 [SP-4 (2-5)]	B175645	1.01	50.0	04/28/17
17D1259-09 [Comp-1]	B175645	1.05	50.0	04/28/17

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-01 [SP-1 (0-1)]	B175749	2.59	100	05/01/17

con-test® ANALYTICAL LABORATORY
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Sample Extraction Data

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-02 [SP-1 (2-5)]	B175749	2.50	100	05/01/17
17D1259-03 [SP-2 (0-1)]	B175749	2.60	100	05/01/17
17D1259-04 [SP-2 (2-5)]	B175749	2.51	100	05/01/17
17D1259-05 [SP-3 (0-1)]	B175749	2.55	100	05/01/17
17D1259-06 [SP-3 (2-5)]	B175749	2.56	100	05/01/17
17D1259-07 [SP-4 (0-1)]	B175749	2.58	100	05/01/17
17D1259-08 [SP-4 (2-5)]	B175749	2.52	100	05/01/17

Prep Method: SW-846 7471-SW-846 7471B

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-09 [Comp-1]	B175731	0.620	50.0	05/01/17

Prep Method: SW-846 3546-SW-846 8082A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-09 [Comp-1]	B175466	10.0	10.0	04/27/17

Prep Method: SW-846 3546-SW-846 8100 Modified

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-09 [Comp-1]	B175469	30.0	1.00	04/27/17

Prep Method: SW-846 5035-SW-846 8260C

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-09 [Comp-1]	B175532	5.15	10.0	04/27/17

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-01 [SP-1 (0-1)]	B175467	30.0	1.00	04/27/17
17D1259-02 [SP-1 (2-5)]	B175467	30.0	1.00	04/27/17
17D1259-02RE1 [SP-1 (2-5)]	B175467	30.0	1.00	04/27/17
17D1259-03 [SP-2 (0-1)]	B175467	30.0	1.00	04/27/17
17D1259-04 [SP-2 (2-5)]	B175467	30.0	1.00	04/27/17
17D1259-05 [SP-3 (0-1)]	B175467	30.0	1.00	04/27/17
17D1259-06 [SP-3 (2-5)]	B175467	30.0	1.00	04/27/17
17D1259-06RE1 [SP-3 (2-5)]	B175467	30.0	1.00	04/27/17
17D1259-07 [SP-4 (0-1)]	B175467	30.0	1.00	04/27/17
17D1259-08 [SP-4 (2-5)]	B175467	30.0	1.00	04/27/17
17D1259-09 [Comp-1]	B175467	30.0	1.00	04/27/17

SW-846 9014

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-09 [Comp-1]	B175788	25.2	250	05/01/17

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Sample Extraction Data

SW-846 9030A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1259-09 [Comp-1]	B175808	25.2	250	05/01/17

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1259-01 [SP-1 (0-1)]	B175443	20.0	04/26/17
17D1259-02 [SP-1 (2-5)]	B175443	20.0	04/26/17
17D1259-03 [SP-2 (0-1)]	B175443	20.0	04/26/17
17D1259-04 [SP-2 (2-5)]	B175443	20.0	04/26/17
17D1259-05 [SP-3 (0-1)]	B175443	20.0	04/26/17
17D1259-06 [SP-3 (2-5)]	B175443	20.0	04/26/17
17D1259-07 [SP-4 (0-1)]	B175443	20.0	04/26/17
17D1259-08 [SP-4 (2-5)]	B175443	20.0	04/26/17
17D1259-09 [Comp-1]	B175443	20.0	04/26/17

con-test® ANALYTICAL LABORATORY
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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175532 - SW-846 5035										
Blank (B175532-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Acetone	ND	0.10	mg/Kg wet							
tert-Amyl Methyl Ether (TAME)	ND	0.0010	mg/Kg wet							
Benzene	ND	0.0020	mg/Kg wet							
Bromobenzene	ND	0.0020	mg/Kg wet							
Bromochloromethane	ND	0.0020	mg/Kg wet							
Bromodichloromethane	ND	0.0020	mg/Kg wet							
Bromoform	ND	0.0020	mg/Kg wet							
Bromomethane	ND	0.010	mg/Kg wet							
2-Butanone (MEK)	ND	0.040	mg/Kg wet							
n-Butylbenzene	ND	0.0020	mg/Kg wet							
sec-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butyl Ethyl Ether (TBEE)	ND	0.0010	mg/Kg wet							
Carbon Disulfide	ND	0.0060	mg/Kg wet							
Carbon Tetrachloride	ND	0.0020	mg/Kg wet							
Chlorobenzene	ND	0.0020	mg/Kg wet							
Chlorodibromomethane	ND	0.0010	mg/Kg wet							
Chloroethane	ND	0.010	mg/Kg wet							
Chloroform	ND	0.0040	mg/Kg wet							
Chloromethane	ND	0.010	mg/Kg wet							
2-Chlorotoluene	ND	0.0020	mg/Kg wet							
4-Chlorotoluene	ND	0.0020	mg/Kg wet							
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0020	mg/Kg wet							
1,2-Dibromoethane (EDB)	ND	0.0010	mg/Kg wet							
Dibromomethane	ND	0.0020	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.0020	mg/Kg wet							
Dichlorodifluoromethane (Freon 12)	ND	0.010	mg/Kg wet							
1,1-Dichloroethane	ND	0.0020	mg/Kg wet							
1,2-Dichloroethane	ND	0.0020	mg/Kg wet							
1,1-Dichloroethylene	ND	0.0040	mg/Kg wet							
cis-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
trans-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
1,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,3-Dichloropropane	ND	0.0010	mg/Kg wet							
2,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,1-Dichloropropene	ND	0.0020	mg/Kg wet							
cis-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
trans-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
Diethyl Ether	ND	0.010	mg/Kg wet							
Diisopropyl Ether (DIPE)	ND	0.0010	mg/Kg wet							
1,4-Dioxane	ND	0.10	mg/Kg wet							V-16
Ethylbenzene	ND	0.0020	mg/Kg wet							
Hexachlorobutadiene	ND	0.0020	mg/Kg wet							
2-Hexanone (MBK)	ND	0.020	mg/Kg wet							
Isopropylbenzene (Cumene)	ND	0.0020	mg/Kg wet							
p-Isopropyltoluene (p-Cymene)	ND	0.0020	mg/Kg wet							
Methyl tert-Butyl Ether (MTBE)	ND	0.0040	mg/Kg wet							
Methylene Chloride	ND	0.010	mg/Kg wet							
4-Methyl-2-pentanone (MIBK)	ND	0.020	mg/Kg wet							
Naphthalene	ND	0.0040	mg/Kg wet							

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175532 - SW-846 5035											
Blank (B175532-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17							
n-Propylbenzene	ND	0.0020	mg/Kg wet								
Styrene	ND	0.0020	mg/Kg wet								
1,1,1,2-Tetrachloroethane	ND	0.0020	mg/Kg wet								
1,1,2,2-Tetrachloroethane	ND	0.0010	mg/Kg wet								
Tetrachloroethylene	ND	0.0020	mg/Kg wet								
Tetrahydrofuran	ND	0.010	mg/Kg wet								
Toluene	ND	0.0020	mg/Kg wet								
1,2,3-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,2,4-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,1,1-Trichloroethane	ND	0.0020	mg/Kg wet								
1,1,2-Trichloroethane	ND	0.0020	mg/Kg wet								
Trichloroethylene	ND	0.0020	mg/Kg wet								
Trichlorofluoromethane (Freon 11)	ND	0.010	mg/Kg wet								
1,2,3-Trichloropropane	ND	0.0020	mg/Kg wet								
1,2,4-Trimethylbenzene	ND	0.0020	mg/Kg wet								
1,3,5-Trimethylbenzene	ND	0.0020	mg/Kg wet								
Vinyl Chloride	ND	0.010	mg/Kg wet								
m+p Xylene	ND	0.0040	mg/Kg wet								
o-Xylene	ND	0.0020	mg/Kg wet								
Surrogate: 1,2-Dichloroethane-d4	*0.0529*		mg/Kg wet	0.0500		106	70-130				
Surrogate: Toluene-d8	*0.0487*		mg/Kg wet	0.0500		97.4	70-130				
Surrogate: 4-Bromofluorobenzene	*0.0466*		mg/Kg wet	0.0500		93.2	70-130				
LCS (B175532-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Acetone	0.146	0.10	mg/Kg wet	0.200		73.0	40-160				†
tert-Amyl Methyl Ether (TAME)	0.0172	0.0010	mg/Kg wet	0.0200		86.2	70-130				
Benzene	0.0195	0.0020	mg/Kg wet	0.0200		97.4	70-130				
Bromobenzene	0.0207	0.0020	mg/Kg wet	0.0200		104	70-130				
Bromochloromethane	0.0233	0.0020	mg/Kg wet	0.0200		117	70-130				
Bromodichloromethane	0.0223	0.0020	mg/Kg wet	0.0200		111	70-130				
Bromoform	0.0235	0.0020	mg/Kg wet	0.0200		117	70-130				
Bromomethane	0.0127	0.010	mg/Kg wet	0.0200		63.6	40-160			L-14	†
2-Butanone (MEK)	0.158	0.040	mg/Kg wet	0.200		79.0	40-160				†
n-Butylbenzene	0.0222	0.0020	mg/Kg wet	0.0200		111	70-130				
sec-Butylbenzene	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130				
tert-Butylbenzene	0.0203	0.0020	mg/Kg wet	0.0200		102	70-130				
tert-Butyl Ethyl Ether (TBEE)	0.0172	0.0010	mg/Kg wet	0.0200		86.2	70-130				
Carbon Disulfide	0.0239	0.0060	mg/Kg wet	0.0200		119	70-130				
Carbon Tetrachloride	0.0229	0.0020	mg/Kg wet	0.0200		115	70-130				
Chlorobenzene	0.0203	0.0020	mg/Kg wet	0.0200		101	70-130				
Chlorodibromomethane	0.0220	0.0010	mg/Kg wet	0.0200		110	70-130				
Chloroethane	0.0168	0.010	mg/Kg wet	0.0200		83.9	70-130				
Chloroform	0.0212	0.0040	mg/Kg wet	0.0200		106	70-130				
Chloromethane	0.0149	0.010	mg/Kg wet	0.0200		74.6	40-160				†
2-Chlorotoluene	0.0213	0.0020	mg/Kg wet	0.0200		107	70-130				
4-Chlorotoluene	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dibromo-3-chloropropane (DBCP)	0.0188	0.0020	mg/Kg wet	0.0200		93.9	70-130				
1,2-Dibromoethane (EDB)	0.0206	0.0010	mg/Kg wet	0.0200		103	70-130				
Dibromomethane	0.0208	0.0020	mg/Kg wet	0.0200		104	70-130				
1,2-Dichlorobenzene	0.0222	0.0020	mg/Kg wet	0.0200		111	70-130				
1,3-Dichlorobenzene	0.0227	0.0020	mg/Kg wet	0.0200		113	70-130				
1,4-Dichlorobenzene	0.0206	0.0020	mg/Kg wet	0.0200		103	70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175532 - SW-846 5035											
LCS (B175532-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Dichlorodifluoromethane (Freon 12)	0.0149	0.010	mg/Kg wet	0.0200		74.3	40-160			V-20	†
1,1-Dichloroethane	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dichloroethane	0.0238	0.0020	mg/Kg wet	0.0200		119	70-130			V-20	
1,1-Dichloroethylene	0.0220	0.0040	mg/Kg wet	0.0200		110	70-130				
cis-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130				
trans-1,2-Dichloroethylene	0.0205	0.0020	mg/Kg wet	0.0200		103	70-130				
1,2-Dichloropropane	0.0205	0.0020	mg/Kg wet	0.0200		102	70-130				
1,3-Dichloropropane	0.0190	0.0010	mg/Kg wet	0.0200		95.2	70-130				
2,2-Dichloropropane	0.0205	0.0020	mg/Kg wet	0.0200		102	70-130				
1,1-Dichloropropene	0.0205	0.0020	mg/Kg wet	0.0200		102	70-130				
cis-1,3-Dichloropropene	0.0191	0.0010	mg/Kg wet	0.0200		95.5	70-130				
trans-1,3-Dichloropropene	0.0189	0.0010	mg/Kg wet	0.0200		94.5	70-130				
Diethyl Ether	0.0181	0.010	mg/Kg wet	0.0200		90.7	70-130				
Diisopropyl Ether (DIPE)	0.0192	0.0010	mg/Kg wet	0.0200		96.0	70-130				
1,4-Dioxane	0.181	0.10	mg/Kg wet	0.200		90.6	40-160			V-16, V-20	†
Ethylbenzene	0.0215	0.0020	mg/Kg wet	0.0200		107	70-130				
Hexachlorobutadiene	0.0251	0.0020	mg/Kg wet	0.0200		126	70-130				
2-Hexanone (MBK)	0.167	0.020	mg/Kg wet	0.200		83.3	40-160				†
Isopropylbenzene (Cumene)	0.0228	0.0020	mg/Kg wet	0.0200		114	70-130				
p-Isopropyltoluene (p-Cymene)	0.0215	0.0020	mg/Kg wet	0.0200		108	70-130				
Methyl tert-Butyl Ether (MTBE)	0.0164	0.0040	mg/Kg wet	0.0200		81.8	70-130				
Methylene Chloride	0.0212	0.010	mg/Kg wet	0.0200		106	70-130				
4-Methyl-2-pentanone (MIBK)	0.187	0.020	mg/Kg wet	0.200		93.5	40-160				†
Naphthalene	0.0167	0.0040	mg/Kg wet	0.0200		83.3	70-130				
n-Propylbenzene	0.0217	0.0020	mg/Kg wet	0.0200		109	70-130				
Styrene	0.0206	0.0020	mg/Kg wet	0.0200		103	70-130				
1,1,1,2-Tetrachloroethane	0.0213	0.0020	mg/Kg wet	0.0200		107	70-130				
1,1,2,2-Tetrachloroethane	0.0222	0.0010	mg/Kg wet	0.0200		111	70-130				
Tetrachloroethylene	0.0245	0.0020	mg/Kg wet	0.0200		123	70-130				
Tetrahydrofuran	0.0184	0.010	mg/Kg wet	0.0200		91.8	70-130				
Toluene	0.0199	0.0020	mg/Kg wet	0.0200		99.6	70-130				
1,2,3-Trichlorobenzene	0.0194	0.0020	mg/Kg wet	0.0200		97.0	70-130				
1,2,4-Trichlorobenzene	0.0189	0.0020	mg/Kg wet	0.0200		94.7	70-130				
1,1,1-Trichloroethane	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130				
1,1,2-Trichloroethane	0.0198	0.0020	mg/Kg wet	0.0200		98.8	70-130				
Trichloroethylene	0.0209	0.0020	mg/Kg wet	0.0200		104	70-130				
Trichlorofluoromethane (Freon 11)	0.0193	0.010	mg/Kg wet	0.0200		96.6	70-130				
1,2,3-Trichloropropane	0.0191	0.0020	mg/Kg wet	0.0200		95.5	70-130				
1,2,4-Trimethylbenzene	0.0202	0.0020	mg/Kg wet	0.0200		101	70-130				
1,3,5-Trimethylbenzene	0.0222	0.0020	mg/Kg wet	0.0200		111	70-130				
Vinyl Chloride	0.0158	0.010	mg/Kg wet	0.0200		78.9	70-130				
m+p Xylene	0.0422	0.0040	mg/Kg wet	0.0400		106	70-130				
o-Xylene	0.0207	0.0020	mg/Kg wet	0.0200		104	70-130				
Surrogate: 1,2-Dichloroethane-d4	*0.0516*		mg/Kg wet	0.0500		103	70-130				
Surrogate: Toluene-d8	*0.0486*		mg/Kg wet	0.0500		97.3	70-130				
Surrogate: 4-Bromofluorobenzene	*0.0501*		mg/Kg wet	0.0500		100	70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175532 - SW-846 5035												
LCS Dup (B175532-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17								
Acetone	0.158	0.10	mg/Kg wet	0.200		79.2		40-160	8.06	20		†
tert-Amyl Methyl Ether (TAME)	0.0176	0.0010	mg/Kg wet	0.0200		88.1		70-130	2.18	20		
Benzene	0.0198	0.0020	mg/Kg wet	0.0200		98.9		70-130	1.53	20		
Bromobenzene	0.0212	0.0020	mg/Kg wet	0.0200		106		70-130	2.20	20		
Bromochloromethane	0.0238	0.0020	mg/Kg wet	0.0200		119		70-130	2.12	20		
Bromodichloromethane	0.0235	0.0020	mg/Kg wet	0.0200		118		70-130	5.50	20		
Bromoform	0.0244	0.0020	mg/Kg wet	0.0200		122		70-130	3.93	20		
Bromomethane	0.0135	0.010	mg/Kg wet	0.0200		67.7		40-160	6.25	20	L-14	†
2-Butanone (MEK)	0.160	0.040	mg/Kg wet	0.200		80.2		40-160	1.57	20		†
n-Butylbenzene	0.0229	0.0020	mg/Kg wet	0.0200		115		70-130	3.19	20		
sec-Butylbenzene	0.0220	0.0020	mg/Kg wet	0.0200		110		70-130	3.98	20		
tert-Butylbenzene	0.0219	0.0020	mg/Kg wet	0.0200		109		70-130	7.40	20		
tert-Butyl Ethyl Ether (TBEE)	0.0177	0.0010	mg/Kg wet	0.0200		88.3		70-130	2.41	20		
Carbon Disulfide	0.0246	0.0060	mg/Kg wet	0.0200		123		70-130	2.97	20		
Carbon Tetrachloride	0.0236	0.0020	mg/Kg wet	0.0200		118		70-130	2.75	20		
Chlorobenzene	0.0213	0.0020	mg/Kg wet	0.0200		106		70-130	4.81	20		
Chlorodibromomethane	0.0235	0.0010	mg/Kg wet	0.0200		117		70-130	6.33	20		
Chloroethane	0.0170	0.010	mg/Kg wet	0.0200		85.0		70-130	1.30	20		
Chloroform	0.0218	0.0040	mg/Kg wet	0.0200		109		70-130	2.51	20		
Chloromethane	0.0155	0.010	mg/Kg wet	0.0200		77.6		40-160	3.94	20		†
2-Chlorotoluene	0.0222	0.0020	mg/Kg wet	0.0200		111		70-130	3.95	20		
4-Chlorotoluene	0.0224	0.0020	mg/Kg wet	0.0200		112		70-130	1.80	20		
1,2-Dibromo-3-chloropropane (DBCP)	0.0190	0.0020	mg/Kg wet	0.0200		94.9		70-130	1.06	20		
1,2-Dibromoethane (EDB)	0.0222	0.0010	mg/Kg wet	0.0200		111		70-130	7.49	20		
Dibromomethane	0.0229	0.0020	mg/Kg wet	0.0200		114		70-130	9.80	20		
1,2-Dichlorobenzene	0.0223	0.0020	mg/Kg wet	0.0200		112		70-130	0.629	20		
1,3-Dichlorobenzene	0.0234	0.0020	mg/Kg wet	0.0200		117		70-130	3.30	20		
1,4-Dichlorobenzene	0.0213	0.0020	mg/Kg wet	0.0200		107		70-130	3.24	20		
Dichlorodifluoromethane (Freon 12)	0.0153	0.010	mg/Kg wet	0.0200		76.7		40-160	3.18	20	V-20	†
1,1-Dichloroethane	0.0228	0.0020	mg/Kg wet	0.0200		114		70-130	3.66	20		
1,2-Dichloroethane	0.0248	0.0020	mg/Kg wet	0.0200		124		70-130	4.11	20	V-20	
1,1-Dichloroethylene	0.0224	0.0040	mg/Kg wet	0.0200		112		70-130	1.71	20		
cis-1,2-Dichloroethylene	0.0216	0.0020	mg/Kg wet	0.0200		108		70-130	2.72	20		
trans-1,2-Dichloroethylene	0.0218	0.0020	mg/Kg wet	0.0200		109		70-130	6.13	20		
1,2-Dichloropropane	0.0210	0.0020	mg/Kg wet	0.0200		105		70-130	2.80	20		
1,3-Dichloropropane	0.0207	0.0010	mg/Kg wet	0.0200		103		70-130	8.16	20		
2,2-Dichloropropane	0.0212	0.0020	mg/Kg wet	0.0200		106		70-130	3.36	20		
1,1-Dichloropropene	0.0214	0.0020	mg/Kg wet	0.0200		107		70-130	4.49	20		
cis-1,3-Dichloropropene	0.0193	0.0010	mg/Kg wet	0.0200		96.5		70-130	1.04	20		
trans-1,3-Dichloropropene	0.0197	0.0010	mg/Kg wet	0.0200		98.7		70-130	4.35	20		
Diethyl Ether	0.0180	0.010	mg/Kg wet	0.0200		90.2		70-130	0.553	20		
Diisopropyl Ether (DIPE)	0.0200	0.0010	mg/Kg wet	0.0200		100		70-130	4.18	20		
1,4-Dioxane	0.219	0.10	mg/Kg wet	0.200		109		40-160	18.8	20	V-16, V-20	†
Ethylbenzene	0.0225	0.0020	mg/Kg wet	0.0200		113		70-130	4.82	20		
Hexachlorobutadiene	0.0267	0.0020	mg/Kg wet	0.0200		**134**	*	70-130	6.33	20	L-07	
2-Hexanone (MBK)	0.180	0.020	mg/Kg wet	0.200		89.8		40-160	7.49	20		†
Isopropylbenzene (Cumene)	0.0238	0.0020	mg/Kg wet	0.0200		119		70-130	4.38	20		
p-Isopropyltoluene (p-Cymene)	0.0223	0.0020	mg/Kg wet	0.0200		112		70-130	3.65	20		
Methyl tert-Butyl Ether (MTBE)	0.0167	0.0040	mg/Kg wet	0.0200		83.3		70-130	1.82	20		
Methylene Chloride	0.0220	0.010	mg/Kg wet	0.0200		110		70-130	3.71	20		
4-Methyl-2-pentanone (MIBK)	0.202	0.020	mg/Kg wet	0.200		101		40-160	7.57	20		†
Naphthalene	0.0174	0.0040	mg/Kg wet	0.0200		87.1		70-130	4.46	20		

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175532 - SW-846 5035										
LCS Dup (B175532-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17						
n-Propylbenzene	0.0226	0.0020	mg/Kg wet	0.0200		113	70-130	3.79	20	
Styrene	0.0215	0.0020	mg/Kg wet	0.0200		107	70-130	4.09	20	
1,1,1,2-Tetrachloroethane	0.0219	0.0020	mg/Kg wet	0.0200		110	70-130	2.87	20	
1,1,2,2-Tetrachloroethane	0.0216	0.0010	mg/Kg wet	0.0200		108	70-130	3.11	20	
Tetrachloroethylene	0.0254	0.0020	mg/Kg wet	0.0200		127	70-130	3.44	20	
Tetrahydrofuran	0.0180	0.010	mg/Kg wet	0.0200		89.8	70-130	2.20	20	
Toluene	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	6.04	20	
1,2,3-Trichlorobenzene	0.0196	0.0020	mg/Kg wet	0.0200		98.0	70-130	1.03	20	
1,2,4-Trichlorobenzene	0.0197	0.0020	mg/Kg wet	0.0200		98.3	70-130	3.73	20	
1,1,1-Trichloroethane	0.0227	0.0020	mg/Kg wet	0.0200		114	70-130	1.42	20	
1,1,2-Trichloroethane	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	7.03	20	
Trichloroethylene	0.0228	0.0020	mg/Kg wet	0.0200		114	70-130	8.70	20	
Trichlorofluoromethane (Freon 11)	0.0209	0.010	mg/Kg wet	0.0200		104	70-130	7.67	20	
1,2,3-Trichloropropane	0.0198	0.0020	mg/Kg wet	0.0200		99.2	70-130	3.80	20	
1,2,4-Trimethylbenzene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	3.78	20	
1,3,5-Trimethylbenzene	0.0230	0.0020	mg/Kg wet	0.0200		115	70-130	3.36	20	
Vinyl Chloride	0.0160	0.010	mg/Kg wet	0.0200		80.1	70-130	1.51	20	
m+p Xylene	0.0433	0.0040	mg/Kg wet	0.0400		108	70-130	2.53	20	
o-Xylene	0.0216	0.0020	mg/Kg wet	0.0200		108	70-130	3.97	20	
Surrogate: 1,2-Dichloroethane-d4	*0.0517*		mg/Kg wet	0.0500		103	70-130			
Surrogate: Toluene-d8	*0.0492*		mg/Kg wet	0.0500		98.3	70-130			
Surrogate: 4-Bromofluorobenzene	*0.0495*		mg/Kg wet	0.0500		99.0	70-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175467 - SW-846 3546										
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Acetophenone	ND	0.34	mg/Kg wet							
Aniline	ND	0.34	mg/Kg wet							L-04
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Bis(2-chloroethoxy)methane	ND	0.34	mg/Kg wet							
Bis(2-chloroethyl)ether	ND	0.34	mg/Kg wet							
Bis(2-chloroisopropyl)ether	ND	0.34	mg/Kg wet							
Bis(2-Ethylhexyl)phthalate	ND	0.34	mg/Kg wet							
4-Bromophenylphenylether	ND	0.34	mg/Kg wet							
Butylbenzylphthalate	ND	0.34	mg/Kg wet							
4-Chloroaniline	ND	0.66	mg/Kg wet							
2-Chloronaphthalene	ND	0.34	mg/Kg wet							
2-Chlorophenol	ND	0.34	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							
Dibenzofuran	ND	0.34	mg/Kg wet							
Di-n-butylphthalate	ND	0.34	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.34	mg/Kg wet							
3,3-Dichlorobenzidine	ND	0.17	mg/Kg wet							
2,4-Dichlorophenol	ND	0.34	mg/Kg wet							
Diethylphthalate	ND	0.34	mg/Kg wet							
2,4-Dimethylphenol	ND	0.34	mg/Kg wet							
Dimethylphthalate	ND	0.34	mg/Kg wet							
2,4-Dinitrophenol	ND	0.66	mg/Kg wet							V-05
2,4-Dinitrotoluene	ND	0.34	mg/Kg wet							
2,6-Dinitrotoluene	ND	0.34	mg/Kg wet							
Di-n-octylphthalate	ND	0.34	mg/Kg wet							
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.34	mg/Kg wet							
Fluoranthene	ND	0.17	mg/Kg wet							
Fluorene	ND	0.17	mg/Kg wet							
Hexachlorobenzene	ND	0.34	mg/Kg wet							
Hexachlorobutadiene	ND	0.34	mg/Kg wet							V-20
Hexachloroethane	ND	0.34	mg/Kg wet							
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet							
Isophorone	ND	0.34	mg/Kg wet							
2-Methylnaphthalene	ND	0.17	mg/Kg wet							
2-Methylphenol	ND	0.34	mg/Kg wet							
3/4-Methylphenol	ND	0.34	mg/Kg wet							
Naphthalene	ND	0.17	mg/Kg wet							
Nitrobenzene	ND	0.34	mg/Kg wet							
2-Nitrophenol	ND	0.34	mg/Kg wet							
4-Nitrophenol	ND	0.66	mg/Kg wet							
Pentachlorophenol	ND	0.34	mg/Kg wet							V-05
Phenanthrene	ND	0.17	mg/Kg wet							

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546												
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17								
Phenol	ND	0.34	mg/Kg wet									
Pyrene	ND	0.17	mg/Kg wet									
1,2,4-Trichlorobenzene	ND	0.34	mg/Kg wet									
2,4,5-Trichlorophenol	ND	0.34	mg/Kg wet									
2,4,6-Trichlorophenol	ND	0.34	mg/Kg wet									
Surrogate: 2-Fluorophenol	*4.00*		mg/Kg wet	6.73		59.4		30-130				
Surrogate: Phenol-d6	*4.09*		mg/Kg wet	6.67		61.3		30-130				
Surrogate: Nitrobenzene-d5	*2.14*		mg/Kg wet	3.33		64.1		30-130				
Surrogate: 2-Fluorobiphenyl	*2.24*		mg/Kg wet	3.33		67.1		30-130				
Surrogate: 2,4,6-Tribromophenol	*5.53*		mg/Kg wet	6.67		83.0		30-130				
Surrogate: p-Terphenyl-d14	*2.66*		mg/Kg wet	3.33		79.7		30-130				
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17								
Acenaphthene	0.968	0.17	mg/Kg wet	1.67		58.1		40-140				
Acenaphthylene	0.945	0.17	mg/Kg wet	1.67		56.7		40-140				
Acetophenone	1.04	0.34	mg/Kg wet	1.67		62.7		40-140				
Aniline	0.629	0.34	mg/Kg wet	1.67		**37.8**	*	40-140			L-04	
Anthracene	1.02	0.17	mg/Kg wet	1.67		61.1		40-140				
Benzo(a)anthracene	1.08	0.17	mg/Kg wet	1.67		64.9		40-140				
Benzo(a)pyrene	1.11	0.17	mg/Kg wet	1.67		66.5		40-140				
Benzo(b)fluoranthene	1.06	0.17	mg/Kg wet	1.67		63.6		40-140				
Benzo(g,h,i)perylene	1.03	0.17	mg/Kg wet	1.67		61.8		40-140				
Benzo(k)fluoranthene	1.04	0.17	mg/Kg wet	1.67		62.5		40-140				
Bis(2-chloroethoxy)methane	0.955	0.34	mg/Kg wet	1.67		57.3		40-140				
Bis(2-chloroethyl)ether	0.921	0.34	mg/Kg wet	1.67		55.3		40-140				
Bis(2-chloroisopropyl)ether	1.02	0.34	mg/Kg wet	1.67		61.5		40-140				
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		61.8		40-140				
4-Bromophenylphenylether	1.19	0.34	mg/Kg wet	1.67		71.3		40-140				
Butylbenzylphthalate	1.08	0.34	mg/Kg wet	1.67		64.7		40-140				
4-Chloroaniline	0.680	0.66	mg/Kg wet	1.67		40.8		15-140				†
2-Chloronaphthalene	0.954	0.34	mg/Kg wet	1.67		57.3		40-140				
2-Chlorophenol	0.985	0.34	mg/Kg wet	1.67		59.1		30-130				
Chrysene	0.967	0.17	mg/Kg wet	1.67		58.0		40-140				
Dibenz(a,h)anthracene	1.08	0.17	mg/Kg wet	1.67		65.1		40-140				
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		67.1		40-140				
Di-n-butylphthalate	0.987	0.34	mg/Kg wet	1.67		59.2		40-140				
1,2-Dichlorobenzene	0.944	0.34	mg/Kg wet	1.67		56.6		40-140				
1,3-Dichlorobenzene	0.918	0.34	mg/Kg wet	1.67		55.1		40-140				
1,4-Dichlorobenzene	0.937	0.34	mg/Kg wet	1.67		56.2		40-140				
3,3-Dichlorobenzidine	0.844	0.17	mg/Kg wet	1.67		50.6		40-140				
2,4-Dichlorophenol	1.15	0.34	mg/Kg wet	1.67		68.7		30-130				
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		65.9		40-140				
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.4		30-130				
Dimethylphthalate	1.13	0.34	mg/Kg wet	1.67		67.8		40-140				
2,4-Dinitrophenol	0.612	0.66	mg/Kg wet	1.67		36.7		15-140			V-05	†
2,4-Dinitrotoluene	1.15	0.34	mg/Kg wet	1.67		68.8		40-140				
2,6-Dinitrotoluene	1.18	0.34	mg/Kg wet	1.67		70.8		40-140				
Di-n-octylphthalate	1.00	0.34	mg/Kg wet	1.67		60.2		40-140				
1,2-Diphenylhydrazine (as Azobenzene)	1.01	0.34	mg/Kg wet	1.67		60.7		40-140				
Fluoranthene	1.03	0.17	mg/Kg wet	1.67		61.6		40-140				
Fluorene	1.04	0.17	mg/Kg wet	1.67		62.5		40-140				
Hexachlorobenzene	1.20	0.34	mg/Kg wet	1.67		71.9		40-140				

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546												
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17								
Hexachlorobutadiene	1.35	0.34	mg/Kg wet	1.67		80.9		40-140			V-20	
Hexachloroethane	0.983	0.34	mg/Kg wet	1.67		59.0		40-140				
Indeno(1,2,3-cd)pyrene	1.09	0.17	mg/Kg wet	1.67		65.5		40-140				
Isophorone	1.03	0.34	mg/Kg wet	1.67		61.7		40-140				
2-Methylnaphthalene	1.14	0.17	mg/Kg wet	1.67		68.1		40-140				
2-Methylphenol	0.974	0.34	mg/Kg wet	1.67		58.4		30-130				
3/4-Methylphenol	1.02	0.34	mg/Kg wet	1.67		61.3		30-130				
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6		40-140				
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		62.8		40-140				
2-Nitrophenol	1.00	0.34	mg/Kg wet	1.67		60.0		30-130				
4-Nitrophenol	1.21	0.66	mg/Kg wet	1.67		72.6		15-140				†
Pentachlorophenol	0.639	0.34	mg/Kg wet	1.67		38.3		30-130			V-05	
Phenanthrene	1.03	0.17	mg/Kg wet	1.67		61.6		40-140				
Phenol	1.02	0.34	mg/Kg wet	1.67		61.2		15-140				†
Pyrene	1.09	0.17	mg/Kg wet	1.67		65.7		40-140				
1,2,4-Trichlorobenzene	1.09	0.34	mg/Kg wet	1.67		65.6		40-140				
2,4,5-Trichlorophenol	1.18	0.34	mg/Kg wet	1.67		71.0		30-130				
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.0		30-130				
Surrogate: 2-Fluorophenol	*4.19*		mg/Kg wet	6.73		62.3		30-130				
Surrogate: Phenol-d6	*4.42*		mg/Kg wet	6.67		66.3		30-130				
Surrogate: Nitrobenzene-d5	*2.29*		mg/Kg wet	3.33		68.6		30-130				
Surrogate: 2-Fluorobiphenyl	*2.43*		mg/Kg wet	3.33		72.9		30-130				
Surrogate: 2,4,6-Tribromophenol	*5.60*		mg/Kg wet	6.67		83.9		30-130				
Surrogate: p-Terphenyl-d14	*2.53*		mg/Kg wet	3.33		76.0		30-130				
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17								
Acenaphthene	0.958	0.17	mg/Kg wet	1.67		57.5		40-140	1.07	30		
Acenaphthylene	0.950	0.17	mg/Kg wet	1.67		57.0		40-140	0.528	30		
Acetophenone	1.05	0.34	mg/Kg wet	1.67		62.9		40-140	0.414	30		
Aniline	0.655	0.34	mg/Kg wet	1.67		**39.3**	*	40-140	3.95	30	L-04	
Anthracene	1.05	0.17	mg/Kg wet	1.67		63.0		40-140	3.03	30		
Benzo(a)anthracene	1.11	0.17	mg/Kg wet	1.67		66.6		40-140	2.46	30		
Benzo(a)pyrene	1.12	0.17	mg/Kg wet	1.67		67.3		40-140	1.29	30		
Benzo(b)fluoranthene	1.08	0.17	mg/Kg wet	1.67		65.0		40-140	2.24	30		
Benzo(g,h,i)perylene	1.05	0.17	mg/Kg wet	1.67		63.2		40-140	2.27	30		
Benzo(k)fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.6		40-140	3.30	30		
Bis(2-chloroethoxy)methane	0.980	0.34	mg/Kg wet	1.67		58.8		40-140	2.65	30		
Bis(2-chloroethyl)ether	0.901	0.34	mg/Kg wet	1.67		54.1		40-140	2.23	30		
Bis(2-chloroisopropyl)ether	1.04	0.34	mg/Kg wet	1.67		62.2		40-140	1.16	30		
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		62.0		40-140	0.355	30		
4-Bromophenylphenylether	1.20	0.34	mg/Kg wet	1.67		72.1		40-140	1.14	30		
Butylbenzylphthalate	1.07	0.34	mg/Kg wet	1.67		64.0		40-140	1.03	30		
4-Chloroaniline	0.689	0.66	mg/Kg wet	1.67		41.3		15-140	1.36	30		†
2-Chloronaphthalene	0.951	0.34	mg/Kg wet	1.67		57.1		40-140	0.315	30		
2-Chlorophenol	0.981	0.34	mg/Kg wet	1.67		58.9		30-130	0.373	30		
Chrysene	0.972	0.17	mg/Kg wet	1.67		58.3		40-140	0.516	30		
Dibenz(a,h)anthracene	1.09	0.17	mg/Kg wet	1.67		65.5		40-140	0.582	30		
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		66.9		40-140	0.269	30		
Di-n-butylphthalate	1.02	0.34	mg/Kg wet	1.67		60.9		40-140	2.86	30		
1,2-Dichlorobenzene	0.972	0.34	mg/Kg wet	1.67		58.3		40-140	2.92	30		
1,3-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	2.26	30		
1,4-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	0.213	30		

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546											
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17							
3,3-Dichlorobenzidine	0.880	0.17	mg/Kg wet	1.67		52.8	40-140	4.21	30		
2,4-Dichlorophenol	1.13	0.34	mg/Kg wet	1.67		67.9	30-130	1.26	30		
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		66.1	40-140	0.303	30		
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.0	30-130	0.654	30		
Dimethylphthalate	1.14	0.34	mg/Kg wet	1.67		68.6	40-140	1.23	30		
2,4-Dinitrophenol	0.602	0.66	mg/Kg wet	1.67		36.1	15-140	1.59	30	V-05	†
2,4-Dinitrotoluene	1.13	0.34	mg/Kg wet	1.67		67.9	40-140	1.43	30		
2,6-Dinitrotoluene	1.19	0.34	mg/Kg wet	1.67		71.3	40-140	0.816	30		
Di-n-octylphthalate	1.04	0.34	mg/Kg wet	1.67		62.6	40-140	3.87	30		
1,2-Diphenylhydrazine (as Azobenzene)	1.02	0.34	mg/Kg wet	1.67		61.4	40-140	1.11	30		
Fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.5	40-140	4.63	30		
Fluorene	1.05	0.17	mg/Kg wet	1.67		62.8	40-140	0.542	30		
Hexachlorobenzene	1.22	0.34	mg/Kg wet	1.67		73.0	40-140	1.49	30		
Hexachlorobutadiene	1.34	0.34	mg/Kg wet	1.67		80.3	40-140	0.695	30	V-20	
Hexachloroethane	1.00	0.34	mg/Kg wet	1.67		60.3	40-140	2.15	30		
Indeno(1,2,3-cd)pyrene	1.10	0.17	mg/Kg wet	1.67		66.2	40-140	1.09	30		
Isophorone	1.03	0.34	mg/Kg wet	1.67		62.0	40-140	0.420	30		
2-Methylnaphthalene	1.11	0.17	mg/Kg wet	1.67		66.5	40-140	2.38	30		
2-Methylphenol	0.950	0.34	mg/Kg wet	1.67		57.0	30-130	2.46	30		
3/4-Methylphenol	1.03	0.34	mg/Kg wet	1.67		61.5	30-130	0.456	30		
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6	40-140	0.0990	30		
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		63.0	40-140	0.286	30		
2-Nitrophenol	1.02	0.34	mg/Kg wet	1.67		60.9	30-130	1.49	30		
4-Nitrophenol	1.26	0.66	mg/Kg wet	1.67		75.5	15-140	3.94	30		†
Pentachlorophenol	0.614	0.34	mg/Kg wet	1.67		36.8	30-130	4.04	30	V-05	
Phenanthrene	1.04	0.17	mg/Kg wet	1.67		62.5	40-140	1.51	30		
Phenol	0.991	0.34	mg/Kg wet	1.67		59.5	15-140	2.82	30		†
Pyrene	1.14	0.17	mg/Kg wet	1.67		68.5	40-140	4.26	30		
1,2,4-Trichlorobenzene	1.11	0.34	mg/Kg wet	1.67		66.8	40-140	1.84	30		
2,4,5-Trichlorophenol	1.27	0.34	mg/Kg wet	1.67		76.2	30-130	7.12	30		
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.2	30-130	0.242	30		
Surrogate: 2-Fluorophenol	*4.13*		mg/Kg wet	6.73		61.3	30-130				
Surrogate: Phenol-d6	*4.35*		mg/Kg wet	6.67		65.2	30-130				
Surrogate: Nitrobenzene-d5	*2.27*		mg/Kg wet	3.33		68.0	30-130				
Surrogate: 2-Fluorobiphenyl	*2.54*		mg/Kg wet	3.33		76.2	30-130				
Surrogate: 2,4,6-Tribromophenol	*5.48*		mg/Kg wet	6.67		82.2	30-130				
Surrogate: p-Terphenyl-d14	*2.59*		mg/Kg wet	3.33		77.8	30-130				

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QUALITY CONTROL

Polychlorinated Biphenyls By GC/ECD - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175466 - SW-846 3546										
Blank (B175466-BLK1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	ND	0.020	mg/Kg wet							
Aroclor-1016 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1221	ND	0.020	mg/Kg wet							
Aroclor-1221 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1232	ND	0.020	mg/Kg wet							
Aroclor-1232 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1242	ND	0.020	mg/Kg wet							
Aroclor-1242 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1248	ND	0.020	mg/Kg wet							
Aroclor-1248 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1254	ND	0.020	mg/Kg wet							
Aroclor-1254 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1260	ND	0.020	mg/Kg wet							
Aroclor-1260 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1262	ND	0.020	mg/Kg wet							
Aroclor-1262 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1268	ND	0.020	mg/Kg wet							
Aroclor-1268 [2C]	ND	0.020	mg/Kg wet							
Surrogate: Decachlorobiphenyl	*0.196*		mg/Kg wet	0.200		98.1	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.4	30-150			
Surrogate: Tetrachloro-m-xylene	*0.193*		mg/Kg wet	0.200		96.4	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.180*		mg/Kg wet	0.200		90.1	30-150			
LCS (B175466-BS1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		100	40-140			
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		103	40-140			
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		89.8	40-140			
Aroclor-1260 [2C]	0.19	0.020	mg/Kg wet	0.200		96.7	40-140			
Surrogate: Decachlorobiphenyl	*0.197*		mg/Kg wet	0.200		98.3	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.7	30-150			
Surrogate: Tetrachloro-m-xylene	*0.200*		mg/Kg wet	0.200		99.9	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.187*		mg/Kg wet	0.200		93.4	30-150			
LCS Dup (B175466-BSD1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		102	40-140	1.17	30	
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		104	40-140	1.11	30	
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		91.2	40-140	1.57	30	
Aroclor-1260 [2C]	0.20	0.020	mg/Kg wet	0.200		98.5	40-140	1.92	30	
Surrogate: Decachlorobiphenyl	*0.199*		mg/Kg wet	0.200		99.5	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.192*		mg/Kg wet	0.200		96.0	30-150			
Surrogate: Tetrachloro-m-xylene	*0.201*		mg/Kg wet	0.200		100	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.189*		mg/Kg wet	0.200		94.3	30-150			

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QUALITY CONTROL

Petroleum Hydrocarbons Analyses - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175469 - SW-846 3546										
Blank (B175469-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	ND	8.3	mg/Kg wet							
Surrogate: o-Terphenyl	*3.07*		mg/Kg wet	3.33		92.0	40-140			
LCS (B175469-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	28.5	8.3	mg/Kg wet	33.3		85.6	40-140			
Surrogate: o-Terphenyl	*3.04*		mg/Kg wet	3.33		91.3	40-140			
LCS Dup (B175469-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	29.6	8.3	mg/Kg wet	33.3		88.8	40-140	3.66	30	
Surrogate: o-Terphenyl	*3.15*		mg/Kg wet	3.33		94.6	40-140			

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes
Batch B175645 - SW-846 3050B											
Blank (B175645-BLK1)				Prepared: 04/28/17 Analyzed: 05/03/17							
Arsenic	ND	2.5	mg/Kg wet								
Barium	ND	2.5	mg/Kg wet								
Cadmium	ND	0.25	mg/Kg wet								
Chromium	ND	0.50	mg/Kg wet								
Lead	ND	0.75	mg/Kg wet								
Selenium	ND	5.0	mg/Kg wet								
Silver	ND	0.50	mg/Kg wet								
LCS (B175645-BS1)				Prepared: 04/28/17 Analyzed: 05/03/17							
Arsenic	53.1	4.8	mg/Kg wet	57.0		93.1		77.8-122.1			
Barium	102	4.8	mg/Kg wet	110		92.8		82-117.4			
Cadmium	70.0	0.48	mg/Kg wet	77.8		90.0		81.9-118.2			
Chromium	56.2	0.96	mg/Kg wet	65.0		86.4		78.7-120.6			
Lead	74.1	1.4	mg/Kg wet	85.6		86.6		82.4-117.8			
Selenium	68.6	9.6	mg/Kg wet	78.9		86.9		77.1-122.3			
Silver	50.2	0.96	mg/Kg wet	54.2		92.7		74.3-125.4			
LCS Dup (B175645-BSD1)				Prepared: 04/28/17 Analyzed: 05/03/17							
Arsenic	52.9	4.9	mg/Kg wet	57.0		92.8		77.8-122.1	0.428	30	
Barium	100	4.9	mg/Kg wet	110		91.3		82-117.4	1.69	30	
Cadmium	68.3	0.49	mg/Kg wet	77.8		87.8		81.9-118.2	2.46	30	
Chromium	56.3	0.99	mg/Kg wet	65.0		86.6		78.7-120.6	0.182	30	
Lead	73.0	1.5	mg/Kg wet	85.6		85.3		82.4-117.8	1.56	30	
Selenium	67.1	9.9	mg/Kg wet	78.9		85.0		77.1-122.3	2.21	30	
Silver	49.8	0.99	mg/Kg wet	54.2		91.9		74.3-125.4	0.822	30	
Duplicate (B175645-DUP1)	**Source: 17D1259-01**			Prepared: 04/28/17 Analyzed: 05/03/17							
Arsenic	15.4	3.6	mg/Kg dry		12.6				20.3	35	
Barium	228	3.6	mg/Kg dry		209				8.77	35	
Cadmium	1.36	0.36	mg/Kg dry		1.23				10.3	35	
Chromium	133	0.72	mg/Kg dry		128				3.75	35	
Lead	420	1.1	mg/Kg dry		399				5.08	35	
Selenium	ND	7.2	mg/Kg dry		ND				NC	35	
Silver	ND	0.72	mg/Kg dry		ND				NC	35	
MRL Check (B175645-MRL1)				Prepared: 04/28/17 Analyzed: 05/03/17							
Lead	0.610	0.71	mg/Kg wet	0.705		86.5		80-120			
Matrix Spike (B175645-MS1)	**Source: 17D1259-01**			Prepared: 04/28/17 Analyzed: 05/03/17							
Arsenic	42.4	3.5	mg/Kg dry	34.8	12.6	85.8		75-125			
Barium	249	3.5	mg/Kg dry	34.8	209	115		75-125			
Cadmium	31.7	0.35	mg/Kg dry	34.8	1.23	87.7		75-125			
Chromium	128	0.70	mg/Kg dry	34.8	128	**-1.67**	*	75-125			MS-07
Lead	397	1.0	mg/Kg dry	34.8	399	**-6.33**	*	75-125			MS-19
Selenium	30.8	7.0	mg/Kg dry	34.8	3.53	78.4		75-125			
Silver	29.5	0.70	mg/Kg dry	34.8	ND	84.7		75-125			

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175731 - SW-846 7471										
Blank (B175731-BLK1)				Prepared & Analyzed: 05/01/17						
Mercury	ND	0.025	mg/Kg wet							
LCS (B175731-BS1)				Prepared & Analyzed: 05/01/17						
Mercury	9.99	1.9	mg/Kg wet	9.36		107	73.7-126.3			
LCS Dup (B175731-BSD1)				Prepared & Analyzed: 05/01/17						
Mercury	11.2	1.9	mg/Kg wet	9.36		119	73.7-126.3	11.3	30	

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175443 - SW-846 9045C										
LCS (B175443-BS1)				Prepared & Analyzed: 04/26/17						
pH	6.05		pH Units	6.00		101	98.5-110			
LCS (B175443-BS2)				Prepared & Analyzed: 04/26/17						
pH	6.04		pH Units	6.00		101	98.5-110			
Duplicate (B175443-DUP1)	**Source: 17D1259-09**			Prepared & Analyzed: 04/26/17						
pH	7.0		pH Units		7.0			0.427	5	
Batch B175749 - SW-846 7196A										
Blank (B175749-BLK1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Hexavalent Chromium	ND	0.16	mg/Kg wet							
LCS (B175749-BS1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Hexavalent Chromium	53	1.8	mg/Kg wet	64.3		83.1	80-120			
LCS Dup (B175749-BSD1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Hexavalent Chromium	54	1.8	mg/Kg wet	64.2		84.9	80-120	2.01	20	
Batch B175788 - SW-846 9014										
Blank (B175788-BLK1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Reactive Cyanide	ND	0.40	mg/Kg							
LCS (B175788-BS1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Reactive Cyanide	11	0.40	mg/Kg	10.0		106	85.9-110			
Batch B175808 - SW-846 9030A										
Blank (B175808-BLK1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Reactive Sulfide	ND	2.0	mg/Kg							
LCS (B175808-BS1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Reactive Sulfide	14	2.0	mg/Kg	14.8		94.6	64.5-120			
Batch B175829 - SM21-22 2510B Modified										
Blank (B175829-BLK1)				Prepared & Analyzed: 05/02/17						
Specific conductance	ND	2.0	µmhos/cm							

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175829 - SM21-22 2510B Modified										
LCS (B175829-BS2)				Prepared & Analyzed: 05/02/17						
Specific conductance	230	2.0	µmhos/cm	234		97.0	89.2-110			

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS

Lab Sample ID: B175466-BS1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.19	5.4

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS Dup

Lab Sample ID: B175466-BSD1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.20	10.5

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
ND	Not Detected
RL	Reporting Limit
DL	Method Detection Limit
MCL	Maximum Contaminant Level
	Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.
	No results have been blank subtracted unless specified in the case narrative section.
L-04	Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.
L-07	Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.
L-14	Compound classified by MA CAM as difficult with acceptable recoveries of 40-160%. Recovery does not meet 70-130% criteria but does meet difficult compound criteria.
MS-07	Matrix spike recovery is outside of control limits. Analysis is in control based on laboratory fortified blank recovery. Possiblity of sample matrix effects that lead to low bias for reported result or non-homogeneous sample aliquot cannot be eliminated.
MS-19	Sample to spike ratio is greater than or equal to 4:1. Spiked amount is not representative of the native amount in the sample. Appropriate or meaningful recoveries cannot be calculated.
O-32	A dilution was performed as part of the standard analytical procedure.
V-05	Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.
V-16	Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.
V-20	Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.
W-06	Elevated method reporting limit due to intense color of sample

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 1030 in Soil	
Ignitability	NY,NH,CT,NC,ME,VA
SW-846 6010C-D in Soil	
Arsenic	CT,NH,NY,ME,VA,NC
Barium	CT,NH,NY,ME,VA,NC
Cadmium	CT,NH,NY,ME,VA,NC
Chromium	CT,NH,NY,ME,VA,NC
Lead	CT,NH,NY,AIHA,ME,VA,NC
Selenium	CT,NH,NY,ME,VA,NC
Silver	CT,NH,NY,ME,VA,NC
SW-846 7196A in Soil	
Hexavalent Chromium	NY,CT,NH,NC,ME,VA
SW-846 7471B in Soil	
Mercury	CT,NH,NY,NC,ME,VA
SW-846 8082A in Soil	
Aroclor-1016	CT,NH,NY,NC,ME,VA
Aroclor-1016 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1221	CT,NH,NY,NC,ME,VA
Aroclor-1221 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1232	CT,NH,NY,NC,ME,VA
Aroclor-1232 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1242	CT,NH,NY,NC,ME,VA
Aroclor-1242 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1248	CT,NH,NY,NC,ME,VA
Aroclor-1248 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1254	CT,NH,NY,NC,ME,VA
Aroclor-1254 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1260	CT,NH,NY,NC,ME,VA
Aroclor-1260 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1262	NH,NY,NC,ME,VA
Aroclor-1262 [2C]	NH,NY,NC,ME,VA
Aroclor-1268	NH,NY,NC,ME,VA
Aroclor-1268 [2C]	NH,NY,NC,ME,VA
SW-846 8260C in Soil	
Acetone	CT,NH,NY,ME
Benzene	CT,NH,NY,ME
Bromobenzene	NH,NY,ME
Bromochloromethane	NH,NY,ME
Bromodichloromethane	CT,NH,NY,ME
Bromoform	CT,NH,NY,ME
Bromomethane	CT,NH,NY,ME
2-Butanone (MEK)	CT,NH,NY,ME
n-Butylbenzene	CT,NH,NY,ME
sec-Butylbenzene	CT,NH,NY,ME
tert-Butylbenzene	CT,NH,NY,ME
Carbon Disulfide	CT,NH,NY,ME

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
Carbon Tetrachloride	CT,NH,NY,ME
Chlorobenzene	CT,NH,NY,ME
Chlorodibromomethane	CT,NH,NY,ME
Chloroethane	CT,NH,NY,ME
Chloroform	CT,NH,NY,ME
Chloromethane	CT,NH,NY,ME
2-Chlorotoluene	CT,NH,NY,ME
4-Chlorotoluene	CT,NH,NY,ME
Dibromomethane	NH,NY,ME
1,2-Dichlorobenzene	CT,NH,NY,ME
1,3-Dichlorobenzene	CT,NH,NY,ME
1,4-Dichlorobenzene	CT,NH,NY,ME
Dichlorodifluoromethane (Freon 12)	NY,ME
1,1-Dichloroethane	CT,NH,NY,ME
1,2-Dichloroethane	CT,NH,NY,ME
1,1-Dichloroethylene	CT,NH,NY,ME
cis-1,2-Dichloroethylene	CT,NH,NY,ME
trans-1,2-Dichloroethylene	CT,NH,NY,ME
1,2-Dichloropropane	CT,NH,NY,ME
1,3-Dichloropropane	NH,NY,ME
2,2-Dichloropropane	NH,NY,ME
1,1-Dichloropropene	NH,NY,ME
cis-1,3-Dichloropropene	CT,NH,NY,ME
trans-1,3-Dichloropropene	CT,NH,NY,ME
1,4-Dioxane	NY
Ethylbenzene	CT,NH,NY,ME
Hexachlorobutadiene	NH,NY,ME
2-Hexanone (MBK)	CT,NH,NY,ME
Isopropylbenzene (Cumene)	CT,NH,NY,ME
p-Isopropyltoluene (p-Cymene)	NH,NY
Methyl tert-Butyl Ether (MTBE)	NH,NY
Methylene Chloride	CT,NH,NY,ME
4-Methyl-2-pentanone (MIBK)	CT,NH,NY
Naphthalene	NH,NY,ME
n-Propylbenzene	NH,NY
Styrene	CT,NH,NY,ME
1,1,1,2-Tetrachloroethane	CT,NH,NY,ME
1,1,2,2-Tetrachloroethane	CT,NH,NY,ME
Tetrachloroethylene	CT,NH,NY,ME
Toluene	CT,NH,NY,ME
1,2,3-Trichlorobenzene	NY
1,2,4-Trichlorobenzene	NH,NY,ME
1,1,1-Trichloroethane	CT,NH,NY,ME
1,1,2-Trichloroethane	CT,NH,NY,ME
Trichloroethylene	CT,NH,NY,ME
Trichlorofluoromethane (Freon 11)	CT,NH,NY,ME
1,2,3-Trichloropropane	NH,NY,ME

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
1,2,4-Trimethylbenzene	CT,NH,NY,ME
1,3,5-Trimethylbenzene	CT,NH,NY,ME
Vinyl Chloride	CT,NH,NY,ME
m+p Xylene	CT,NH,NY,ME
o-Xylene	CT,NH,NY,ME
SW-846 8270D in Soil	
Acenaphthene	CT,NY,NH
Acenaphthene	CT,NY,NH,ME,NC,VA
Acenaphthylene	CT,NY,NH,ME,NC,VA
Acenaphthylene	CT,NY,NH
Acetophenone	NY,NH
Aniline	NY,NH
Anthracene	CT,NY,NH,ME,NC,VA
Anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH,ME,NC,VA
Benzo(a)pyrene	CT,NY,NH
Benzo(a)pyrene	CT,NY,NH,ME,NC,VA
Benzo(b)fluoranthene	CT,NY,NH,ME,NC,VA
Benzo(b)fluoranthene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH,ME,NC,VA
Benzo(g,h,i)perylene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH,ME,NC,VA
Bis(2-chloroethoxy)methane	CT,NY,NH
Bis(2-chloroethyl)ether	CT,NY,NH
Bis(2-chloroisopropyl)ether	CT,NY,NH
Bis(2-Ethylhexyl)phthalate	CT,NY,NH
4-Bromophenylphenylether	CT,NY,NH
Butylbenzylphthalate	CT,NY,NH
4-Chloroaniline	CT,NY,NH
2-Chloronaphthalene	CT,NY,NH
2-Chlorophenol	CT,NY,NH
Chrysene	CT,NY,NH
Chrysene	CT,NY,NH,ME,NC,VA
Dibenz(a,h)anthracene	CT,NY,NH
Dibenz(a,h)anthracene	CT,NY,NH,ME,NC,VA
Dibenzofuran	CT,NY,NH
Di-n-butylphthalate	CT,NY,NH
1,2-Dichlorobenzene	NY,NH
1,3-Dichlorobenzene	NY,NH
1,4-Dichlorobenzene	NY,NH
3,3-Dichlorobenzidine	CT,NY,NH
2,4-Dichlorophenol	CT,NY,NH
Diethylphthalate	CT,NY,NH
2,4-Dimethylphenol	CT,NY,NH

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8270D in Soil	
Dimethylphthalate	CT,NY,NH
2,4-Dinitrophenol	CT,NY,NH
2,4-Dinitrotoluene	CT,NY,NH
2,6-Dinitrotoluene	CT,NY,NH
Di-n-octylphthalate	CT,NY,NH
1,2-Diphenylhydrazine (as Azobenzene)	NY,NH
Fluoranthene	CT,NY,NH,ME,NC,VA
Fluoranthene	CT,NY,NH
Fluorene	CT,NY,NH,ME,NC,VA
Fluorene	NY,NH
Hexachlorobenzene	CT,NY,NH
Hexachlorobutadiene	CT,NY,NH
Hexachloroethane	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH,ME,NC,VA
Indeno(1,2,3-cd)pyrene	CT,NY,NH
Isophorone	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH,ME,NC,VA
2-Methylphenol	CT,NY,NH
3/4-Methylphenol	CT,NY,NH
Naphthalene	CT,NY,NH
Naphthalene	CT,NY,NH,ME,NC,VA
Nitrobenzene	CT,NY,NH
2-Nitrophenol	CT,NY,NH
4-Nitrophenol	CT,NY,NH
Pentachlorophenol	CT,NY,NH
Phenanthrene	CT,NY,NH
Phenanthrene	CT,NY,NH,ME,NC,VA
Phenol	CT,NY,NH
Pyrene	CT,NY,NH
Pyrene	CT,NY,NH,ME,NC,VA
1,2,4-Trichlorobenzene	CT,NY,NH
2,4,5-Trichlorophenol	CT,NY,NH
2,4,6-Trichlorophenol	CT,NY,NH

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC - ISO17025:2005	100033	02/1/2018
MA	Massachusetts DEP	M-MA100	06/30/2017
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2017
NY	New York State Department of Health	10899 NELAP	04/1/2018
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2018
RI	Rhode Island Department of Health	LAO00112	12/30/2017
NC	North Carolina Div. of Water Quality	652	12/31/2017
NJ	New Jersey DEP	MA007 NELAP	06/30/2017
FL	Florida Department of Health	E871027 NELAP	06/30/2017
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2017
ME	State of Maine	2011028	06/9/2017
VA	Commonwealth of Virginia	460217	12/14/2017
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2017

CHAIN OF CUSTODY RECORD

17D1259

Rev 04.05.12

con-test® ANALYTICAL LABORATORY
Phone: 413-525-2332
Fax: 413-525-6405
Email: info@contestlabs.com
www.contestlabs.com
39 Spruce Street
East longmeadow, MA 01028

Page ____ of ____

Company Name: Weston + Sampson
Address: 5 Centennial Drive Peabody, MA
Attention: Joe Spencer
Project Location: 13 Wallis St
Sampled By: Taylor Smith

Telephone: 978-532-1900
Project #: 2160299
Client PO#:

DATA DELIVERY (check all that apply)
○ FAX ☒ EMAIL ○ WEBSITE
Fax #:
Email: JSpencerJ@WSEinc.com
Format: ○ PDF ☒ EXCEL ○ GIS
○ OTHER
○ "Enhanced Data Package"

Project Proposal Provided? (for billing purposes)
○ yes _____ proposal date

Con-Test Lab ID (laboratory use only)	Client Sample ID / Description	Collection Beginning Date/Time	Collection Ending Date/Time	Composite	Grab	*Matrix Code	Conc Code	# of Containers	** Preservation	***Container Code	Selenium + Silver	PAHs	VOCs	Hexavalent Chromium	Disposal Characterization
01	SP-1 (0-1)	4/26	10:25		X	S					X	X		X	
02	SP-1 (2-5)		10:30		X						X	X		X	
03	SP-2 (0-1)		1100		X						X	X		X	
04	SP-2 (2-5)		1105		X						X	X		X	
05	SP-3 (0-1)		1150		X						X	X		X	
06	SP-3 (2-5)		1200		X						X	X		X	
07	SP-4 (0-1)		1215		X						X	X		X	
08	SP-4 (2-5)		1220		X						X	X		X	
09	Comp-1		1230	X							X	X	X	X	X

ANALYSIS REQUESTED

Dissolved Metals
○ Field Filtered
○ Lab to Filter

***Cont. Code:**
A=amber glass
G=glass
P=plastic
ST=sterile
V= vial
S=summa can
T=tedlar bag
O=Other

****Preservation**
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium bisulfate
X = Na hydroxide
T = Na thiosulfate
O = Other _____

*Matrix Code:
GW= groundwater
WW= wastewater
DW= drinking water
A = air
S = soil/solid
SL = sludge
O = other _____

Comments: * PARAMETERS TO INCLUDE RCRA-8, VOCs, SVOCs, PCBs, TPH, pH, SpC, Reactive Cyanide, Reactive Sulfide, IGNITABILITY

Please use the following codes to let Con-Test know if a specific sample may be high in concentration in Matrix/Conc. Code Box:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

Relinquished by: (signature)		Date/Time: 4/26
Received by: (signature)		Date/Time: 3:30
Relinquished by: (signature)		Date/Time: 4/26/17
Received by: (signature)	3.8°C	Date/Time: 1830

Turnaround ††
☐ 7-Day
☐ 10-Day
☒ Other 5 Day
RUSH †
☐ †24-Hr ☐ †48-Hr
☐ †72-Hr ☐ †4-Day
† Require lab approval

Detection Limit Requirements
Massachusetts: S-1
Connecticut:
Other:

Is your project MCP or RCP ?
☒ MCP Form Required
○ RCP Form Required
○ MA State DW Form Required PWSID # _____

NELAC & AIHA-LAP, LLC Accredited
WBE/DBE Certified

†† TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR INCORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

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Table of Contents

39 Spruce St.
East Longmeadow, MA. 01028
P: 413-525-2332
F: 413-525-6405
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con-test® ANALYTICAL LABORATORY

Sample Receipt Checklist

CLIENT NAME: Weston & Sampson **RECEIVED BY:** RLF **DATE:** 4/26/17

1) **Was the chain(s) of custody relinquished and signed?** Yes X No ____ No COC Incl.

2) **Does the chain agree with the samples?** Yes X No ____
If not, explain:

3) **Are all the samples in good condition?** Yes X No ____
If not, explain:

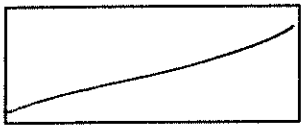
4) **How were the samples received:**
On Ice X Direct from Sampling ____ Ambient ____ In Cooler(s) X

Were the samples received in Temperature Compliance of (2-6°C)? Yes X No ____ N/A ____

Temperature °C by Temp blank ____ # ____ Temperature °C by Temp gun 3.8°C # 7

5) **Are there Dissolved samples for the lab to filter?** Yes ____ No X
Who was notified ____ Date ____ Time ____

6) **Are there any RUSH or SHORT HOLDING TIME samples?** Yes X No ____
Who was notified ~~Tara~~ Dawn Date 4/26 Time 1845

7) **Location where samples are stored:** 

Permission to subcontract samples? Yes No
(Walk-in clients only) if not already approved
Client Signature: ____

8) **Do all samples have the proper Acid pH:** Yes ____ No ____ N/A X

9) **Do all samples have the proper Base pH:** Yes ____ No ____ N/A X

10) **Was the PC notified of any discrepancies with the CoC vs the samples:** Yes ____ N/A X

Containers received at Con-Test

	# of containers		# of containers
1 Liter Amber		16 oz amber	6
500 mL Amber		8 oz amber/clear jar	3
250 mL Amber (8oz amber)		4 oz amber/clear jar	8
1 Liter Plastic		2 oz amber/clear jar	
500 mL Plastic		Plastic Bag / Ziploc	
250 mL plastic		SOC Kit	
40 mL Vial - type listed below	3	Perchlorate Kit	
Colisure / bacteria bottle		Flashpoint bottle	
Dissolved Oxygen bottle		Other glass jar	
Encore		Other	

40 mL vials: # HCl ____ # Methanol 1
Bisulfate 2 # DI Water ____
Thiosulfate ____ Unpreserved ____

Time and Date Frozen:

Login Sample Receipt Checklist

(Rejection Criteria Listing - Using Sample Acceptance Policy)

Any False statement will be brought to the attention of Client

Question	Answer (True/False) T/F/NA	Comment
1) The cooler's custody seal, if present, is intact.	NA	
2) The cooler or samples do not appear to have been compromised or tampered with.	T	
3) Samples were received on ice.	T	
4) Cooler Temperature is acceptable.	T	
5) Cooler Temperature is recorded.	T	
6) COC is filled out in ink and legible.	T	
7) COC is filled out with all pertinent information.	T	
8) Field Sampler's name present on COC.	T	
9) There are no discrepancies between the sample IDs on the container and the COC.	T	
10) Samples are received within Holding Time.	T	
11) Sample containers have legible labels.	T	
12) Containers are not broken or leaking.	T	
13) Air Cassettes are not broken/open.	NA	
14) Sample collection date/times are provided.	T	
15) Appropriate sample containers are used.	T	
16) Proper collection media used.	T	
17) No headspace sample bottles are completely filled.	NA	
18) There is sufficient volume for all requsted analyses, including any requested MS/MSDs.	T	
19) Trip blanks provided if applicable.	NA	
20) VOA sample vials do not have head space or bubble is <6mm (1/4") in diameter.	NA	
21) Samples do not require splitting or compositing.	T	

Who notified of False statements? **Date/Time:**

Doc #277 Rev. 4 August 2013 **Log-In Technician Initials:** **Date/Time:**

RLF 4/24/17 1830

MADEP MCP Analytical Method Report Certification Form

Laboratory Name: Con-Test Analytical Laboratory	Project #: 17D1259
Project Location: 13 Wallis St.	RTN:

This Form provides certifications for the following data set: [list Laboratory Sample ID Number(s)]

17D1259-01 thru 17D1259-09

Matrices: Soil

CAM Protocol (check all that below)

8260 VOC CAM II A (X)	7470/7471 Hg CAM IIIB (X)	MassDEP VPH CAM IV A ( )	8081 Pesticides CAM V B ( )	7196 Hex Cr CAM VI B (X)	MassDEP APH CAM IX A ( )
8270 SVOC CAM II B (X)	7010 Metals CAM III C ( )	MassDEP EPH CAM IV A ( )	8151 Herbicides CAM V C ( )	8330 Explosives CAM VIII A ( )	TO-15 VOC CAM IX B ( )
6010 Metals CAM III A (X)	6020 Metals CAM III D ( )	8082 PCB CAM V A (X)	9014 Total Cyanide/PAC CAM VI A ( )	6860 Perchlorate CAM VIII B ( )	

Affirmative response to Questions A throughF is required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☑ Yes	☐ No[1]
B	Were the analytical method(s) and all associated QC requirements specificed in the selected CAM protocol(s) followed?	☑ Yes	☐ No[1]
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☑ Yes	☐ No[1]
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, Quality Assurance and Quality Control Guidlines for the Acquisition and Reporting of Analytical Data?	☑ Yes	☐ No[1]
E a	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	☐ Yes	☐ No[1]
E b	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes	☐ No[1]
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all No responses to Qestions A through E)?	☑ Yes	☐ No[1]

A response to questions G, H and I below is required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☑ Yes	☐ No[1]

<u>Data User Note:</u> Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were all QC perfomance standards specified in the CAM protocol(s) achieved?	☐ Yes	☑ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes	☑ No[1]

[1] *All Negative responses must be addressed in an attached Environmental Laboratory case narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:  Position: Project Manager

Printed Name: Lisa A. Worthington Date: 05/04/17

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

June 16, 2017

Joe Spencer
Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960

Project Location: 13 Wallis St.
Client Job Number:
Project Number: [none]
Laboratory Work Order Number: 17F0708

Enclosed are results of analyses for samples received by the laboratory on June 14, 2017. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Meghan E. Kelley
Project Manager

Table of Contents

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 6/16/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: [none]

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17F0708

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 13 Wallis St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
Comp-1	17F0708-01	Soil		SM 2540G SW-846 1311 SW-846 6010C-D	

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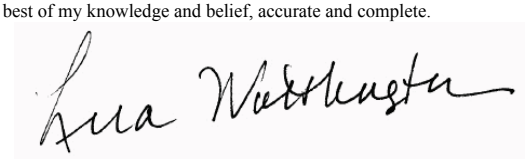
CASE NARRATIVE SUMMARY

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

SW-846 6010C/D SW-846 6020A/B

For NC, Metals methods SW-846 6010D and SW-846 6020B are followed, and for all other states methods SW-846 6010C and SW-846 6020A are followed.

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Lisa A. Worthington
Project Manager

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17F0708

Date Received: 6/14/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17F0708-01

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
% Solids	86.1		% Wt	1		SM 2540G	4/27/17	6/16/17 9:58	FWD

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 13 Wallis St. Sample Description: Work Order: 17F0708

Date Received: 6/14/2017

Field Sample #: Comp-1 Sampled: 4/26/2017 12:30

Sample ID: 17F0708-01

Sample Matrix: Soil

TCLP - Metals Analyses

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Lead	0.26	0.010	mg/L	1		SW-846 6010C-D	6/15/17	6/16/17 11:30	SHN

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Sample Extraction Data

Prep Method: % Solids-SM 2540G

Lab Number [Field ID]	Batch	Date
17F0708-01 [Comp-1]	B175514	04/27/17

Prep Method: SW-846 3010A-SW-846 6010C-D **Leachates were extracted on 6/14/2017 per SW-846 1311 in Batch B179247**

Lab Number [Field ID]	Batch	Initial [mL]	Final [mL]	Date
17F0708-01 [Comp-1]	B179322	50.0	50.0	06/15/17

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

QUALITY CONTROL

TCLP - Metals Analyses - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B179322 - SW-846 3010A										
Blank (B179322-BLK1)				Prepared: 06/15/17 Analyzed: 06/16/17						
Lead	ND	0.010	mg/L							
LCS (B179322-BS1)				Prepared: 06/15/17 Analyzed: 06/16/17						
Lead	0.517	0.010	mg/L	0.500		103	80-120			
LCS Dup (B179322-BSD1)				Prepared: 06/15/17 Analyzed: 06/16/17						
Lead	0.519	0.010	mg/L	0.500		104	80-120	0.353	20	

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
ND	Not Detected
RL	Reporting Limit
DL	Method Detection Limit
MCL	Maximum Contaminant Level

Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.

No results have been blank subtracted unless specified in the case narrative section.

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 6010C-D in Water	
Lead	NY,CT,ME,NC,NH,VA

The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC - ISO17025:2005	100033	02/1/2018
MA	Massachusetts DEP	M-MA100	06/30/2017
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2017
NY	New York State Department of Health	10899 NELAP	04/1/2018
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2018
RI	Rhode Island Department of Health	LAO00112	12/30/2017
NC	North Carolina Div. of Water Quality	652	12/31/2017
NJ	New Jersey DEP	MA007 NELAP	06/30/2017
FL	Florida Department of Health	E871027 NELAP	06/30/2018
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2017
ME	State of Maine	2011028	06/9/2019
VA	Commonwealth of Virginia	460217	12/14/2017
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2017
VT-DW	Vermont Department of Health Drinking Water	VT-255716	06/12/2018

CHAIN OF CUSTODY RECORD

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East longmeadow, MA 01028

Page ____ of ____

Rev 04.05.12

17F0708

Company Name: Weston + Sampson
Address: 5 Centennial Drive Peabody, MA
Attention: Joe Spencer
Project Location: 13 Wallis St
Sampled By: Taylor Smith

Telephone: 978-532-1900
Project #: 160299
Client PO#:

DATA DELIVERY (check all that apply)
○ FAX ☒ EMAIL ○ WEBSITE
Fax #:
Email: JSpencerJ@WSInc.com
Format: ○ PDF ☒ EXCEL ○ GIS
○ OTHER
○ "Enhanced Data Package"

Project Proposal Provided? (for billing purposes)
○ yes _____ proposal date

Con-Test Lab ID (laboratory use only)	Client Sample ID / Description	Collection Beginning Date/Time	Collection Ending Date/Time	Composite	Grab	*Matrix Code	Conc Code	# of Containers	** Preservation	*** Container Code	Selenium + Silver	PAHs	VOCs	Hexavalent Chromium	Dissolved Chromium	TCLP Pb
01	SP-1 (0-1)	4/26	10:25		X	S					X	X		X		
02	SP-1 (2-5)		10:30		X						X	X		X		
03	SP-2 (0-1)		1100		X						X	X		X		
04	SP-2 (2-5)		1105		X						X	X		X		
05	SP-3 (0-1)		1150		X						X	X		X		
06	SP-3 (2-5)		1200		X						X	X		X		
07	SP-4 (0-1)		1215		X						X	X		X		
08	SP-4 (2-5)		1220		X						X	X		X		
09	Comp-1		1230	X							[illegible]	[illegible]	X	[illegible]	X	X

Hold for TCLP Pb per Joe S. 4/27/17

Comments: *Chemistries to include RCRA-8, VOCs, SVOCs, PCBs, TPH, pH, SpC, Reactive Cyanide, Reactive Sulfide, Ignitability

ANALYSIS REQUESTED

Dissolved Metals
○ Field Filtered
○ Lab to Filter

***Cont. Code:
A=amber glass
G=glass
P=plastic
ST=sterile
V= vial
S=summa can
T=tedlar bag
O=Other

**Preservation
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium bisulfate
X = Na hydroxide
T = Na thiosulfate
O = Other _____

*Matrix Code:
GW= groundwater
WW= wastewater
DW= drinking water
A = air
S = soil/solid
SL = sludge
O = other _____

Please use the following codes to let Con-Test know if a specific sample may be high in concentration in Matrix/Conc. Code Box:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

Relinquished by: (signature)		Date/Time: 4/26
Received by: (signature)		Date/Time: 3:30
Relinquished by: (signature)	4/26/17	Date/Time: 6:30
Received by: (signature)	4/26/17	Date/Time: 1830

Turnaround ††
☐ 7-Day
☐ 10-Day
☒ Other 5 Day
RUSH †
☐ †24-Hr ☐ †48-Hr
☐ †72-Hr ☐ †4-Day
† Require lab approval

Detection Limit Requirements
Massachusetts: S-1
Connecticut:
Other:

Is your project MCP or RCP ?
☒ MCP Form Required
○ RCP Form Required
○ MA State DW Form Required PWSID # _____

NELAC & AIHA-LAP, LLC Accredited
WBE/DBE Certified

†† TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR IS INCORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

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39 Spruce St.
East Longmeadow, MA. 01028
P: 413-525-2332
F: 413-525-6405
www.contestlabs.com

con-test® ANALYTICAL LABORATORY

Sample Receipt Checklist

CLIENT NAME: Western Sampson **RECEIVED BY:** RLF **DATE:** 4/26/17

1) **Was the chain(s) of custody relinquished and signed?** Yes X No ____ No COC Incl.

2) **Does the chain agree with the samples?** Yes X No ____
If not, explain:

3) **Are all the samples in good condition?** Yes X No ____
If not, explain:

4) **How were the samples received:**
On Ice X Direct from Sampling ____ Ambient ____ In Cooler(s) X

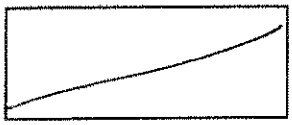
Were the samples received in Temperature Compliance of (2-6°C)? Yes X No ____ N/A ____

Temperature °C by Temp blank ____ # ____ Temperature °C by Temp gun 3.8°C # 7

5) **Are there Dissolved samples for the lab to filter?** Yes ____ No X
Who was notified ____ Date ____ Time ____

6) **Are there any RUSH or SHORT HOLDING TIME samples?** Yes X No ____
Who was notified Jenna Date 4/26 Time 1845
David

7) **Location where samples are stored:**



Permission to subcontract samples? Yes No
(Walk-in clients only) if not already approved
Client Signature: ____

8) **Do all samples have the proper Acid pH:** Yes ____ No ____ N/A X

9) **Do all samples have the proper Base pH:** Yes ____ No ____ N/A X

10) **Was the PC notified of any discrepancies with the CoC vs the samples:** Yes ____ N/A X

Containers received at Con-Test

	# of containers		# of containers
1 Liter Amber		16 oz amber	9
500 mL Amber		8 oz amber/clear jar	3
250 mL Amber (8oz amber)		4 oz amber/clear jar	8
1 Liter Plastic		2 oz amber/clear jar	
500 mL Plastic		Plastic Bag / Ziploc	
250 mL plastic		SOC Kit	
40 mL Vial - type listed below	3	Perchlorate Kit	
Colisure / bacteria bottle		Flashpoint bottle	
Dissolved Oxygen bottle		Other glass jar	
Encore		Other	

40 mL vials: # HCl ____ # Methanol 1 **Time and Date Frozen:**
Bisulfate 2 # DI Water ____
Thiosulfate ____ Unpreserved ____

Login Sample Receipt Checklist

(Rejection Criteria Listing - Using Sample Acceptance Policy)

Any False statement will be brought to the attention of Client

Question	Answer (True/False) T/F/NA	Comment
1) The cooler's custody seal, if present, is intact.	NA	
2) The cooler or samples do not appear to have been compromised or tampered with.	T	
3) Samples were received on ice.	T	
4) Cooler Temperature is acceptable.	T	
5) Cooler Temperature is recorded.	T	
6) COC is filled out in ink and legible.	T	
7) COC is filled out with all pertinent information.	T	
8) Field Sampler's name present on COC.	T	
9) There are no discrepancies between the sample IDs on the container and the COC.	T	
10) Samples are received within Holding Time.	T	
11) Sample containers have legible labels.	T	
12) Containers are not broken or leaking.	T	
13) Air Cassettes are not broken/open.	NA	
14) Sample collection date/times are provided.	T	
15) Appropriate sample containers are used.	T	
16) Proper collection media used.	T	
17) No headspace sample bottles are completely filled.	NA	
18) There is sufficient volume for all requsted analyses, including any requested MS/MSDs.	T	
19) Trip blanks provided if applicable.	NA	
20) VOA sample vials do not have head space or bubble is <6mm (1/4") in diameter.	NA	
21) Samples do not require splitting or compositing.	T	

Who notified of False statements? **Date/Time:**

Doc #277 Rev. 4 August 2013 **Log-In Technician Initials:** **Date/Time:**

RLF 4/24/17 1830

MADEP MCP Analytical Method Report Certification Form

Laboratory Name: Con-Test Analytical Laboratory	Project #: 17F0708
Project Location: 13 Wallis St.	RTN:

This Form provides certifications for the following data set: [list Laboratory Sample ID Number(s)]

17F0708-01

Matrices: Soil

CAM Protocol (check all that below)

8260 VOC CAM II A ( )	7470/7471 Hg CAM IIIB ( )	MassDEP VPH CAM IV A ( )	8081 Pesticides CAM V B ( )	7196 Hex Cr CAM VI B ( )	MassDEP APH CAM IX A ( )
8270 SVOC CAM II B ( )	7010 Metals CAM III C ( )	MassDEP EPH CAM IV A ( )	8151 Herbicides CAM V C ( )	8330 Explosives CAM VIII A ( )	TO-15 VOC CAM IX B ( )
6010 Metals CAM III A (X)	6020 Metals CAM III D ( )	8082 PCB CAM V A ( )	9014 Total Cyanide/PAC CAM VI A ( )	6860 Perchlorate CAM VIII B ( )	

Affirmative response to Questions A throughF is required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☑ Yes	☐ No[1]
B	Were the analytical method(s) and all associated QC requirements specificed in the selected CAM protocol(s) followed?	☑ Yes	☐ No[1]
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☑ Yes	☐ No[1]
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, Quality Assurance and Quality Control Guidlines for the Acquisition and Reporting of Analytical Data?	☑ Yes	☐ No[1]
E a	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	☐ Yes	☐ No[1]
E b	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes	☐ No[1]
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all No responses to Qestions A through E)?	☑ Yes	☐ No[1]

A response to questions G, H and I below is required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☑ Yes	☐ No[1]

***Data User Note:* Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.**

H	Were all QC perfomance standards specified in the CAM protocol(s) achieved?	☑ Yes	☐ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes	☑ No[1]

[1] *All Negative responses must be addressed in an attached Environmental Laboratory case narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:  Position: Project Manager

Printed Name: Lisa A. Worthington Date: 06/16/17

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

June 22, 2017

Mr. Brendan Callahan
Department of Community Development and Planning
24 Lowell Street
Peabody, Massachusetts 01960

Re: Limited Subsurface Site Investigation
North River Corridor Riverwalk
18 Howley Street
Peabody, Massachusetts

Dear Mr. Callahan:

Weston & Sampson is pleased to submit this Limited Subsurface Site Investigation Letter Report for the portion of 18 Howley Street located adjacent to the North River Canal in Peabody, Massachusetts. Specifically, this assessment evaluated an approximate 10-foot wide strip of land abutting the south side of the North River in Peabody, Massachusetts (the Site). The assessment was performed as part of a multi-parcel limited assessment in support of the proposed Riverwalk project along the North River Corridor. Weston & Sampson performed the following tasks as part of the Limited Subsurface Site Investigation:

- Site reconnaissance and review of previous investigations conducted at the Site;
- Soil boring advancement; and,
- Soil sampling and analysis.

See attached Figures 1 and 2 for a Site Locus Map and a Site Plan (with soil sampling locations), respectively.

SITE BACKGROUND

In support of the City of Peabody's (the City's) desire to construct a Riverwalk along the North River Corridor, the City is evaluating potential property acquisition and/or easement takings at selected properties along the corridor. Specifically, the City is interested in purchasing a portion of the property located at 18 Howley Street (Parcel ID 086-150). The property has a documented history of environmental releases and was regulated under the MCP. 18 Howley Street, identified by the Massachusetts Department of Environmental Protection (MassDEP) as Release Tracking Number (RTN) 3-0577, is closed under the MCP in 2013 with a B-2 Response Action Outcome (RAO) and Activity and Use Limitation (AUL) [i.e., a Permanent Solution Statement with Conditions].

The AUL restricts the use of the property as a residence, school, daycare, nursery recreational area (e.g., park or athletic field) and/or any other use in which a child's presence (other than incidental). The AUL also restricts the use of the property for growing produce for human consumption as well as any long-term (greater than 1 month) activity at the property that is likely to result in the excavation, relocation and/or removal of soils, unless such activity is first evaluated by a Licensed Site Professional (LSP). The AUL is applicable to the entire parcel, and therefore includes the Site.

The primary contaminants of concern are metals (i.e., arsenic, chromium and lead), polycyclic aromatic hydrocarbons (PAHs), extractable petroleum hydrocarbons (EPHs), dioxins, and polychlorinated biphenyls (PCBs). Historical fill containing ash and/or coal has also been observed. Contamination appears to be limited to the top 8 feet of soil across the property.

SUBSURFACE INVESTIGATION

Weston & Sampson performed a Limited Subsurface Investigation at the Site on April 25, 2017, to evaluate the quality of the surficial and near surficial soils. The investigation, which included the advancement of two (2) soil borings and the collection and analysis of four (4) soil samples, was limited to the area of the proposed

Riverwalk only. A detailed summary of the investigation is provided below. See Figure 2 for sampling locations. A summary of laboratory analytical results is provided in Tables 1 and 2.

Soil Boring Advancement

On April 25, 2017, Weston & Sampson oversaw the advancement of two (2) soil borings (SP-1 and SP-2) at the Site. The borings were advanced by New England Geotech, LLC, of Jamestown, Rhode Island, to depths of 5 feet below ground surface (bgs) using direct-push methods. Boring locations were selected by Weston & Sampson based on documented historical Site use and a review of previous Site investigations, and were spatially distributed to obtain a representative evaluation of the conditions of the proposed Riverwalk area.

Soil Sampling and Analysis

A Weston & Sampson representative screened each soil boring at continuous depth intervals and logged soil descriptions using a modified Burmeister Soil Classification System. Each sample was field-screened for visual and olfactory evidence of impacts, as well as total volatile organic compounds (VOCs) using a photoionization detector (PID) in accordance with the Massachusetts Department of Environmental Protection (MassDEP) jar headspace screening method. Field screening results are included in the soil boring logs Attachment A.

Two (2) soil samples from each boring, one at the 0-1 foot interval, and one at the 2-5 foot interval, were submitted to Con-Test Analytical Laboratory of East Longmeadow, Massachusetts (Con-Test) for analysis of MCP 14 metals (antimony, arsenic, barium, beryllium, cadmium, total chromium, nickel, lead, mercury, selenium, silver, thallium, vanadium, and zinc), hexavalent chromium, and PAHs. Additionally, one sample, SP-1 (2-5) was analyzed for VOCs due to an elevated jar headspace screening concentration and olfactory evidence of petroleum impacts.

Weston & Sampson also composited soil from both soil boring locations, and submitted the composite sample (Comp-1) for analysis of typical disposal characterization parameters. The disposal characterization was conducted in accordance with the MassDEP Policy # COMM-97-001: Reuse and Disposal of Contaminated Soil in Massachusetts and included the following analyses: total petroleum hydrocarbons (TPH); Resource Conservation and Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver); VOCs; semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); pH; ignitability; specific conductivity; and reactivity. The sample was also analyzed for Toxicity Characteristic Leaching Procedure (TCLP) chromium and lead analysis because the concentration of those analytes was above the RCRA “Rule of 20.”

SUBSURFACE INVESTIGATION RESULTS

In general, the following shallow geologic conditions were encountered during the subsurface soil investigation program:

Fill Material: Light brown to dark brown fine to coarse sand matrix containing variable amounts of fractured rocks and organics. Note the borings were not advanced deeper than five (5) feet below ground surface.

Bedrock was not encountered during the investigation.

Field Screening Results

As shown in the attached boring logs, PID field screening of soil samples collected from soil borings SP-1 and SP-2, did not identify detectable VOCs except for SP-1 (2-5). The PID field screening of the soil sample collected from SP-1 from 2-5 feet bgs showed VOCs at a headspace concentration of 140 parts per million by volume (ppmv). Soil boring logs are included in Attachment A.

Soil Analytical Results

As shown in Table 1, analysis of soil samples identified concentrations of metals above applicable Massachusetts Contingency Plan (MCP) Method 1 S-1/GW-2 and S-1/GW-3 standards. The following is a summary of the exceedances identified:

- Antimony was identified at concentrations exceeding the applicable Method 1 standards in samples SP-1 (0-1), and SP-2 (0-1);
- Arsenic was identified at concentrations exceeding the applicable Method 1 standards in samples SP-1 (0-1), SP-1 (2-5), SP-2 (0-1), and SP-2 (2-5);
- Barium was identified at concentrations exceeding the applicable Method 1 standards in samples SP-1 (0-1) and SP-2 (0-1);
- Trivalent chromium was identified at concentrations exceeding the applicable Method 1 standards in samples SP-1 (0-1), SP-1 (2-5), SP-2 (0-1), and SP-2 (2-5); and,
- Lead was identified at concentrations exceeding the applicable Method 1 standards in sample SP-1 (0-1), SP-2 (0-1), and SP-2 (2-5).

No other analytes were detected in excess of the applicable Method 1 standards in SP-1 and SP-2.

It should be noted that, at the time of sampling, Weston & Sampson evaluated the need to perform an Imminent Hazard (IH) investigation in accordance with the MCP 310 CMR 40.0426. Weston & Sampson determined that, because contaminant concentrations were similar to those included in the IH investigation included in the RAO report, an IH investigation was not necessary.

The results of the disposal characterization analyses are presented in Table 2. The results were compared to the COMM-97-001 requirements for reuse at Massachusetts lined and unlined landfills. As shown in Table 2, soil analytical results indicate that arsenic, chromium, and lead are present at concentrations exceeding the RCS-1 thresholds; therefore, the soil is considered Contaminated Media under the MCP, and will be classified as Remediation Waste if transported off-Site. The results for the TCLP analysis indicate that chromium and lead are not leachable and therefore would not constitute a "hazardous waste" as defined RCRA. The arsenic concentration of 83 mg/kg exceeds the COMM-97-001 Reuse level for In-State Lined and Unlined Landfills; therefore, the material cannot be disposed of at an In-State Landfill.

CONCLUSIONS & COST ESTIMATES

In summary, the data is generally consistent with the limited findings in the RAO report for RTN 3-0577. Based on the data collected, no new reportable conditions under the MCP were encountered. Concentrations indicate that:

- In general, contaminants in the 0-1 feet bgs depth interval tend to be greater than the concentrations of contaminants in soils in the 2-5 ft bgs depth interval;
- Excavation will require soil management under the MCP;
- The contaminated media (soil) will require disposal at an appropriate facility and documentation by a Licensed Site Professional (LSP); and
- The soil did not fail the leachability test and does not require disposal at a RCRA facility.

Future Site use for the Riverwalk trail will have a different exposure scenario than current site conditions; therefore, a Method 3 Risk Characterization for the proposed Riverwalk (i.e. easement) area will need to evaluate risks under the new conditions and with new (i.e., post-construction) exposure point concentrations. Specifically, recreational use (such as a park or athletic fields) and/or any other use at which a child's presence is likely, are currently prohibited at the Site, in accordance with the AUL. Likewise, any long-term (greater than 1 month) activity at the property that is likely to result in the excavation, relocation and/or removal of soils, unless such activity is first evaluated by a Licensed Site Professional (LSP).

In summary, to construct the Riverwalk, soils will likely be excavated and disposed of at a licensed facility. Following removal of impacted fill, soil sampling will be required to evaluate remaining conditions and associated risk. Clean fill will be used to construct the Riverwalk pathways. A new risk characterization will be required for the Riverwalk area. A geotextile membrane barrier may also be required to separate impacted fill as

part of the risk management strategy. A separate Activity and Use Limitation (AUL) may also be required to document and manage site risks along the Riverwalk corridor area.

Assuming only the Riverwalk portion of the property were to be obtained through an easement, potential obligations to the City to construct a river walk along the corridor at the 18 Howley Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $30,000
  - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
  - RAM Status Report
  - Method 3 Risk Assessment for Riverwalk Area
  - Revised PSS and AUL for Riverwalk Area (and associated land survey)
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Specifications ~ $5,000
- Construction Administration, Coordination & Oversight ~ $5,000
- Soil removal and out-of-state disposal of approximately 70 tons (assumed to be an area measuring 90 feet long by 10 feet wide and a depth of 2 feet) of impacted soil from the Riverwalk ~ $7,000

Estimated TOTAL = $47,000* (not including permitting or associated Riverwalk construction costs).
*Note: Given the existing condition of the canal wall along the 24 Caller Street property, further structural evaluations may conclude that additional soils require removal as part of wall repair alternatives.

We look forward to discussing these findings with you in greater detail and working with the City to make your visions for the Riverwalk a reality. If you have any comments or questions, please contact us at 978-532-1900.

Very truly yours,

WESTON & SAMPSON ENGINEERS, INC.

George D. Naslas, PG, LSP
Vice President

Attachments: Figures
Tables
Attachment A – Soil Boring Logs
Attachment B – Laboratory Analytical Report

O:\Peabody MA\North River Corridor Due Diligence\18 & 20 Howley St\Subsurface Investigation\18 Howley\18 Howley Site Investigation Summary.docx

FIGURES



FIGURE 1
18 HOWLEY STREET
PEABODY, MASSACHUSETTS

LOCUS MAP

0 2,000 4,000 **Feet**

Weston & Sampson

Path: C:\Users\SpencerJ\Documents\ArcGIS\Peabody\Locus Maps_06022017.mxd **User:** SpencerJ **Saved:** 6/2/2017 9:30:14 AM **Opened:** 6/2/2017 9:40:33 AM



FIGURE 2

18 HOWLEY STREET
PEABODY, MASSACHUSETTS

SITE PLAN

JUNE 2017 SCALE: NOTED

Weston & Sampson

Path: C:\Users\Spencer.J\Documents\ArcGIS\Peabody\HOWLEY STREET PLAN.mxd **User:** Spencer.J **Saved:** 6/13/2017 1:18:34 PM **Opened:** 6/13/2017 1:24:18 PM

TABLES

Table 1
Summary of Laboratory Analytical Results - Soil Borings
18 Howley Street
Peabody, Massachusetts
April 25, 2017

Parameter	Units	Method 1 Cleanup Standards (1)		Sample Location, Depth, and Date			
		S-1/GW-2	S-1/GW-3	SP-1 (0-1)	SP-1 (2-5)	SP-2 (0-1)	SP-2 (2-5)
				0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet
Metals							
ANTIMONY	mg/kg	20	20	**350**	**9.7**	**110**	**20**
ARSENIC	mg/kg	20	20	**63**	**30**	**34**	**83**
BARIUM	mg/kg	1000	1000	**2700**	**73**	**1500**	**180**
BERYLLIUM	mg/kg	90	90	**0.62**	**0.58**	**0.54**	**0.53**
CADMIUM	mg/kg	70	70	**3.3**	**2.5**	**5.3**	**6.2**
TRIVALENT CHROMIUM	mg/kg	1000	1000	**14000**	**270**	**4200**	**430**
HEXAVALENT CHROMIUM	mg/kg	100	100	<2.5	<1.5	<1.2	<1.0
LEAD	mg/kg	200	200	**1100**	**120**	**940**	**660**
MERCURY	mg/kg	20	20	**0.9**	**0.31**	**1.1**	**0.31**
NICKEL	mg/kg	600	600	**14**	**13**	**20**	**27**
SELENIUM	mg/kg	400	400	<7.9	<9.0	<7.6	<6.2
SILVER	mg/kg	100	100	<0.79	<0.90	<0.76	<0.62
THALLIUM	mg/kg	8	8	<4.0	<4.5	<3.8	<3.1
VANADIUM	mg/kg	400	400	**46**	**17**	**72**	**33**
ZINC	mg/kg	1000	1000	**210**	**460**	**360**	**590**
VOCs							
SEC-BUTYLBENZENE	mg/kg	NS	NS	NT	**0.029**	NT	NT
TERT-BUTYLBENZENE	mg/kg	NS	NS	NT	**0.0052**	NT	NT
ISOPROPYLBENZENE	mg/kg	NS	NS	NT	**0.0068**	NT	NT
NAPHTHALENE	mg/kg	20	500	NT	**0.034**	NT	NT
N-PROPYLBENZENE	mg/kg	NS	NS	NT	**0.0093**	NT	NT
PAHs							
ACENAPHTHENE	mg/kg	1000	1000	<0.27	<0.64	<0.26	<0.45
ACENAPHTHYLENE	mg/kg	600	10	**0.34**	<0.64	<0.26	<0.45
ANTHRACENE	mg/kg	1000	1000	**1.2**	<0.64	<0.26	<0.45
BENZO(A)ANTHRACENE	mg/kg	7	7	**1**	<0.64	**0.9**	**0.59**
BENZO(A)PYRENE	mg/kg	2	2	**1.6**	<0.64	**0.88**	**0.57**
BENZO(B)FLUORANTHENE	mg/kg	7	7	**3.9**	<0.64	**1.5**	**0.87**
BENZO(G,H,I)PERYLENE	mg/kg	1000	1000	**1.2**	<0.64	**0.71**	<0.45
BENZO(K)FLUORANTHENE	mg/kg	70	70	**1.6**	<0.64	**0.47**	<0.45
CHRYSENE	mg/kg	70	70	**1.6**	<0.64	**1.1**	**0.7**
DIBENZ(A,H)ANTHRACENE	mg/kg	0.7	0.7	**0.42**	<0.64	<0.26	<0.45
FLUORANTHENE	mg/kg	1000	1000	**1.8**	<0.64	**1.9**	**1.2**
FLUORENE	mg/kg	1000	1000	<0.27	<0.64	<0.26	<0.45
INDENO(1,2,3-CD)PYRENE	mg/kg	7	7	**1.7**	<0.64	**0.9**	<0.45
2-METHYLNAPHTHALENE	mg/kg	80	300	**0.38**	**4.6**	<0.26	<0.45
NAPHTHALENE	mg/kg	20	500	**0.32**	<0.64	**0.33**	<0.45
PHENANTHRENE	mg/kg	500	500	**1.1**	<0.64	**1.0**	**0.62**
PYRENE	mg/kg	1000	1000	**2.1**	<0.64	**2.0**	**1.1**
General Chemistry							
% Solids	%Wt	NS	NS	**62.9**	**53**	**66.3**	**75.8**
SPECIFIC CONDUCTANCE	(µmhos/cm)	NS	NS	NT	NT	NT	NT
IGNITABILITY	(present/absent)	NS	NS	NT	NT	NT	NT
REACTIVE CYANIDE	mg/kg	NS	NS	NT	NT	NT	NT
REACTIVE SULFIDE	mg/kg	NS	NS	NT	NT	NT	NT
PH	pH Units	NS	NS	**5.3**	**6.0**	**4.7**	**6.7**

QC by JRS 6/9/17

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard
MCP = Massachusetts Contingency Plan
mg/kg = milligram per killiogram

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

Table 2
Summary of Laboratory Analytical Results - Disposal Characterization
18 Howley Street
Peabody, Massachusetts
April 25, 2017

Parameter	Units	Reportable Concentrations[1]	COMM-97-001 In-State Disposal/Reuse Levels		Sample Location, Depth, and Date
		RCS-1	Unlined	Lined	Disposal Characterization
Metals					
ARSENIC	mg/kg	20	40	40	**83**
BARIUM	mg/kg	1000	NS	NS	**420**
CADMIUM	mg/kg	70	30	80	**6.1**
CHROMIUM	mg/kg	100	1000	1000	**930**
TCLP CHROMIUM	mg/L	NS	5	5	**0.35**
LEAD	mg/kg	200	1000	2000	**640**
TCLP LEAD	mg/L	NS	5	5	**0.40**
MERCURY	mg/kg	20	10	10	**0.49**
SELENIUM	mg/kg	400	NS	NS	<6.7
SILVER	mg/kg	100	NS	NS	<0.67
PCBs					
PCB 1254	mg/kg	1	<2	<2	**0.57**
PCB 1260	mg/kg	1	<2	<2	**0.23**
Total PCBs	mg/kg	1	<2	<2	**0.8**
TPH					
TPH	mg/kg	1000	2500	5000	**190**
VOCs					
SEC-BUTYLBENZENE	mg/kg	~	NS	NS	**0.029**
TERT-BUTYLBENZENE	mg/kg	100	NS	NS	**0.0052**
NAPHTHALENE	mg/kg	4	NS	NS	**0.034**
N-PROPYLBENZENE	mg/kg	100	NS	NS	**0.0093**
Total VOCs	mg/kg	NS	4	10	**0.0843**
SVOCs					
BENZO(A)ANTHRACENE	mg/kg	7	NS	NS	**0.63**
BENZO(A)PYRENE	mg/kg	2	NS	NS	**0.66**
BENZO(B)FLUORANTHENE	mg/kg	7	NS	NS	**0.98**
BENZO(G,H,I)PERYLENE	mg/kg	1000	NS	NS	**0.51**
BENZO(K)FLUORANTHENE	mg/kg	70	NS	NS	**0.34**
CHRYSENE	mg/kg	70	NS	NS	**0.74**
FLUORANTHENE	mg/kg	1000	NS	NS	**1.3**
INDENO(1,2,3-CD)PYRENE	mg/kg	7	NS	NS	**0.52**
NAPHTHALENE	mg/kg	4	NS	NS	**0.28**
PHENANTHRENE	mg/kg	10	NS	NS	**0.64**
PYRENE	mg/kg	1000	NS	NS	**1.2**
Total SVOCs	mg/kg	NS	100	100	**7.8**
General Chemistry					
% Solids	%Wt	NS	NS	NS	**70.6**
SPECIFIC CONDUCTANCE	(µmhos/cm)	NS	4000	8000	**3.6**
IGNITABILITY	(present/absent)	NS	Absent	Absent	Absent
REACTIVE CYANIDE	mg/kg	NS	ND	ND	<4.0
REACTIVE SULFIDE	mg/kg	NS	ND	ND	<20
PH	pH Units	NS	>2 and <12	>2 and <12	**7.3**

QC by JRS 6/9/17

O:\Peabody MA\North River Corridor Due Diligence\18 & 20 Howley St\Subsurface Investigation\18 Howley\Tables\[Table 1 - 18 Howley Street.xls]Disposal Characterization

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
BOLD Parameter exceeds the COMM-97-001 standard for reuse at In-State landfills
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

ATTACHEMNT A
Soil Boring Logs

Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-1
18 Howley St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	Joseph Spencer

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 4/25/17	DATE END 4/25/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (in)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			10/12	0-2	0-2	0	Dark brown fine to coarse SAND, silt; trace brick and fractured rock		
			24/36	2-5	2-5	140	Dark brown fine to coarse SAND, silt; trace brick, fractured rock, coal ash, coal	*	SAND FILL
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

*Petroleum odor

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-1

Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-2
18 Howley St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	Joseph Spencer

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 4/25/17	DATE END 4/25/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher

CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	SAMPLE REC/PEN (in)	SAMPLE DEPTH (ft)	SAMPLE PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			10/12	0-2	0-2	0	Brown fine to coarse SAND, silt		SAND FILL
			24/36	2-5	2-5	0	Dark brown to brown fine to coarse SAND, silt; trace brick, fractured rock, asphalt		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-2

ATTACHMENT B
Laboratory Analytical Reports

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

May 3, 2017

Joe Spencer
Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960

Project Location: 18 Howley St.
Client Job Number:
Project Number: 2160299
Laboratory Work Order Number: 17D1128

Enclosed are results of analyses for samples received by the laboratory on April 25, 2017. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Meghan E. Kelley
Project Manager

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con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 5/3/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: 2160299

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17D1128

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 18 Howley St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
SP-1 (0-1)	17D1128-01	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
SP-1 (2-5)	17D1128-02	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8260C	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (0-1)	17D1128-03	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (2-5)	17D1128-04	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
Disposal Characterization	17D1128-05	Soil		SM 2540G	
				SM21-22 2510B Modified	
				SW-846 1030	
				SW-846 6010C-D	
				SW-846 7471B	
				SW-846 8082A	
				SW-846 8100 Modified	
				SW-846 8270D	
				SW-846 9014	
				SW-846 9030A	
				SW-846 9045C	

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

CASE NARRATIVE SUMMARY

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

For method 8270, 17D1128-01,02,03,04 only PAHs were requested and reported.

For method 6010, only RCRA 8 metals were requested and reported for sample -05

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

SW-846 7196A

Qualifications:

W-06

Elevated method reporting limit due to intense color of sample

Analyte & Samples(s) Qualified:

Hexavalent Chromium

17D1128-01[SP-1 (0-1)], 17D1128-02[SP-1 (2-5)], 17D1128-03[SP-2 (0-1)], 17D1128-04[SP-2 (2-5)]

SW-846 7471B

Qualifications:

MS-11

Matrix spike recovery outside of control limits. Possibility of sample matrix effects that lead to a high bias for reported result or non-homogeneous sample aliquots cannot be eliminated.

Analyte & Samples(s) Qualified:

Mercury

17D1128-03[SP-2 (0-1)], B175482-MS1

SW-846 8260C

Qualifications:

L-07

Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.

Analyte & Samples(s) Qualified:

Hexachlorobutadiene

B175403-BS1

V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

Dichlorodifluoromethane (Freon 1

17D1128-02[SP-1 (2-5)], B175403-BLK1, B175403-BS1, B175403-BSD1

Naphthalene

17D1128-02[SP-1 (2-5)], B175403-BLK1, B175403-BS1, B175403-BSD1

V-16

Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.

Analyte & Samples(s) Qualified:

1,4-Dioxane

17D1128-02[SP-1 (2-5)], B175403-BLK1, B175403-BS1, B175403-BSD1

SW-846 8270D

Qualifications:

L-04

Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

Aniline

17D1128-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

RL-12

Elevated reporting limit due to matrix interference.

Analyte & Samples(s) Qualified:

17D1128-02[SP-1 (2-5)]

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V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

2,4-Dinitrophenol
17D1128-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

Benzo(b)fluoranthene
17D1128-01[SP-1 (0-1)], 17D1128-03[SP-2 (0-1)], 17D1128-04[SP-2 (2-5)]

Benzo(k)fluoranthene
17D1128-01[SP-1 (0-1)], 17D1128-03[SP-2 (0-1)], 17D1128-04[SP-2 (2-5)]

Pentachlorophenol
17D1128-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

V-20

Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.

Analyte & Samples(s) Qualified:

Benzo(g,h,i)perylene
17D1128-02[SP-1 (2-5)], B175339-BLK1, B175339-BS1, B175339-BSD1

Dibenz(a,h)anthracene
17D1128-02[SP-1 (2-5)], B175339-BLK1, B175339-BS1, B175339-BSD1

Hexachlorobutadiene
17D1128-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

Indeno(1,2,3-cd)pyrene
17D1128-02[SP-1 (2-5)], B175339-BLK1, B175339-BS1, B175339-BSD1

SW-846 6010C/D SW-846 6020A/B

For NC, Metals methods SW-846 6010D and SW-846 6020B are followed, and for all other states methods SW-846 6010C and SW-846 6020A are followed.

SW-846 8100 Modified

TPH (C9-C36) is quantitated against a calibration made with a diesel standard.

SW-846 8260C

Laboratory control sample recoveries for required MCP Data Enhancement 8260 compounds were all within limits specified by the method except for “difficult analytes” where recovery control limits of 40-160% are used and/or unless otherwise listed in this narrative. Difficult analytes: MIBK, MEK, acetone, 1,4-dioxane, chloromethane, dichlorodifluoromethane, 2-hexanone, and bromomethane.

SW-846 8270D

Laboratory control sample recoveries for required MCP Data Enhancement 8270 compounds were all within control limits specified by the method, 40-140% for base/neutrals and 30-130% for acids except for “difficult analytes” listed below and/or otherwise listed in this narrative. Difficult analytes limits are 15 and 140%: 2,4-dinitrophenol, 4-chloroaniline, 4-nitrophenol, and phenol.

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Lisa A. Worthington
Project Manager

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (0-1) Sampled: 4/25/2017 12:00

Sample ID: 17D1128-01

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Acenaphthylene	0.34	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Anthracene	1.2	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Benzo(a)anthracene	1.0	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Benzo(a)pyrene	1.6	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Benzo(b)fluoranthene	3.9	0.27	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Benzo(g,h,i)perylene	1.2	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Benzo(k)fluoranthene	1.6	0.27	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Chrysene	1.6	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Dibenz(a,h)anthracene	0.42	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Fluoranthene	1.8	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Fluorene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Indeno(1,2,3-cd)pyrene	1.7	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
2-Methylnaphthalene	0.38	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Naphthalene	0.32	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Phenanthrene	1.1	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC
Pyrene	2.1	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:04	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	42.6	30-130		5/1/17 19:04
2-Fluorobiphenyl	41.6	30-130		5/1/17 19:04
p-Terphenyl-d14	60.8	30-130		5/1/17 19:04

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (0-1) Sampled: 4/25/2017 12:00

Sample ID: 17D1128-01

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	350	4.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Arsenic	63	4.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Barium	2700	4.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Beryllium	0.62	0.40	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Cadmium	3.3	0.40	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Chromium	14000	0.79	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Lead	1100	1.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Mercury	0.90	0.20	mg/Kg dry	5		SW-846 7471B	4/27/17	4/27/17 13:06	TJK
Nickel	14	0.79	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Selenium	ND	7.9	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Silver	ND	0.79	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Thallium	ND	4.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Vanadium	46	1.6	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN
Zinc	210	1.6	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:53	SHN

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (0-1) Sampled: 4/25/2017 12:00

Sample ID: 17D1128-01

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	2.5	mg/Kg dry	10	W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	160		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @21.9°C	5.3		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	62.9		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 11:55

Sample ID: 17D1128-02

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acetone	ND	0.17	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
tert-Amyl Methyl Ether (TAME)	ND	0.0017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Benzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Bromobenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Bromochloromethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Bromodichloromethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Bromoform	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Bromomethane	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
2-Butanone (MEK)	ND	0.067	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
n-Butylbenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
sec-Butylbenzene	0.029	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
tert-Butylbenzene	0.0052	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
tert-Butyl Ethyl Ether (TBEE)	ND	0.0017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Carbon Disulfide	ND	0.010	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Carbon Tetrachloride	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Chlorobenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Chlorodibromomethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Chloroethane	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Chloroform	ND	0.0067	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Chloromethane	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
2-Chlorotoluene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
4-Chlorotoluene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0067	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2-Dibromoethane (EDB)	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Dibromomethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2-Dichlorobenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,3-Dichlorobenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,4-Dichlorobenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Dichlorodifluoromethane (Freon 12)	ND	0.017	mg/Kg dry	1	V-05	SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,1-Dichloroethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2-Dichloroethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,1-Dichloroethylene	ND	0.0067	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
cis-1,2-Dichloroethylene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
trans-1,2-Dichloroethylene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2-Dichloropropane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,3-Dichloropropane	ND	0.0017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
2,2-Dichloropropane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,1-Dichloropropene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
cis-1,3-Dichloropropene	ND	0.0017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
trans-1,3-Dichloropropene	ND	0.0017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Diethyl Ether	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Diisopropyl Ether (DIPE)	ND	0.0017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,4-Dioxane	ND	0.33	mg/Kg dry	1	V-16	SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Ethylbenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 11:55

Sample ID: 17D1128-02

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexachlorobutadiene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
2-Hexanone (MBK)	ND	0.033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Isopropylbenzene (Cumene)	0.0068	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
p-Isopropyltoluene (p-Cymene)	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Methyl tert-Butyl Ether (MTBE)	ND	0.0067	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Methylene Chloride	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
4-Methyl-2-pentanone (MIBK)	ND	0.033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Naphthalene	0.034	0.017	mg/Kg dry	1	V-05	SW-846 8260C	4/26/17	4/26/17 14:03	MFF
n-Propylbenzene	0.0093	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Styrene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,1,1,2-Tetrachloroethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,1,2,2-Tetrachloroethane	ND	0.0017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Tetrachloroethylene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Tetrahydrofuran	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Toluene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2,3-Trichlorobenzene	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2,4-Trichlorobenzene	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,1,1-Trichloroethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,1,2-Trichloroethane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Trichloroethylene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Trichlorofluoromethane (Freon 11)	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2,3-Trichloropropane	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,2,4-Trimethylbenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
1,3,5-Trimethylbenzene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
Vinyl Chloride	ND	0.017	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
m+p Xylene	ND	0.0067	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF
o-Xylene	ND	0.0033	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 14:03	MFF

Surrogates	% Recovery	Recovery Limits	Flag/Qual		
1,2-Dichloroethane-d4	105	70-130		4/26/17	14:03
Toluene-d8	99.1	70-130		4/26/17	14:03
4-Bromofluorobenzene	89.8	70-130		4/26/17	14:03

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Project Location: 18 Howley St. | Sample Description: | Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) | Sampled: 4/25/2017 11:55

Sample ID: 17D1128-02

Sample Matrix: Soil

Sample Flags: RL-12

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Acenaphthylene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Anthracene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Benzo(a)anthracene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Benzo(a)pyrene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Benzo(b)fluoranthene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Benzo(g,h,i)perylene	ND	0.64	mg/Kg dry	2	V-20	SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Benzo(k)fluoranthene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Chrysene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Dibenz(a,h)anthracene	ND	0.64	mg/Kg dry	2	V-20	SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Fluoranthene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Fluorene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Indeno(1,2,3-cd)pyrene	ND	0.64	mg/Kg dry	2	V-20	SW-846 8270D	4/26/17	5/1/17 13:39	MJC
2-Methylnaphthalene	4.6	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Naphthalene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Phenanthrene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC
Pyrene	ND	0.64	mg/Kg dry	2		SW-846 8270D	4/26/17	5/1/17 13:39	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	52.4	30-130		5/1/17 13:39
2-Fluorobiphenyl	50.8	30-130		5/1/17 13:39
p-Terphenyl-d14	52.2	30-130		5/1/17 13:39

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 11:55

Sample ID: 17D1128-02

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	9.7	4.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Arsenic	30	4.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Barium	73	4.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Beryllium	0.58	0.45	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Cadmium	2.5	0.45	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Chromium	270	0.90	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Lead	120	1.4	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Mercury	0.31	0.047	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:42	TJK
Nickel	13	0.90	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Selenium	ND	9.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Silver	ND	0.90	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Thallium	ND	4.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Vanadium	17	1.8	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN
Zinc	460	1.8	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:58	SHN

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Project Location: 18 Howley St. | Sample Description: | Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) | Sampled: 4/25/2017 11:55

Sample ID: 17D1128-02

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.5	mg/Kg dry	5	W-06	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	160		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @23.4°C	6.0		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	53.0		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 11:00

Sample ID: 17D1128-03

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Acenaphthylene	ND	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Anthracene	ND	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Benzo(a)anthracene	0.90	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Benzo(a)pyrene	0.88	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Benzo(b)fluoranthene	1.5	0.26	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Benzo(g,h,i)perylene	0.71	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Benzo(k)fluoranthene	0.47	0.26	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Chrysene	1.1	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Dibenz(a,h)anthracene	ND	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Fluoranthene	1.9	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Fluorene	ND	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Indeno(1,2,3-cd)pyrene	0.90	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
2-Methylnaphthalene	ND	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Naphthalene	0.33	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Phenanthrene	1.0	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC
Pyrene	2.0	0.26	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:28	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	42.7	30-130		5/1/17 19:28
2-Fluorobiphenyl	42.6	30-130		5/1/17 19:28
p-Terphenyl-d14	59.0	30-130		5/1/17 19:28

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 11:00

Sample ID: 17D1128-03

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	110	3.8	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Arsenic	34	3.8	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Barium	1500	3.8	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Beryllium	0.54	0.38	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Cadmium	5.3	0.38	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Chromium	4200	0.76	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Lead	940	1.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Mercury	1.1	0.19	mg/Kg dry	5	MS-11	SW-846 7471B	4/27/17	4/27/17 13:04	TJK
Nickel	20	0.76	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Selenium	ND	7.6	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Silver	ND	0.76	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Thallium	ND	3.8	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Vanadium	72	1.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN
Zinc	360	1.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:03	SHN

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 11:00

Sample ID: 17D1128-03

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.2	mg/Kg dry	5	W-06	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	180		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @23.5°C	4.7		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	66.3		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 12:10

Sample ID: 17D1128-04

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Acenaphthylene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Anthracene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Benzo(a)anthracene	0.59	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Benzo(a)pyrene	0.57	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Benzo(b)fluoranthene	0.87	0.45	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Benzo(g,h,i)perylene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Benzo(k)fluoranthene	ND	0.45	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Chrysene	0.70	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Dibenz(a,h)anthracene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Fluoranthene	1.2	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Fluorene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Indeno(1,2,3-cd)pyrene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
2-Methylnaphthalene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Naphthalene	ND	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Phenanthrene	0.62	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC
Pyrene	1.1	0.45	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 19:53	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	42.6	30-130		5/1/17 19:53
2-Fluorobiphenyl	42.3	30-130		5/1/17 19:53
p-Terphenyl-d14	54.1	30-130		5/1/17 19:53

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 12:10

Sample ID: 17D1128-04

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	20	3.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Arsenic	83	3.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Barium	180	3.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Beryllium	0.53	0.31	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Cadmium	6.2	0.31	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Chromium	430	0.62	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Lead	660	0.92	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Mercury	0.31	0.032	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:44	TJK
Nickel	27	0.62	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Selenium	ND	6.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Silver	ND	0.62	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Thallium	ND	3.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Vanadium	33	1.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN
Zinc	590	1.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:09	SHN

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 12:10

Sample ID: 17D1128-04

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.0	mg/Kg dry	5	W-06	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	120		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @23.1°C	6.7		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	75.8		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17D1128-05

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Acenaphthylene	ND	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Acetophenone	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Aniline	ND	0.48	mg/Kg dry	1	L-04	SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Anthracene	ND	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Benzo(a)anthracene	0.63	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Benzo(a)pyrene	0.66	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Benzo(b)fluoranthene	0.98	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Benzo(g,h,i)perylene	0.51	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Benzo(k)fluoranthene	0.34	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Bis(2-chloroethoxy)methane	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Bis(2-chloroethyl)ether	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Bis(2-chloroisopropyl)ether	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Bis(2-Ethylhexyl)phthalate	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
4-Bromophenylphenylether	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Butylbenzylphthalate	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
4-Chloroaniline	ND	0.93	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2-Chloronaphthalene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2-Chlorophenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Chrysene	0.74	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Dibenz(a,h)anthracene	ND	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Dibenzofuran	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Di-n-butylphthalate	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
1,2-Dichlorobenzene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
1,3-Dichlorobenzene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
1,4-Dichlorobenzene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
3,3-Dichlorobenzidine	ND	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2,4-Dichlorophenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Diethylphthalate	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2,4-Dimethylphenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Dimethylphthalate	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2,4-Dinitrophenol	ND	0.93	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2,4-Dinitrotoluene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2,6-Dinitrotoluene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Di-n-octylphthalate	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Fluoranthene	1.3	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Fluorene	ND	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Hexachlorobenzene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Hexachlorobutadiene	ND	0.48	mg/Kg dry	1	V-20	SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Hexachloroethane	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Indeno(1,2,3-cd)pyrene	0.52	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Isophorone	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2-Methylnaphthalene	ND	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17D1128-05

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
2-Methylphenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
3/4-Methylphenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Naphthalene	0.28	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Nitrobenzene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2-Nitrophenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
4-Nitrophenol	ND	0.93	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Pentachlorophenol	ND	0.48	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Phenanthrene	0.64	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Phenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
Pyrene	1.2	0.24	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
1,2,4-Trichlorobenzene	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2,4,5-Trichlorophenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL
2,4,6-Trichlorophenol	ND	0.48	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:03	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
2-Fluorophenol	55.4	30-130		5/1/17 20:03
Phenol-d6	57.0	30-130		5/1/17 20:03
Nitrobenzene-d5	66.0	30-130		5/1/17 20:03
2-Fluorobiphenyl	67.9	30-130		5/1/17 20:03
2,4,6-Tribromophenol	71.3	30-130		5/1/17 20:03
p-Terphenyl-d14	68.3	30-130		5/1/17 20:03

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17D1128-05

Sample Matrix: Soil

Polychlorinated Biphenyls By GC/ECD

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1221 [1]	ND	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1232 [1]	ND	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1242 [1]	ND	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1248 [1]	ND	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1254 [1]	0.57	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1260 [2]	0.23	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1262 [1]	ND	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL
Aroclor-1268 [1]	ND	0.14	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:28	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	84.9	30-150		5/1/17 10:28
Decachlorobiphenyl [2]	102	30-150		5/1/17 10:28
Tetrachloro-m-xylene [1]	91.5	30-150		5/1/17 10:28
Tetrachloro-m-xylene [2]	90.5	30-150		5/1/17 10:28

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17D1128-05

Sample Matrix: Soil

Petroleum Hydrocarbons Analyses

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
TPH (C9-C36)	190	59	mg/Kg dry	5		SW-846 8100 Modified	4/27/17	5/2/17 0:29	PJG

Surrogates	% Recovery	Recovery Limits	Flag/Qual				
o-Terphenyl	66.8	40-140					5/2/17 0:29

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17D1128-05

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Arsenic	83	3.4	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:14	SHN
Barium	420	3.4	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:14	SHN
Cadmium	6.1	0.34	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:14	SHN
Chromium	930	0.67	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:14	SHN
Lead	640	1.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:14	SHN
Mercury	0.49	0.036	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:45	TJK
Selenium	ND	6.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:14	SHN
Silver	ND	0.67	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:14	SHN

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Project Location: 18 Howley St. Sample Description: Work Order: 17D1128

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17D1128-05

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Ignitability	Absent		present/absent	1		SW-846 1030	4/27/17	4/27/17 15:20	DCF
pH @21.6°C	7.3		pH Units	1		SW-846 9045C	4/26/17	4/26/17 8:45	LL
Reactive Cyanide	ND	4.0	mg/Kg	1		SW-846 9014	4/27/17	4/28/17 8:35	LL
Reactive Sulfide	ND	20	mg/Kg	1		SW-846 9030A	4/27/17	4/28/17 8:20	LL
Specific conductance	3.6	2.0	µmhos/cm	1		SM21-22 2510B Modified	5/2/17	5/2/17 10:15	EC
% Solids	70.6		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Sample Extraction Data

Prep Method: % Solids-SM 2540G

Lab Number [Field ID]	Batch	Date
17D1128-01 [SP-1 (0-1)]	B175514	04/27/17
17D1128-02 [SP-1 (2-5)]	B175514	04/27/17
17D1128-03 [SP-2 (0-1)]	B175514	04/27/17
17D1128-04 [SP-2 (2-5)]	B175514	04/27/17
17D1128-05 [Disposal Characterization]	B175514	04/27/17

SM21-22 2510B Modified

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1128-05 [Disposal Characterization]	B175829	1.00	05/02/17

SM2580 A

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1128-01 [SP-1 (0-1)]	B175351	20.0	04/26/17
17D1128-02 [SP-1 (2-5)]	B175351	20.0	04/26/17
17D1128-03 [SP-2 (0-1)]	B175351	20.0	04/26/17
17D1128-04 [SP-2 (2-5)]	B175351	20.0	04/26/17

SW-846 1030

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1128-05 [Disposal Characterization]	B175571	50.0	04/27/17

Prep Method: SW-846 3050B-SW-846 6010C-D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-01 [SP-1 (0-1)]	B175526	1.00	50.0	04/27/17
17D1128-02 [SP-1 (2-5)]	B175526	1.04	50.0	04/27/17
17D1128-03 [SP-2 (0-1)]	B175526	0.993	50.0	04/27/17
17D1128-04 [SP-2 (2-5)]	B175526	1.07	50.0	04/27/17
17D1128-05 [Disposal Characterization]	B175526	1.05	50.0	04/27/17

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-02 [SP-1 (2-5)]	B175501	2.57	100	04/27/17
17D1128-03 [SP-2 (0-1)]	B175501	2.50	100	04/27/17
17D1128-04 [SP-2 (2-5)]	B175501	2.54	100	04/27/17

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-01 [SP-1 (0-1)]	B175749	2.55	100	05/01/17

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Sample Extraction Data

Prep Method: SW-846 7471-SW-846 7471B

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-01 [SP-1 (0-1)]	B175482	0.602	50.0	04/27/17
17D1128-02 [SP-1 (2-5)]	B175482	0.598	50.0	04/27/17
17D1128-03 [SP-2 (0-1)]	B175482	0.604	50.0	04/27/17
17D1128-04 [SP-2 (2-5)]	B175482	0.626	50.0	04/27/17
17D1128-05 [Disposal Characterization]	B175482	0.594	50.0	04/27/17

Prep Method: SW-846 3546-SW-846 8082A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-05 [Disposal Characterization]	B175466	10.0	10.0	04/27/17

Prep Method: SW-846 3546-SW-846 8100 Modified

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-05 [Disposal Characterization]	B175469	30.0	1.00	04/27/17

Prep Method: SW-846 5035-SW-846 8260C

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-02 [SP-1 (2-5)]	B175403	5.64	10.0	04/26/17

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-01 [SP-1 (0-1)]	B175339	30.0	1.00	04/26/17
17D1128-02 [SP-1 (2-5)]	B175339	30.0	1.00	04/26/17
17D1128-03 [SP-2 (0-1)]	B175339	30.0	1.00	04/26/17
17D1128-04 [SP-2 (2-5)]	B175339	15.0	1.00	04/26/17

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-05 [Disposal Characterization]	B175467	30.0	1.00	04/27/17

SW-846 9014

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-05 [Disposal Characterization]	B175566	25.2	250	04/27/17

SW-846 9030A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1128-05 [Disposal Characterization]	B175577	25.2	250	04/27/17

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Sample Extraction Data

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1128-01 [SP-1 (0-1)]	B175358	20.0	04/26/17
17D1128-02 [SP-1 (2-5)]	B175358	20.0	04/26/17
17D1128-03 [SP-2 (0-1)]	B175358	20.0	04/26/17
17D1128-04 [SP-2 (2-5)]	B175358	20.0	04/26/17

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1128-05 [Disposal Characterization]	B175376	20.0	04/26/17

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175403 - SW-846 5035										
Blank (B175403-BLK1)				Prepared & Analyzed: 04/26/17						
Acetone	ND	0.10	mg/Kg wet							
tert-Amyl Methyl Ether (TAME)	ND	0.0010	mg/Kg wet							
Benzene	ND	0.0020	mg/Kg wet							
Bromobenzene	ND	0.0020	mg/Kg wet							
Bromochloromethane	ND	0.0020	mg/Kg wet							
Bromodichloromethane	ND	0.0020	mg/Kg wet							
Bromoform	ND	0.0020	mg/Kg wet							
Bromomethane	ND	0.010	mg/Kg wet							
2-Butanone (MEK)	ND	0.040	mg/Kg wet							
n-Butylbenzene	ND	0.0020	mg/Kg wet							
sec-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butyl Ethyl Ether (TBEE)	ND	0.0010	mg/Kg wet							
Carbon Disulfide	ND	0.0060	mg/Kg wet							
Carbon Tetrachloride	ND	0.0020	mg/Kg wet							
Chlorobenzene	ND	0.0020	mg/Kg wet							
Chlorodibromomethane	ND	0.0010	mg/Kg wet							
Chloroethane	ND	0.010	mg/Kg wet							
Chloroform	ND	0.0040	mg/Kg wet							
Chloromethane	ND	0.010	mg/Kg wet							
2-Chlorotoluene	ND	0.0020	mg/Kg wet							
4-Chlorotoluene	ND	0.0020	mg/Kg wet							
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0020	mg/Kg wet							
1,2-Dibromoethane (EDB)	ND	0.0010	mg/Kg wet							
Dibromomethane	ND	0.0020	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.0020	mg/Kg wet							
Dichlorodifluoromethane (Freon 12)	ND	0.010	mg/Kg wet							V-05
1,1-Dichloroethane	ND	0.0020	mg/Kg wet							
1,2-Dichloroethane	ND	0.0020	mg/Kg wet							
1,1-Dichloroethylene	ND	0.0040	mg/Kg wet							
cis-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
trans-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
1,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,3-Dichloropropane	ND	0.0010	mg/Kg wet							
2,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,1-Dichloropropene	ND	0.0020	mg/Kg wet							
cis-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
trans-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
Diethyl Ether	ND	0.010	mg/Kg wet							
Diisopropyl Ether (DIPE)	ND	0.0010	mg/Kg wet							
1,4-Dioxane	ND	0.10	mg/Kg wet							V-16
Ethylbenzene	ND	0.0020	mg/Kg wet							
Hexachlorobutadiene	ND	0.0020	mg/Kg wet							
2-Hexanone (MBK)	ND	0.020	mg/Kg wet							
Isopropylbenzene (Cumene)	ND	0.0020	mg/Kg wet							
p-Isopropyltoluene (p-Cymene)	ND	0.0020	mg/Kg wet							
Methyl tert-Butyl Ether (MTBE)	ND	0.0040	mg/Kg wet							
Methylene Chloride	ND	0.010	mg/Kg wet							
4-Methyl-2-pentanone (MIBK)	ND	0.020	mg/Kg wet							
Naphthalene	ND	0.0040	mg/Kg wet							V-05

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035											
Blank (B175403-BLK1)				Prepared & Analyzed: 04/26/17							
n-Propylbenzene	ND	0.0020	mg/Kg wet								
Styrene	ND	0.0020	mg/Kg wet								
1,1,1,2-Tetrachloroethane	ND	0.0020	mg/Kg wet								
1,1,2,2-Tetrachloroethane	ND	0.0010	mg/Kg wet								
Tetrachloroethylene	ND	0.0020	mg/Kg wet								
Tetrahydrofuran	ND	0.010	mg/Kg wet								
Toluene	ND	0.0020	mg/Kg wet								
1,2,3-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,2,4-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,1,1-Trichloroethane	ND	0.0020	mg/Kg wet								
1,1,2-Trichloroethane	ND	0.0020	mg/Kg wet								
Trichloroethylene	ND	0.0020	mg/Kg wet								
Trichlorofluoromethane (Freon 11)	ND	0.010	mg/Kg wet								
1,2,3-Trichloropropane	ND	0.0020	mg/Kg wet								
1,2,4-Trimethylbenzene	ND	0.0020	mg/Kg wet								
1,3,5-Trimethylbenzene	ND	0.0020	mg/Kg wet								
Vinyl Chloride	ND	0.010	mg/Kg wet								
m+p Xylene	ND	0.0040	mg/Kg wet								
o-Xylene	ND	0.0020	mg/Kg wet								
Surrogate: 1,2-Dichloroethane-d4	*0.0537*		mg/Kg wet	0.0500		107	70-130				
Surrogate: Toluene-d8	*0.0492*		mg/Kg wet	0.0500		98.5	70-130				
Surrogate: 4-Bromofluorobenzene	*0.0472*		mg/Kg wet	0.0500		94.4	70-130				
LCS (B175403-BS1)				Prepared & Analyzed: 04/26/17							
Acetone	0.155	0.10	mg/Kg wet	0.200		77.4	40-160				†
tert-Amyl Methyl Ether (TAME)	0.0183	0.0010	mg/Kg wet	0.0200		91.6	70-130				
Benzene	0.0202	0.0020	mg/Kg wet	0.0200		101	70-130				
Bromobenzene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130				
Bromochloromethane	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130				
Bromodichloromethane	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130				
Bromoform	0.0246	0.0020	mg/Kg wet	0.0200		123	70-130				
Bromomethane	0.0136	0.010	mg/Kg wet	0.0200		68.0	40-160			L-14	†
2-Butanone (MEK)	0.167	0.040	mg/Kg wet	0.200		83.7	40-160				†
n-Butylbenzene	0.0242	0.0020	mg/Kg wet	0.0200		121	70-130				
sec-Butylbenzene	0.0231	0.0020	mg/Kg wet	0.0200		116	70-130				
tert-Butylbenzene	0.0223	0.0020	mg/Kg wet	0.0200		112	70-130				
tert-Butyl Ethyl Ether (TBEE)	0.0182	0.0010	mg/Kg wet	0.0200		91.2	70-130				
Carbon Disulfide	0.0232	0.0060	mg/Kg wet	0.0200		116	70-130				
Carbon Tetrachloride	0.0234	0.0020	mg/Kg wet	0.0200		117	70-130				
Chlorobenzene	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130				
Chlorodibromomethane	0.0235	0.0010	mg/Kg wet	0.0200		117	70-130				
Chloroethane	0.0167	0.010	mg/Kg wet	0.0200		83.3	70-130				
Chloroform	0.0218	0.0040	mg/Kg wet	0.0200		109	70-130				
Chloromethane	0.0132	0.010	mg/Kg wet	0.0200		66.0	40-160			L-14	†
2-Chlorotoluene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130				
4-Chlorotoluene	0.0221	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dibromo-3-chloropropane (DBCP)	0.0192	0.0020	mg/Kg wet	0.0200		96.1	70-130				
1,2-Dibromoethane (EDB)	0.0207	0.0010	mg/Kg wet	0.0200		103	70-130				
Dibromomethane	0.0221	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dichlorobenzene	0.0235	0.0020	mg/Kg wet	0.0200		118	70-130				
1,3-Dichlorobenzene	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130				
1,4-Dichlorobenzene	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035												
LCS (B175403-BS1)				Prepared & Analyzed: 04/26/17								
Dichlorodifluoromethane (Freon 12)	0.00998	0.010	mg/Kg wet	0.0200		49.9		40-160			L-14, V-05	†
1,1-Dichloroethane	0.0222	0.0020	mg/Kg wet	0.0200		111		70-130				
1,2-Dichloroethane	0.0237	0.0020	mg/Kg wet	0.0200		118		70-130				
1,1-Dichloroethylene	0.0215	0.0040	mg/Kg wet	0.0200		108		70-130				
cis-1,2-Dichloroethylene	0.0217	0.0020	mg/Kg wet	0.0200		108		70-130				
trans-1,2-Dichloroethylene	0.0207	0.0020	mg/Kg wet	0.0200		104		70-130				
1,2-Dichloropropane	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,3-Dichloropropane	0.0210	0.0010	mg/Kg wet	0.0200		105		70-130				
2,2-Dichloropropane	0.0209	0.0020	mg/Kg wet	0.0200		104		70-130				
1,1-Dichloropropene	0.0212	0.0020	mg/Kg wet	0.0200		106		70-130				
cis-1,3-Dichloropropene	0.0191	0.0010	mg/Kg wet	0.0200		95.5		70-130				
trans-1,3-Dichloropropene	0.0200	0.0010	mg/Kg wet	0.0200		100		70-130				
Diethyl Ether	0.0180	0.010	mg/Kg wet	0.0200		90.2		70-130				
Diisopropyl Ether (DIPE)	0.0198	0.0010	mg/Kg wet	0.0200		99.2		70-130				
1,4-Dioxane	0.196	0.10	mg/Kg wet	0.200		97.9		40-160			V-16	†
Ethylbenzene	0.0222	0.0020	mg/Kg wet	0.0200		111		70-130				
Hexachlorobutadiene	0.0275	0.0020	mg/Kg wet	0.0200		**138**	*	70-130			L-07	
2-Hexanone (MBK)	0.173	0.020	mg/Kg wet	0.200		86.4		40-160				†
Isopropylbenzene (Cumene)	0.0238	0.0020	mg/Kg wet	0.0200		119		70-130				
p-Isopropyltoluene (p-Cymene)	0.0236	0.0020	mg/Kg wet	0.0200		118		70-130				
Methyl tert-Butyl Ether (MTBE)	0.0188	0.0040	mg/Kg wet	0.0200		94.2		70-130				
Methylene Chloride	0.0218	0.010	mg/Kg wet	0.0200		109		70-130				
4-Methyl-2-pentanone (MIBK)	0.200	0.020	mg/Kg wet	0.200		99.8		40-160				†
Naphthalene	0.0166	0.0040	mg/Kg wet	0.0200		83.0		70-130			V-05	
n-Propylbenzene	0.0226	0.0020	mg/Kg wet	0.0200		113		70-130				
Styrene	0.0214	0.0020	mg/Kg wet	0.0200		107		70-130				
1,1,1,2-Tetrachloroethane	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,1,2,2-Tetrachloroethane	0.0215	0.0010	mg/Kg wet	0.0200		108		70-130				
Tetrachloroethylene	0.0253	0.0020	mg/Kg wet	0.0200		126		70-130				
Tetrahydrofuran	0.0187	0.010	mg/Kg wet	0.0200		93.6		70-130				
Toluene	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,2,3-Trichlorobenzene	0.0194	0.0020	mg/Kg wet	0.0200		97.0		70-130				
1,2,4-Trichlorobenzene	0.0191	0.0020	mg/Kg wet	0.0200		95.3		70-130				
1,1,1-Trichloroethane	0.0226	0.0020	mg/Kg wet	0.0200		113		70-130				
1,1,2-Trichloroethane	0.0215	0.0020	mg/Kg wet	0.0200		107		70-130				
Trichloroethylene	0.0220	0.0020	mg/Kg wet	0.0200		110		70-130				
Trichlorofluoromethane (Freon 11)	0.0197	0.010	mg/Kg wet	0.0200		98.5		70-130				
1,2,3-Trichloropropane	0.0213	0.0020	mg/Kg wet	0.0200		107		70-130				
1,2,4-Trimethylbenzene	0.0217	0.0020	mg/Kg wet	0.0200		108		70-130				
1,3,5-Trimethylbenzene	0.0228	0.0020	mg/Kg wet	0.0200		114		70-130				
Vinyl Chloride	0.0147	0.010	mg/Kg wet	0.0200		73.5		70-130				
m+p Xylene	0.0440	0.0040	mg/Kg wet	0.0400		110		70-130				
o-Xylene	0.0209	0.0020	mg/Kg wet	0.0200		104		70-130				
Surrogate: 1,2-Dichloroethane-d4	*0.0521*		mg/Kg wet	0.0500		104		70-130				
Surrogate: Toluene-d8	*0.0481*		mg/Kg wet	0.0500		96.3		70-130				
Surrogate: 4-Bromofluorobenzene	*0.0492*		mg/Kg wet	0.0500		98.4		70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035											
LCS Dup (B175403-BSD1)				Prepared & Analyzed: 04/26/17							
Acetone	0.158	0.10	mg/Kg wet	0.200		78.8	40-160	1.78	20		†
tert-Amyl Methyl Ether (TAME)	0.0184	0.0010	mg/Kg wet	0.0200		92.1	70-130	0.544	20		
Benzene	0.0200	0.0020	mg/Kg wet	0.0200		99.9	70-130	1.19	20		
Bromobenzene	0.0205	0.0020	mg/Kg wet	0.0200		102	70-130	6.15	20		
Bromochloromethane	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130	0.0849	20		
Bromodichloromethane	0.0235	0.0020	mg/Kg wet	0.0200		117	70-130	2.59	20		
Bromoform	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	9.52	20		
Bromomethane	0.0145	0.010	mg/Kg wet	0.0200		72.6	40-160	6.54	20		†
2-Butanone (MEK)	0.171	0.040	mg/Kg wet	0.200		85.5	40-160	2.14	20		†
n-Butylbenzene	0.0228	0.0020	mg/Kg wet	0.0200		114	70-130	6.12	20		
sec-Butylbenzene	0.0221	0.0020	mg/Kg wet	0.0200		111	70-130	4.33	20		
tert-Butylbenzene	0.0211	0.0020	mg/Kg wet	0.0200		105	70-130	5.80	20		
tert-Butyl Ethyl Ether (TBEE)	0.0186	0.0010	mg/Kg wet	0.0200		93.0	70-130	1.95	20		
Carbon Disulfide	0.0231	0.0060	mg/Kg wet	0.0200		115	70-130	0.778	20		
Carbon Tetrachloride	0.0229	0.0020	mg/Kg wet	0.0200		115	70-130	1.99	20		
Chlorobenzene	0.0211	0.0020	mg/Kg wet	0.0200		105	70-130	1.51	20		
Chlorodibromomethane	0.0231	0.0010	mg/Kg wet	0.0200		116	70-130	1.46	20		
Chloroethane	0.0156	0.010	mg/Kg wet	0.0200		77.9	70-130	6.70	20		
Chloroform	0.0217	0.0040	mg/Kg wet	0.0200		108	70-130	0.644	20		
Chloromethane	0.0129	0.010	mg/Kg wet	0.0200		64.7	40-160	1.99	20	L-14	†
2-Chlorotoluene	0.0219	0.0020	mg/Kg wet	0.0200		110	70-130	0.457	20		
4-Chlorotoluene	0.0217	0.0020	mg/Kg wet	0.0200		108	70-130	1.83	20		
1,2-Dibromo-3-chloropropane (DBCP)	0.0192	0.0020	mg/Kg wet	0.0200		96.2	70-130	0.104	20		
1,2-Dibromoethane (EDB)	0.0211	0.0010	mg/Kg wet	0.0200		106	70-130	2.11	20		
Dibromomethane	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130	3.56	20		
1,2-Dichlorobenzene	0.0217	0.0020	mg/Kg wet	0.0200		109	70-130	7.95	20		
1,3-Dichlorobenzene	0.0227	0.0020	mg/Kg wet	0.0200		114	70-130	3.80	20		
1,4-Dichlorobenzene	0.0213	0.0020	mg/Kg wet	0.0200		106	70-130	7.25	20		
Dichlorodifluoromethane (Freon 12)	0.0102	0.010	mg/Kg wet	0.0200		50.8	40-160	1.79	20	L-14, V-05	†
1,1-Dichloroethane	0.0223	0.0020	mg/Kg wet	0.0200		111	70-130	0.0899	20		
1,2-Dichloroethane	0.0244	0.0020	mg/Kg wet	0.0200		122	70-130	2.92	20		
1,1-Dichloroethylene	0.0214	0.0040	mg/Kg wet	0.0200		107	70-130	0.465	20		
cis-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	3.28	20		
trans-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	1.44	20		
1,2-Dichloropropane	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	4.09	20		
1,3-Dichloropropane	0.0212	0.0010	mg/Kg wet	0.0200		106	70-130	0.950	20		
2,2-Dichloropropane	0.0208	0.0020	mg/Kg wet	0.0200		104	70-130	0.384	20		
1,1-Dichloropropene	0.0216	0.0020	mg/Kg wet	0.0200		108	70-130	2.06	20		
cis-1,3-Dichloropropene	0.0197	0.0010	mg/Kg wet	0.0200		98.5	70-130	3.09	20		
trans-1,3-Dichloropropene	0.0197	0.0010	mg/Kg wet	0.0200		98.5	70-130	1.71	20		
Diethyl Ether	0.0173	0.010	mg/Kg wet	0.0200		86.5	70-130	4.19	20		
Diisopropyl Ether (DIPE)	0.0199	0.0010	mg/Kg wet	0.0200		99.4	70-130	0.201	20		
1,4-Dioxane	0.227	0.10	mg/Kg wet	0.200		114	40-160	14.8	20	V-16	†
Ethylbenzene	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130	1.08	20		
Hexachlorobutadiene	0.0254	0.0020	mg/Kg wet	0.0200		127	70-130	8.08	20		
2-Hexanone (MBK)	0.173	0.020	mg/Kg wet	0.200		86.3	40-160	0.127	20		†
Isopropylbenzene (Cumene)	0.0234	0.0020	mg/Kg wet	0.0200		117	70-130	1.61	20		
p-Isopropyltoluene (p-Cymene)	0.0223	0.0020	mg/Kg wet	0.0200		111	70-130	5.75	20		
Methyl tert-Butyl Ether (MTBE)	0.0190	0.0040	mg/Kg wet	0.0200		95.2	70-130	1.06	20		
Methylene Chloride	0.0213	0.010	mg/Kg wet	0.0200		106	70-130	2.23	20		
4-Methyl-2-pentanone (MIBK)	0.200	0.020	mg/Kg wet	0.200		99.8	40-160	0.0601	20		†
Naphthalene	0.0158	0.0040	mg/Kg wet	0.0200		79.2	70-130	4.69	20	V-05	

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175403 - SW-846 5035										
LCS Dup (B175403-BSD1)				Prepared & Analyzed: 04/26/17						
n-Propylbenzene	0.0217	0.0020	mg/Kg wet	0.0200		108	70-130	4.42	20	
Styrene	0.0206	0.0020	mg/Kg wet	0.0200		103	70-130	4.00	20	
1,1,1,2-Tetrachloroethane	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	2.87	20	
1,1,2,2-Tetrachloroethane	0.0209	0.0010	mg/Kg wet	0.0200		105	70-130	2.82	20	
Tetrachloroethylene	0.0251	0.0020	mg/Kg wet	0.0200		125	70-130	0.874	20	
Tetrahydrofuran	0.0206	0.010	mg/Kg wet	0.0200		103	70-130	9.56	20	
Toluene	0.0209	0.0020	mg/Kg wet	0.0200		105	70-130	1.44	20	
1,2,3-Trichlorobenzene	0.0186	0.0020	mg/Kg wet	0.0200		93.0	70-130	4.21	20	
1,2,4-Trichlorobenzene	0.0184	0.0020	mg/Kg wet	0.0200		92.0	70-130	3.52	20	
1,1,1-Trichloroethane	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130	3.05	20	
1,1,2-Trichloroethane	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	0.186	20	
Trichloroethylene	0.0225	0.0020	mg/Kg wet	0.0200		113	70-130	2.33	20	
Trichlorofluoromethane (Freon 11)	0.0195	0.010	mg/Kg wet	0.0200		97.3	70-130	1.23	20	
1,2,3-Trichloropropane	0.0182	0.0020	mg/Kg wet	0.0200		91.1	70-130	15.7	20	
1,2,4-Trimethylbenzene	0.0207	0.0020	mg/Kg wet	0.0200		104	70-130	4.72	20	
1,3,5-Trimethylbenzene	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	1.77	20	
Vinyl Chloride	0.0143	0.010	mg/Kg wet	0.0200		71.5	70-130	2.76	20	
m+p Xylene	0.0427	0.0040	mg/Kg wet	0.0400		107	70-130	3.04	20	
o-Xylene	0.0213	0.0020	mg/Kg wet	0.0200		107	70-130	1.99	20	
Surrogate: 1,2-Dichloroethane-d4	*0.0518*		mg/Kg wet	0.0500		104	70-130			
Surrogate: Toluene-d8	*0.0503*		mg/Kg wet	0.0500		101	70-130			
Surrogate: 4-Bromofluorobenzene	*0.0482*		mg/Kg wet	0.0500		96.5	70-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175339 - SW-846 3546										
Blank (B175339-BLK1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							V-20
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							V-20
Fluoranthene	ND	0.17	mg/Kg wet							
Fluorene	ND	0.17	mg/Kg wet							
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet							V-20
2-Methylnaphthalene	ND	0.17	mg/Kg wet							
Naphthalene	ND	0.17	mg/Kg wet							
Phenanthrene	ND	0.17	mg/Kg wet							
Pyrene	ND	0.17	mg/Kg wet							
Surrogate: Nitrobenzene-d5	*3.04*		mg/Kg wet	3.33		91.3	30-130			
Surrogate: 2-Fluorobiphenyl	*3.18*		mg/Kg wet	3.33		95.4	30-130			
Surrogate: p-Terphenyl-d14	*3.61*		mg/Kg wet	3.33		108	30-130			
LCS (B175339-BS1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	1.28	0.17	mg/Kg wet	1.67		76.7	40-140			
Acenaphthylene	1.22	0.17	mg/Kg wet	1.67		73.0	40-140			
Anthracene	1.37	0.17	mg/Kg wet	1.67		82.2	40-140			
Benzo(a)anthracene	1.43	0.17	mg/Kg wet	1.67		85.7	40-140			
Benzo(a)pyrene	1.42	0.17	mg/Kg wet	1.67		85.1	40-140			
Benzo(b)fluoranthene	1.39	0.17	mg/Kg wet	1.67		83.4	40-140			
Benzo(g,h,i)perylene	1.72	0.17	mg/Kg wet	1.67		103	40-140			V-20
Benzo(k)fluoranthene	1.45	0.17	mg/Kg wet	1.67		86.8	40-140			
Chrysene	1.40	0.17	mg/Kg wet	1.67		83.9	40-140			
Dibenz(a,h)anthracene	1.80	0.17	mg/Kg wet	1.67		108	40-140			V-20
Fluoranthene	1.46	0.17	mg/Kg wet	1.67		87.5	40-140			
Fluorene	1.32	0.17	mg/Kg wet	1.67		79.5	40-140			
Indeno(1,2,3-cd)pyrene	1.83	0.17	mg/Kg wet	1.67		110	40-140			V-20
2-Methylnaphthalene	1.29	0.17	mg/Kg wet	1.67		77.5	40-140			
Naphthalene	1.17	0.17	mg/Kg wet	1.67		70.4	40-140			
Phenanthrene	1.37	0.17	mg/Kg wet	1.67		82.5	40-140			
Pyrene	1.43	0.17	mg/Kg wet	1.67		85.7	40-140			
Surrogate: Nitrobenzene-d5	*2.73*		mg/Kg wet	3.33		82.0	30-130			
Surrogate: 2-Fluorobiphenyl	*2.88*		mg/Kg wet	3.33		86.3	30-130			
Surrogate: p-Terphenyl-d14	*3.35*		mg/Kg wet	3.33		101	30-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175339 - SW-846 3546										
LCS Dup (B175339-BSD1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	1.21	0.17	mg/Kg wet	1.67		72.7	40-140	5.35	30	
Acenaphthylene	1.17	0.17	mg/Kg wet	1.67		70.3	40-140	3.77	30	
Anthracene	1.32	0.17	mg/Kg wet	1.67		79.1	40-140	3.89	30	
Benzo(a)anthracene	1.35	0.17	mg/Kg wet	1.67		81.2	40-140	5.42	30	
Benzo(a)pyrene	1.37	0.17	mg/Kg wet	1.67		82.2	40-140	3.42	30	
Benzo(b)fluoranthene	1.30	0.17	mg/Kg wet	1.67		78.0	40-140	6.72	30	
Benzo(g,h,i)perylene	1.70	0.17	mg/Kg wet	1.67		102	40-140	1.68	30	V-20
Benzo(k)fluoranthene	1.34	0.17	mg/Kg wet	1.67		80.6	40-140	7.33	30	
Chrysene	1.31	0.17	mg/Kg wet	1.67		78.7	40-140	6.32	30	
Dibenz(a,h)anthracene	1.76	0.17	mg/Kg wet	1.67		105	40-140	2.27	30	V-20
Fluoranthene	1.40	0.17	mg/Kg wet	1.67		84.2	40-140	3.89	30	
Fluorene	1.24	0.17	mg/Kg wet	1.67		74.2	40-140	6.79	30	
Indeno(1,2,3-cd)pyrene	1.73	0.17	mg/Kg wet	1.67		104	40-140	5.54	30	V-20
2-Methylnaphthalene	1.29	0.17	mg/Kg wet	1.67		77.2	40-140	0.336	30	
Naphthalene	1.14	0.17	mg/Kg wet	1.67		68.5	40-140	2.68	30	
Phenanthrene	1.30	0.17	mg/Kg wet	1.67		78.1	40-140	5.38	30	
Pyrene	1.30	0.17	mg/Kg wet	1.67		78.0	40-140	9.38	30	
Surrogate: Nitrobenzene-d5	*2.60*		mg/Kg wet	3.33		77.9	30-130			
Surrogate: 2-Fluorobiphenyl	*2.63*		mg/Kg wet	3.33		79.0	30-130			
Surrogate: p-Terphenyl-d14	*3.00*		mg/Kg wet	3.33		90.0	30-130			
Matrix Spike (B175339-MS1)	**Source: 17D1128-01**			Prepared: 04/26/17 Analyzed: 05/01/17						
Acenaphthene	1.19	0.27	mg/Kg dry	2.65	0.0853	41.8	40-140			
Batch B175467 - SW-846 3546										
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Acetophenone	ND	0.34	mg/Kg wet							
Aniline	ND	0.34	mg/Kg wet							L-04
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Bis(2-chloroethoxy)methane	ND	0.34	mg/Kg wet							
Bis(2-chloroethyl)ether	ND	0.34	mg/Kg wet							
Bis(2-chloroisopropyl)ether	ND	0.34	mg/Kg wet							
Bis(2-Ethylhexyl)phthalate	ND	0.34	mg/Kg wet							
4-Bromophenylphenylether	ND	0.34	mg/Kg wet							
Butylbenzylphthalate	ND	0.34	mg/Kg wet							
4-Chloroaniline	ND	0.66	mg/Kg wet							
2-Chloronaphthalene	ND	0.34	mg/Kg wet							
2-Chlorophenol	ND	0.34	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							
Dibenzofuran	ND	0.34	mg/Kg wet							
Di-n-butylphthalate	ND	0.34	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.34	mg/Kg wet							

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175467 - SW-846 3546										
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17						
3,3-Dichlorobenzidine	ND	0.17	mg/Kg wet							
2,4-Dichlorophenol	ND	0.34	mg/Kg wet							
Diethylphthalate	ND	0.34	mg/Kg wet							
2,4-Dimethylphenol	ND	0.34	mg/Kg wet							
Dimethylphthalate	ND	0.34	mg/Kg wet							
2,4-Dinitrophenol	ND	0.66	mg/Kg wet							V-05
2,4-Dinitrotoluene	ND	0.34	mg/Kg wet							
2,6-Dinitrotoluene	ND	0.34	mg/Kg wet							
Di-n-octylphthalate	ND	0.34	mg/Kg wet							
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.34	mg/Kg wet							
Fluoranthene	ND	0.17	mg/Kg wet							
Fluorene	ND	0.17	mg/Kg wet							
Hexachlorobenzene	ND	0.34	mg/Kg wet							
Hexachlorobutadiene	ND	0.34	mg/Kg wet							V-20
Hexachloroethane	ND	0.34	mg/Kg wet							
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet							
Isophorone	ND	0.34	mg/Kg wet							
2-Methylnaphthalene	ND	0.17	mg/Kg wet							
2-Methylphenol	ND	0.34	mg/Kg wet							
3/4-Methylphenol	ND	0.34	mg/Kg wet							
Naphthalene	ND	0.17	mg/Kg wet							
Nitrobenzene	ND	0.34	mg/Kg wet							
2-Nitrophenol	ND	0.34	mg/Kg wet							
4-Nitrophenol	ND	0.66	mg/Kg wet							
Pentachlorophenol	ND	0.34	mg/Kg wet							V-05
Phenanthrene	ND	0.17	mg/Kg wet							
Phenol	ND	0.34	mg/Kg wet							
Pyrene	ND	0.17	mg/Kg wet							
1,2,4-Trichlorobenzene	ND	0.34	mg/Kg wet							
2,4,5-Trichlorophenol	ND	0.34	mg/Kg wet							
2,4,6-Trichlorophenol	ND	0.34	mg/Kg wet							
Surrogate: 2-Fluorophenol	*4.00*		mg/Kg wet	6.73		59.4	30-130			
Surrogate: Phenol-d6	*4.09*		mg/Kg wet	6.67		61.3	30-130			
Surrogate: Nitrobenzene-d5	*2.14*		mg/Kg wet	3.33		64.1	30-130			
Surrogate: 2-Fluorobiphenyl	*2.24*		mg/Kg wet	3.33		67.1	30-130			
Surrogate: 2,4,6-Tribromophenol	*5.53*		mg/Kg wet	6.67		83.0	30-130			
Surrogate: p-Terphenyl-d14	*2.66*		mg/Kg wet	3.33		79.7	30-130			
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Acenaphthene	0.968	0.17	mg/Kg wet	1.67		58.1	40-140			
Acenaphthylene	0.945	0.17	mg/Kg wet	1.67		56.7	40-140			
Acetophenone	1.04	0.34	mg/Kg wet	1.67		62.7	40-140			
Aniline	0.629	0.34	mg/Kg wet	1.67		**37.8**	* 40-140			L-04
Anthracene	1.02	0.17	mg/Kg wet	1.67		61.1	40-140			
Benzo(a)anthracene	1.08	0.17	mg/Kg wet	1.67		64.9	40-140			
Benzo(a)pyrene	1.11	0.17	mg/Kg wet	1.67		66.5	40-140			
Benzo(b)fluoranthene	1.06	0.17	mg/Kg wet	1.67		63.6	40-140			
Benzo(g,h,i)perylene	1.03	0.17	mg/Kg wet	1.67		61.8	40-140			
Benzo(k)fluoranthene	1.04	0.17	mg/Kg wet	1.67		62.5	40-140			
Bis(2-chloroethoxy)methane	0.955	0.34	mg/Kg wet	1.67		57.3	40-140			
Bis(2-chloroethyl)ether	0.921	0.34	mg/Kg wet	1.67		55.3	40-140			
Bis(2-chloroisopropyl)ether	1.02	0.34	mg/Kg wet	1.67		61.5	40-140			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546											
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17							
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		61.8	40-140				
4-Bromophenylphenylether	1.19	0.34	mg/Kg wet	1.67		71.3	40-140				
Butylbenzylphthalate	1.08	0.34	mg/Kg wet	1.67		64.7	40-140				
4-Chloroaniline	0.680	0.66	mg/Kg wet	1.67		40.8	15-140				†
2-Chloronaphthalene	0.954	0.34	mg/Kg wet	1.67		57.3	40-140				
2-Chlorophenol	0.985	0.34	mg/Kg wet	1.67		59.1	30-130				
Chrysene	0.967	0.17	mg/Kg wet	1.67		58.0	40-140				
Dibenz(a,h)anthracene	1.08	0.17	mg/Kg wet	1.67		65.1	40-140				
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		67.1	40-140				
Di-n-butylphthalate	0.987	0.34	mg/Kg wet	1.67		59.2	40-140				
1,2-Dichlorobenzene	0.944	0.34	mg/Kg wet	1.67		56.6	40-140				
1,3-Dichlorobenzene	0.918	0.34	mg/Kg wet	1.67		55.1	40-140				
1,4-Dichlorobenzene	0.937	0.34	mg/Kg wet	1.67		56.2	40-140				
3,3-Dichlorobenzidine	0.844	0.17	mg/Kg wet	1.67		50.6	40-140				
2,4-Dichlorophenol	1.15	0.34	mg/Kg wet	1.67		68.7	30-130				
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		65.9	40-140				
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.4	30-130				
Dimethylphthalate	1.13	0.34	mg/Kg wet	1.67		67.8	40-140				
2,4-Dinitrophenol	0.612	0.66	mg/Kg wet	1.67		36.7	15-140			V-05	†
2,4-Dinitrotoluene	1.15	0.34	mg/Kg wet	1.67		68.8	40-140				
2,6-Dinitrotoluene	1.18	0.34	mg/Kg wet	1.67		70.8	40-140				
Di-n-octylphthalate	1.00	0.34	mg/Kg wet	1.67		60.2	40-140				
1,2-Diphenylhydrazine (as Azobenzene)	1.01	0.34	mg/Kg wet	1.67		60.7	40-140				
Fluoranthene	1.03	0.17	mg/Kg wet	1.67		61.6	40-140				
Fluorene	1.04	0.17	mg/Kg wet	1.67		62.5	40-140				
Hexachlorobenzene	1.20	0.34	mg/Kg wet	1.67		71.9	40-140				
Hexachlorobutadiene	1.35	0.34	mg/Kg wet	1.67		80.9	40-140			V-20	
Hexachloroethane	0.983	0.34	mg/Kg wet	1.67		59.0	40-140				
Indeno(1,2,3-cd)pyrene	1.09	0.17	mg/Kg wet	1.67		65.5	40-140				
Isophorone	1.03	0.34	mg/Kg wet	1.67		61.7	40-140				
2-Methylnaphthalene	1.14	0.17	mg/Kg wet	1.67		68.1	40-140				
2-Methylphenol	0.974	0.34	mg/Kg wet	1.67		58.4	30-130				
3/4-Methylphenol	1.02	0.34	mg/Kg wet	1.67		61.3	30-130				
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6	40-140				
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		62.8	40-140				
2-Nitrophenol	1.00	0.34	mg/Kg wet	1.67		60.0	30-130				
4-Nitrophenol	1.21	0.66	mg/Kg wet	1.67		72.6	15-140				†
Pentachlorophenol	0.639	0.34	mg/Kg wet	1.67		38.3	30-130			V-05	
Phenanthrene	1.03	0.17	mg/Kg wet	1.67		61.6	40-140				
Phenol	1.02	0.34	mg/Kg wet	1.67		61.2	15-140				†
Pyrene	1.09	0.17	mg/Kg wet	1.67		65.7	40-140				
1,2,4-Trichlorobenzene	1.09	0.34	mg/Kg wet	1.67		65.6	40-140				
2,4,5-Trichlorophenol	1.18	0.34	mg/Kg wet	1.67		71.0	30-130				
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.0	30-130				
Surrogate: 2-Fluorophenol	*4.19*		mg/Kg wet	6.73		62.3	30-130				
Surrogate: Phenol-d6	*4.42*		mg/Kg wet	6.67		66.3	30-130				
Surrogate: Nitrobenzene-d5	*2.29*		mg/Kg wet	3.33		68.6	30-130				
Surrogate: 2-Fluorobiphenyl	*2.43*		mg/Kg wet	3.33		72.9	30-130				
Surrogate: 2,4,6-Tribromophenol	*5.60*		mg/Kg wet	6.67		83.9	30-130				
Surrogate: p-Terphenyl-d14	*2.53*		mg/Kg wet	3.33		76.0	30-130				

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546												
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17								
Acenaphthene	0.958	0.17	mg/Kg wet	1.67		57.5		40-140	1.07	30		
Acenaphthylene	0.950	0.17	mg/Kg wet	1.67		57.0		40-140	0.528	30		
Acetophenone	1.05	0.34	mg/Kg wet	1.67		62.9		40-140	0.414	30		
Aniline	0.655	0.34	mg/Kg wet	1.67		**39.3**	*	40-140	3.95	30	L-04	
Anthracene	1.05	0.17	mg/Kg wet	1.67		63.0		40-140	3.03	30		
Benzo(a)anthracene	1.11	0.17	mg/Kg wet	1.67		66.6		40-140	2.46	30		
Benzo(a)pyrene	1.12	0.17	mg/Kg wet	1.67		67.3		40-140	1.29	30		
Benzo(b)fluoranthene	1.08	0.17	mg/Kg wet	1.67		65.0		40-140	2.24	30		
Benzo(g,h,i)perylene	1.05	0.17	mg/Kg wet	1.67		63.2		40-140	2.27	30		
Benzo(k)fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.6		40-140	3.30	30		
Bis(2-chloroethoxy)methane	0.980	0.34	mg/Kg wet	1.67		58.8		40-140	2.65	30		
Bis(2-chloroethyl)ether	0.901	0.34	mg/Kg wet	1.67		54.1		40-140	2.23	30		
Bis(2-chloroisopropyl)ether	1.04	0.34	mg/Kg wet	1.67		62.2		40-140	1.16	30		
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		62.0		40-140	0.355	30		
4-Bromophenylphenylether	1.20	0.34	mg/Kg wet	1.67		72.1		40-140	1.14	30		
Butylbenzylphthalate	1.07	0.34	mg/Kg wet	1.67		64.0		40-140	1.03	30		
4-Chloroaniline	0.689	0.66	mg/Kg wet	1.67		41.3		15-140	1.36	30		†
2-Chloronaphthalene	0.951	0.34	mg/Kg wet	1.67		57.1		40-140	0.315	30		
2-Chlorophenol	0.981	0.34	mg/Kg wet	1.67		58.9		30-130	0.373	30		
Chrysene	0.972	0.17	mg/Kg wet	1.67		58.3		40-140	0.516	30		
Dibenz(a,h)anthracene	1.09	0.17	mg/Kg wet	1.67		65.5		40-140	0.582	30		
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		66.9		40-140	0.269	30		
Di-n-butylphthalate	1.02	0.34	mg/Kg wet	1.67		60.9		40-140	2.86	30		
1,2-Dichlorobenzene	0.972	0.34	mg/Kg wet	1.67		58.3		40-140	2.92	30		
1,3-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	2.26	30		
1,4-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	0.213	30		
3,3-Dichlorobenzidine	0.880	0.17	mg/Kg wet	1.67		52.8		40-140	4.21	30		
2,4-Dichlorophenol	1.13	0.34	mg/Kg wet	1.67		67.9		30-130	1.26	30		
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		66.1		40-140	0.303	30		
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.0		30-130	0.654	30		
Dimethylphthalate	1.14	0.34	mg/Kg wet	1.67		68.6		40-140	1.23	30		
2,4-Dinitrophenol	0.602	0.66	mg/Kg wet	1.67		36.1		15-140	1.59	30	V-05	†
2,4-Dinitrotoluene	1.13	0.34	mg/Kg wet	1.67		67.9		40-140	1.43	30		
2,6-Dinitrotoluene	1.19	0.34	mg/Kg wet	1.67		71.3		40-140	0.816	30		
Di-n-octylphthalate	1.04	0.34	mg/Kg wet	1.67		62.6		40-140	3.87	30		
1,2-Diphenylhydrazine (as Azobenzene)	1.02	0.34	mg/Kg wet	1.67		61.4		40-140	1.11	30		
Fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.5		40-140	4.63	30		
Fluorene	1.05	0.17	mg/Kg wet	1.67		62.8		40-140	0.542	30		
Hexachlorobenzene	1.22	0.34	mg/Kg wet	1.67		73.0		40-140	1.49	30		
Hexachlorobutadiene	1.34	0.34	mg/Kg wet	1.67		80.3		40-140	0.695	30	V-20	
Hexachloroethane	1.00	0.34	mg/Kg wet	1.67		60.3		40-140	2.15	30		
Indeno(1,2,3-cd)pyrene	1.10	0.17	mg/Kg wet	1.67		66.2		40-140	1.09	30		
Isophorone	1.03	0.34	mg/Kg wet	1.67		62.0		40-140	0.420	30		
2-Methylnaphthalene	1.11	0.17	mg/Kg wet	1.67		66.5		40-140	2.38	30		
2-Methylphenol	0.950	0.34	mg/Kg wet	1.67		57.0		30-130	2.46	30		
3/4-Methylphenol	1.03	0.34	mg/Kg wet	1.67		61.5		30-130	0.456	30		
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6		40-140	0.0990	30		
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		63.0		40-140	0.286	30		
2-Nitrophenol	1.02	0.34	mg/Kg wet	1.67		60.9		30-130	1.49	30		
4-Nitrophenol	1.26	0.66	mg/Kg wet	1.67		75.5		15-140	3.94	30		†
Pentachlorophenol	0.614	0.34	mg/Kg wet	1.67		36.8		30-130	4.04	30	V-05	
Phenanthrene	1.04	0.17	mg/Kg wet	1.67		62.5		40-140	1.51	30		

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175467 - SW-846 3546										
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Phenol	0.991	0.34	mg/Kg wet	1.67		59.5	15-140	2.82	30	†
Pyrene	1.14	0.17	mg/Kg wet	1.67		68.5	40-140	4.26	30	
1,2,4-Trichlorobenzene	1.11	0.34	mg/Kg wet	1.67		66.8	40-140	1.84	30	
2,4,5-Trichlorophenol	1.27	0.34	mg/Kg wet	1.67		76.2	30-130	7.12	30	
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.2	30-130	0.242	30	
Surrogate: 2-Fluorophenol	*4.13*		mg/Kg wet	6.73		61.3	30-130			
Surrogate: Phenol-d6	*4.35*		mg/Kg wet	6.67		65.2	30-130			
Surrogate: Nitrobenzene-d5	*2.27*		mg/Kg wet	3.33		68.0	30-130			
Surrogate: 2-Fluorobiphenyl	*2.54*		mg/Kg wet	3.33		76.2	30-130			
Surrogate: 2,4,6-Tribromophenol	*5.48*		mg/Kg wet	6.67		82.2	30-130			
Surrogate: p-Terphenyl-d14	*2.59*		mg/Kg wet	3.33		77.8	30-130			

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QUALITY CONTROL

Polychlorinated Biphenyls By GC/ECD - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175466 - SW-846 3546										
Blank (B175466-BLK1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	ND	0.020	mg/Kg wet							
Aroclor-1016 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1221	ND	0.020	mg/Kg wet							
Aroclor-1221 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1232	ND	0.020	mg/Kg wet							
Aroclor-1232 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1242	ND	0.020	mg/Kg wet							
Aroclor-1242 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1248	ND	0.020	mg/Kg wet							
Aroclor-1248 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1254	ND	0.020	mg/Kg wet							
Aroclor-1254 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1260	ND	0.020	mg/Kg wet							
Aroclor-1260 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1262	ND	0.020	mg/Kg wet							
Aroclor-1262 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1268	ND	0.020	mg/Kg wet							
Aroclor-1268 [2C]	ND	0.020	mg/Kg wet							
Surrogate: Decachlorobiphenyl	*0.196*		mg/Kg wet	0.200		98.1	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.4	30-150			
Surrogate: Tetrachloro-m-xylene	*0.193*		mg/Kg wet	0.200		96.4	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.180*		mg/Kg wet	0.200		90.1	30-150			
LCS (B175466-BS1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		100	40-140			
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		103	40-140			
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		89.8	40-140			
Aroclor-1260 [2C]	0.19	0.020	mg/Kg wet	0.200		96.7	40-140			
Surrogate: Decachlorobiphenyl	*0.197*		mg/Kg wet	0.200		98.3	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.7	30-150			
Surrogate: Tetrachloro-m-xylene	*0.200*		mg/Kg wet	0.200		99.9	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.187*		mg/Kg wet	0.200		93.4	30-150			
LCS Dup (B175466-BSD1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		102	40-140	1.17	30	
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		104	40-140	1.11	30	
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		91.2	40-140	1.57	30	
Aroclor-1260 [2C]	0.20	0.020	mg/Kg wet	0.200		98.5	40-140	1.92	30	
Surrogate: Decachlorobiphenyl	*0.199*		mg/Kg wet	0.200		99.5	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.192*		mg/Kg wet	0.200		96.0	30-150			
Surrogate: Tetrachloro-m-xylene	*0.201*		mg/Kg wet	0.200		100	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.189*		mg/Kg wet	0.200		94.3	30-150			

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QUALITY CONTROL

Petroleum Hydrocarbons Analyses - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175469 - SW-846 3546										
Blank (B175469-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	ND	8.3	mg/Kg wet							
Surrogate: o-Terphenyl	*3.07*		mg/Kg wet	3.33		92.0	40-140			
LCS (B175469-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	28.5	8.3	mg/Kg wet	33.3		85.6	40-140			
Surrogate: o-Terphenyl	*3.04*		mg/Kg wet	3.33		91.3	40-140			
LCS Dup (B175469-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	29.6	8.3	mg/Kg wet	33.3		88.8	40-140	3.66	30	
Surrogate: o-Terphenyl	*3.15*		mg/Kg wet	3.33		94.6	40-140			

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes
Batch B175482 - SW-846 7471											
Blank (B175482-BLK1)				Prepared & Analyzed: 04/27/17							
Mercury	ND	0.025	mg/Kg wet								
LCS (B175482-BS1)				Prepared & Analyzed: 04/27/17							
Mercury	9.48	1.9	mg/Kg wet	9.36		101		73.7-126.3			
LCS Dup (B175482-BSD1)				Prepared & Analyzed: 04/27/17							
Mercury	9.99	1.9	mg/Kg wet	9.36		107		73.7-126.3	5.20	30	
Duplicate (B175482-DUP1)		**Source: 17D1128-03**		Prepared & Analyzed: 04/27/17							
Mercury	1.28	0.19	mg/Kg dry		1.13				11.8	35	
Matrix Spike (B175482-MS1)		**Source: 17D1128-03**		Prepared & Analyzed: 04/27/17							
Mercury	1.52	0.19	mg/Kg dry	0.251	1.13	**153**	*	75-125			MS-11
Batch B175526 - SW-846 3050B											
Blank (B175526-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17							
Antimony	ND	2.5	mg/Kg wet								
Arsenic	ND	2.5	mg/Kg wet								
Barium	ND	2.5	mg/Kg wet								
Beryllium	ND	0.25	mg/Kg wet								
Cadmium	ND	0.25	mg/Kg wet								
Chromium	ND	0.50	mg/Kg wet								
Lead	ND	0.75	mg/Kg wet								
Nickel	ND	0.50	mg/Kg wet								
Selenium	ND	5.0	mg/Kg wet								
Silver	ND	0.50	mg/Kg wet								
Thallium	ND	2.5	mg/Kg wet								
Vanadium	ND	1.0	mg/Kg wet								
Zinc	ND	1.0	mg/Kg wet								
LCS (B175526-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17							
Antimony	125	5.0	mg/Kg wet	88.2		142		0-210.3			
Arsenic	54.1	5.0	mg/Kg wet	57.0		95.0		77.8-122.1			
Barium	94.3	5.0	mg/Kg wet	110		85.8		82-117.4			
Beryllium	72.6	0.50	mg/Kg wet	67.5		108		82.3-117.7			
Cadmium	75.3	0.50	mg/Kg wet	77.8		96.8		81.9-118.2			
Chromium	59.2	1.0	mg/Kg wet	65.0		91.1		78.7-120.6			
Lead	76.0	1.5	mg/Kg wet	85.6		88.8		82.4-117.8			
Nickel	57.8	1.0	mg/Kg wet	61.3		94.2		82.2-117.8			
Selenium	75.1	10	mg/Kg wet	78.9		95.2		77.1-122.3			
Silver	51.2	1.0	mg/Kg wet	54.2		94.4		74.3-125.4			
Thallium	172	5.0	mg/Kg wet	178		96.9		78.2-121.6			
Vanadium	48.6	2.0	mg/Kg wet	56.3		86.3		64.8-135.2			
Zinc	182	2.0	mg/Kg wet	198		91.9		79.7-120.8			

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175526 - SW-846 3050B										
LCS Dup (B175526-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Antimony	143	4.9	mg/Kg wet	88.2		162	0-210.3	13.3	30	
Arsenic	53.4	4.9	mg/Kg wet	57.0		93.7	77.8-122.1	1.37	30	
Barium	101	4.9	mg/Kg wet	110		91.4	82-117.4	6.40	30	
Beryllium	76.5	0.49	mg/Kg wet	67.5		113	82.3-117.7	5.21	30	
Cadmium	73.3	0.49	mg/Kg wet	77.8		94.2	81.9-118.2	2.76	30	
Chromium	59.9	0.98	mg/Kg wet	65.0		92.1	78.7-120.6	1.15	30	
Lead	74.9	1.5	mg/Kg wet	85.6		87.5	82.4-117.8	1.47	30	
Nickel	57.1	0.98	mg/Kg wet	61.3		93.2	82.2-117.8	1.15	30	
Selenium	74.5	9.8	mg/Kg wet	78.9		94.4	77.1-122.3	0.818	30	
Silver	51.2	0.98	mg/Kg wet	54.2		94.4	74.3-125.4	0.0109	30	
Thallium	171	4.9	mg/Kg wet	178		96.1	78.2-121.6	0.835	30	
Vanadium	51.1	2.0	mg/Kg wet	56.3		90.7	64.8-135.2	5.03	30	
Zinc	177	2.0	mg/Kg wet	198		89.6	79.7-120.8	2.49	30	
MRL Check (B175526-MRL1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Lead	0.693	0.74	mg/Kg wet	0.741		93.6	80-120			

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175351 - SM2580 A										
Duplicate (B175351-DUP1)	**Source: 17D1128-01**			Prepared & Analyzed: 04/26/17						
Oxidation/Reduction Potential	154		mV		162			5.06	24.6	
Batch B175358 - SW-846 9045C										
LCS (B175358-BS1)				Prepared & Analyzed: 04/26/17						
pH	6.05		pH Units	6.00		101	98.5-110			
LCS (B175358-BS2)				Prepared & Analyzed: 04/26/17						
pH	5.95		pH Units	6.00		99.2	98.5-110			
Duplicate (B175358-DUP1)	**Source: 17D1128-01**			Prepared & Analyzed: 04/26/17						
pH	5.3		pH Units		5.3			0.377	5	
Batch B175376 - SW-846 9045C										
LCS (B175376-BS1)				Prepared & Analyzed: 04/26/17						
pH	6.05		pH Units	6.00		101	98.5-110			
Batch B175501 - SW-846 7196A										
Blank (B175501-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Hexavalent Chromium	ND	0.16	mg/Kg wet							
LCS (B175501-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Hexavalent Chromium	56	1.8	mg/Kg wet	64.0		87.5	80-120			
LCS Dup (B175501-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Hexavalent Chromium	58	1.8	mg/Kg wet	63.9		91.6	80-120	4.27	20	
Batch B175566 - SW-846 9014										
Blank (B175566-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Cyanide	ND	0.40	mg/Kg							
LCS (B175566-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Cyanide	9.0	0.40	mg/Kg	10.0		90.4	85.9-110			
Batch B175577 - SW-846 9030A										
Blank (B175577-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Sulfide	ND	2.0	mg/Kg							

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175577 - SW-846 9030A										
LCS (B175577-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Sulfide	13	2.0	mg/Kg	14.8		86.5	64.5-120			
Batch B175749 - SW-846 7196A										
Blank (B175749-BLK1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Hexavalent Chromium	ND	0.16	mg/Kg wet							
LCS (B175749-BS1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Hexavalent Chromium	53	1.8	mg/Kg wet	64.3		83.1	80-120			
LCS Dup (B175749-BSD1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Hexavalent Chromium	54	1.8	mg/Kg wet	64.2		84.9	80-120	2.01	20	
Batch B175829 - SM21-22 2510B Modified										
Blank (B175829-BLK1)				Prepared & Analyzed: 05/02/17						
Specific conductance	ND	2.0	µmhos/cm							
LCS (B175829-BS2)				Prepared & Analyzed: 05/02/17						
Specific conductance	230	2.0	µmhos/cm	234		97.0	89.2-110			

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

Disposal Characterization

Lab Sample ID: 17D1128-05 Date(s) Analyzed 05/01/2017 05/01/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1254	1	0.000	0.000	0.000	0.57	
	2	0.000	0.000	0.000	0.56	1.8
Aroclor-1260	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.23	14.0

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS

Lab Sample ID: B175466-BS1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.19	5.4

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS Dup

Lab Sample ID: B175466-BSD1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.20	10.5

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
ND	Not Detected
RL	Reporting Limit
DL	Method Detection Limit
MCL	Maximum Contaminant Level
	Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.
	No results have been blank subtracted unless specified in the case narrative section.
L-04	Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.
L-07	Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.
L-14	Compound classified by MA CAM as difficult with acceptable recoveries of 40-160%. Recovery does not meet 70-130% criteria but does meet difficult compound criteria.
MS-11	Matrix spike recovery outside of control limits. Possibility of sample matrix effects that lead to a high bias for reported result or non-homogeneous sample aliquots cannot be eliminated.
RL-12	Elevated reporting limit due to matrix interference.
V-05	Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.
V-16	Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.
V-20	Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.
W-06	Elevated method reporting limit due to intense color of sample

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 1030 in Soil	
Ignitability	NY,NH,CT,NC,ME,VA
SW-846 6010C-D in Soil	
Antimony	CT,NH,NY,ME,VA,NC
Arsenic	CT,NH,NY,ME,VA,NC
Barium	CT,NH,NY,ME,VA,NC
Beryllium	CT,NH,NY,ME,VA,NC
Cadmium	CT,NH,NY,ME,VA,NC
Chromium	CT,NH,NY,ME,VA,NC
Lead	CT,NH,NY,AIHA,ME,VA,NC
Nickel	CT,NH,NY,ME,VA,NC
Selenium	CT,NH,NY,ME,VA,NC
Silver	CT,NH,NY,ME,VA,NC
Thallium	CT,NH,NY,ME,VA,NC
Vanadium	CT,NH,NY,ME,VA,NC
Zinc	CT,NH,NY,ME,VA,NC
SW-846 7196A in Soil	
Hexavalent Chromium	NY,CT,NH,NC,ME,VA
SW-846 7471B in Soil	
Mercury	CT,NH,NY,NC,ME,VA
SW-846 8082A in Soil	
Aroclor-1016	CT,NH,NY,NC,ME,VA
Aroclor-1016 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1221	CT,NH,NY,NC,ME,VA
Aroclor-1221 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1232	CT,NH,NY,NC,ME,VA
Aroclor-1232 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1242	CT,NH,NY,NC,ME,VA
Aroclor-1242 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1248	CT,NH,NY,NC,ME,VA
Aroclor-1248 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1254	CT,NH,NY,NC,ME,VA
Aroclor-1254 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1260	CT,NH,NY,NC,ME,VA
Aroclor-1260 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1262	NH,NY,NC,ME,VA
Aroclor-1262 [2C]	NH,NY,NC,ME,VA
Aroclor-1268	NH,NY,NC,ME,VA
Aroclor-1268 [2C]	NH,NY,NC,ME,VA
SW-846 8260C in Soil	
Acetone	CT,NH,NY,ME
Benzene	CT,NH,NY,ME
Bromobenzene	NH,NY,ME
Bromochloromethane	NH,NY,ME
Bromodichloromethane	CT,NH,NY,ME
Bromoform	CT,NH,NY,ME

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
Bromomethane	CT,NH,NY,ME
2-Butanone (MEK)	CT,NH,NY,ME
n-Butylbenzene	CT,NH,NY,ME
sec-Butylbenzene	CT,NH,NY,ME
tert-Butylbenzene	CT,NH,NY,ME
Carbon Disulfide	CT,NH,NY,ME
Carbon Tetrachloride	CT,NH,NY,ME
Chlorobenzene	CT,NH,NY,ME
Chlorodibromomethane	CT,NH,NY,ME
Chloroethane	CT,NH,NY,ME
Chloroform	CT,NH,NY,ME
Chloromethane	CT,NH,NY,ME
2-Chlorotoluene	CT,NH,NY,ME
4-Chlorotoluene	CT,NH,NY,ME
Dibromomethane	NH,NY,ME
1,2-Dichlorobenzene	CT,NH,NY,ME
1,3-Dichlorobenzene	CT,NH,NY,ME
1,4-Dichlorobenzene	CT,NH,NY,ME
Dichlorodifluoromethane (Freon 12)	NY,ME
1,1-Dichloroethane	CT,NH,NY,ME
1,2-Dichloroethane	CT,NH,NY,ME
1,1-Dichloroethylene	CT,NH,NY,ME
cis-1,2-Dichloroethylene	CT,NH,NY,ME
trans-1,2-Dichloroethylene	CT,NH,NY,ME
1,2-Dichloropropane	CT,NH,NY,ME
1,3-Dichloropropane	NH,NY,ME
2,2-Dichloropropane	NH,NY,ME
1,1-Dichloropropene	NH,NY,ME
cis-1,3-Dichloropropene	CT,NH,NY,ME
trans-1,3-Dichloropropene	CT,NH,NY,ME
1,4-Dioxane	NY
Ethylbenzene	CT,NH,NY,ME
Hexachlorobutadiene	NH,NY,ME
2-Hexanone (MBK)	CT,NH,NY,ME
Isopropylbenzene (Cumene)	CT,NH,NY,ME
p-Isopropyltoluene (p-Cymene)	NH,NY
Methyl tert-Butyl Ether (MTBE)	NH,NY
Methylene Chloride	CT,NH,NY,ME
4-Methyl-2-pentanone (MIBK)	CT,NH,NY
Naphthalene	NH,NY,ME
n-Propylbenzene	NH,NY
Styrene	CT,NH,NY,ME
1,1,1,2-Tetrachloroethane	CT,NH,NY,ME
1,1,2,2-Tetrachloroethane	CT,NH,NY,ME
Tetrachloroethylene	CT,NH,NY,ME
Toluene	CT,NH,NY,ME
1,2,3-Trichlorobenzene	NY

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
1,2,4-Trichlorobenzene	NH,NY,ME
1,1,1-Trichloroethane	CT,NH,NY,ME
1,1,2-Trichloroethane	CT,NH,NY,ME
Trichloroethylene	CT,NH,NY,ME
Trichlorofluoromethane (Freon 11)	CT,NH,NY,ME
1,2,3-Trichloropropane	NH,NY,ME
1,2,4-Trimethylbenzene	CT,NH,NY,ME
1,3,5-Trimethylbenzene	CT,NH,NY,ME
Vinyl Chloride	CT,NH,NY,ME
m+p Xylene	CT,NH,NY,ME
o-Xylene	CT,NH,NY,ME
SW-846 8270D in Soil	
Acenaphthene	CT,NY,NH,ME,NC,VA
Acenaphthene	CT,NY,NH
Acenaphthylene	CT,NY,NH,ME,NC,VA
Acenaphthylene	CT,NY,NH
Acetophenone	NY,NH
Aniline	NY,NH
Anthracene	CT,NY,NH
Anthracene	CT,NY,NH,ME,NC,VA
Benzo(a)anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH,ME,NC,VA
Benzo(a)pyrene	CT,NY,NH,ME,NC,VA
Benzo(a)pyrene	CT,NY,NH
Benzo(b)fluoranthene	CT,NY,NH,ME,NC,VA
Benzo(b)fluoranthene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH,ME,NC,VA
Benzo(k)fluoranthene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH,ME,NC,VA
Bis(2-chloroethoxy)methane	CT,NY,NH
Bis(2-chloroethyl)ether	CT,NY,NH
Bis(2-chloroisopropyl)ether	CT,NY,NH
Bis(2-Ethylhexyl)phthalate	CT,NY,NH
4-Bromophenylphenylether	CT,NY,NH
Butylbenzylphthalate	CT,NY,NH
4-Chloroaniline	CT,NY,NH
2-Chloronaphthalene	CT,NY,NH
2-Chlorophenol	CT,NY,NH
Chrysene	CT,NY,NH
Chrysene	CT,NY,NH,ME,NC,VA
Dibenz(a,h)anthracene	CT,NY,NH
Dibenz(a,h)anthracene	CT,NY,NH,ME,NC,VA
Dibenzofuran	CT,NY,NH
Di-n-butylphthalate	CT,NY,NH
1,2-Dichlorobenzene	NY,NH

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8270D in Soil	
1,3-Dichlorobenzene	NY,NH
1,4-Dichlorobenzene	NY,NH
3,3-Dichlorobenzidine	CT,NY,NH
2,4-Dichlorophenol	CT,NY,NH
Diethylphthalate	CT,NY,NH
2,4-Dimethylphenol	CT,NY,NH
Dimethylphthalate	CT,NY,NH
2,4-Dinitrophenol	CT,NY,NH
2,4-Dinitrotoluene	CT,NY,NH
2,6-Dinitrotoluene	CT,NY,NH
Di-n-octylphthalate	CT,NY,NH
1,2-Diphenylhydrazine (as Azobenzene)	NY,NH
Fluoranthene	CT,NY,NH
Fluoranthene	CT,NY,NH,ME,NC,VA
Fluorene	CT,NY,NH,ME,NC,VA
Fluorene	NY,NH
Hexachlorobenzene	CT,NY,NH
Hexachlorobutadiene	CT,NY,NH
Hexachloroethane	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH,ME,NC,VA
Isophorone	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH,ME,NC,VA
2-Methylphenol	CT,NY,NH
3/4-Methylphenol	CT,NY,NH
Naphthalene	CT,NY,NH,ME,NC,VA
Naphthalene	CT,NY,NH
Nitrobenzene	CT,NY,NH
2-Nitrophenol	CT,NY,NH
4-Nitrophenol	CT,NY,NH
Pentachlorophenol	CT,NY,NH
Phenanthrene	CT,NY,NH,ME,NC,VA
Phenanthrene	CT,NY,NH
Phenol	CT,NY,NH
Pyrene	CT,NY,NH
Pyrene	CT,NY,NH,ME,NC,VA
1,2,4-Trichlorobenzene	CT,NY,NH
2,4,5-Trichlorophenol	CT,NY,NH
2,4,6-Trichlorophenol	CT,NY,NH

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The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC - ISO17025:2005	100033	02/1/2018
MA	Massachusetts DEP	M-MA100	06/30/2017
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2017
NY	New York State Department of Health	10899 NELAP	04/1/2018
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2018
RI	Rhode Island Department of Health	LAO00112	12/30/2017
NC	North Carolina Div. of Water Quality	652	12/31/2017
NJ	New Jersey DEP	MA007 NELAP	06/30/2017
FL	Florida Department of Health	E871027 NELAP	06/30/2017
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2017
ME	State of Maine	2011028	06/9/2017
VA	Commonwealth of Virginia	460217	12/14/2017
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2017

con-test® ANALYTICAL LABORATORY
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Email: info@contestlabs.com
www.contestlabs.com
39 Spruce Street
East longmeadow, MA 01028

CHAIN OF CUSTODY RECORD

17D1128

Rev 04.05.12

Company Name: Weston + Sampson
Address: 5 Centennial Drive
Peabody, MA
Attention: Joe Spencer
Project Location: 18 Howley St
Sampled By: Taylor Smith

Telephone: 978-532-1900
Project #: 2160297
Client PO#:

Project Proposal Provided? (for billing purposes)
○ yes _____ proposal date

DATA DELIVERY (check all that apply)
○ FAX ☒ EMAIL ○ WEBSITE
Fax #:
Email: SpencerJ@WSEinc.com
Format: ○ PDF ☒ EXCEL ○ GIS
○ OTHER
○ "Enhanced Data Package"

Con-Test Lab ID (laboratory use only)	Client Sample ID / Description	Collection Beginning Date/Time	Collection Ending Date/Time	Composite	Grab	*Matrix Code	Conc Code	# of Containers	** Preservation	***Container Code	MCP-14	VOCs	Hexavalent Chromium	Disposal Char.
1	SP-1 (0-1)	4/25	12:00		X	S		4	H	A	X		X	
2	SP-1 (2-5)	↓	11:55		X	↓	H	3	M	V	X	X	X	
3	SP-2 (0-1)		11:00		X			4	H	A	X		X	
4	SP-2 (2-5)		12:10		X			4	H	A	X		X	
5	~~Disposal~~ Disposal Char.		12:05	X								[illegible]	[illegible]	X

Disposal list= RCRA-8 metals, 8082, 8270, 8100, pH, conductivity, reactivity and ignitability. Also run PAHs on samples -01 through -04 per Joe S - MEK 4/26/17

Comments: 18 Howley St Use SP-2 (2-5) VOCs as disposal characterization

ANALYSIS REQUESTED

Dissolved Metals
○ Field Filtered
○ Lab to Filter

***Cont. Code:**
A=amber glass
G=glass
P=plastic
ST=sterile
V=vial
S=summa can
T=tedlar bag
O=Other

****Preservation**
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium bisulfate
X = Na hydroxide
T = Na thiosulfate
O = Other_____

*Matrix Code:
GW= groundwater
WW= wastewater
DW= drinking water
A = air
S = soil/solid
SL = sludge
O = other_____

Please use the following codes to let Con-Test know if a specific sample may be high in concentration in Matrix/Conc. Code Box:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

Relinquished by: (signature)		Date/Time: 4/25
Received by: (signature)		Date/Time: 4:40
Relinquished by: (signature)		Date/Time: 7:20
Received by: (signature)	4/25/17	Date/Time: 1920

Turnaround ††
☐ 7-Day
☐ 10-Day
☒ Other Sday
RUSH †
☒ †24-Hr ☐ †48-Hr
☐ †72-Hr ☐ †4-Day
† Require lab approval

Detection Limit Requirements
Massachusetts: MCP + Disposal Char.
Connecticut:
Other:

Is your project MCP or RCP ?
☒ MCP Form Required
○ RCP Form Required
○ MA State DW Form Required PWSID # _____

NELAC & AIHA-LAP, LLC Accredited
WBE/DBE Certified

†† TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR IS NOT CORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

PLEASE BE CAREFUL NOT TO CONTAMINATE THIS DOCUMENT

Table of Contents

39 Spruce St.
East Longmeadow, MA. 01028
P: 413-525-2332
F: 413-525-6405
www.contestlabs.com

con-test ANALYTICAL LABORATORY

Sample Receipt Checklist

CLIENT NAME: Weston & Sampson RECEIVED BY: JM DATE: 4/25/17

1) Was the chain(s) of custody relinquished and signed? Yes X No ____ No COC Incl.

2) Does the chain agree with the samples? Yes X No ____

If not, explain:

3) Are all the samples in good condition? Yes X No ____

If not, explain:

4) How were the samples received:

On Ice X Direct from Sampling ____ Ambient ____ In Cooler(s) X

Were the samples received in Temperature Compliance of (2-6°C)? Yes X No ____ N/A ____

Temperature °C by Temp blank ____ # ____ Temperature °C by Temp gun 5.1 # 7

5) Are there Dissolved samples for the lab to filter? Yes ____ No X

Who was notified ____ Date ____ Time ____

6) Are there any RUSH or SHORT HOLDING TIME samples? Yes X No ____

Who was notified ____ Date ____ Time ____

7) Location where samples are stored:

Permission to subcontract samples? Yes No

(Walk-in clients only) if not already approved

Client Signature: ____

8) Do all samples have the proper Acid pH: Yes ____ No ____ N/A X

9) Do all samples have the proper Base pH: Yes ____ No ____ N/A X

10) Was the PC notified of any discrepancies with the CoC vs the samples: Yes ____ N/A X

Containers received at Con-Test

	# of containers		# of containers
1 Liter Amber		16 oz amber	
500 mL Amber		8 oz amber/clear jar	5
250 mL Amber (8oz amber)		4 oz amber/clear jar	4
1 Liter Plastic		2 oz amber/clear jar	
500 mL Plastic		Plastic Bag / Ziploc	
250 mL plastic		SOC Kit	
40 mL Vial - type listed below	3	Perchlorate Kit	
Colisure / bacteria bottle		Flashpoint bottle	
Dissolved Oxygen bottle		Other glass jar	
Encore		Other	

40 mL vials: # HCl ____ # Methanol 1

Bisulfate 2 # DI Water ____

Thiosulfate ____ Unpreserved ____

Time and Date Frozen:

Login Sample Receipt Checklist

(Rejection Criteria Listing - Using Sample Acceptance Policy)

Any False statement will be brought to the attention of Client

Question	Answer (True/False) T/F/NA	Comment
1) The cooler's custody seal, if present, is intact.	NA	
2) The cooler or samples do not appear to have been compromised or tampered with.	T	
3) Samples were received on ice.	T	
4) Cooler Temperature is acceptable.	T	
5) Cooler Temperature is recorded.	T	
6) COC is filled out in ink and legible.	T	
7) COC is filled out with all pertinent information.	T	
8) Field Sampler's name present on COC.	T	
9) There are no discrepancies between the sample IDs on the container and the COC.	T	
10) Samples are received within Holding Time.	T	
11) Sample containers have legible labels.	T	
12) Containers are not broken or leaking.	T	
13) Air Cassettes are not broken/open.	NA	
14) Sample collection date/times are provided.	T	
15) Appropriate sample containers are used.	T	
16) Proper collection media used.	T	
17) No headspace sample bottles are completely filled.	NA	
18) There is sufficient volume for all requsted analyses, including any requested MS/MSDs.	T	
19) Trip blanks provided if applicable.	NA	
20) VOA sample vials do not have head space or bubble is <6mm (1/4") in diameter.	NA	
21) Samples do not require splitting or compositing.	T	

Who notified of False statements? **Date/Time:**

Doc #277 Rev. 4 August 2013 **Log-In Technician Initials:** SM **Date/Time:** 4/25/17 1920

MADEP MCP Analytical Method Report Certification Form

Laboratory Name:	Con-Test Analytical Laboratory	Project #:	17D1128
Project Location:	18 Howley St.	RTN:	

This Form provides certifications for the following data set: [list Laboratory Sample ID Number(s)]

17D1128-01 thru 17D1128-05

Matrices: Soil

CAM Protocol (check all that below)

8260 VOC CAM II A (X)	7470/7471 Hg CAM IIIB (X)	MassDEP VPH CAM IV A ( )	8081 Pesticides CAM V B ( )	7196 Hex Cr CAM VI B (X)	MassDEP APH CAM IX A ( )
8270 SVOC CAM II B (X)	7010 Metals CAM III C ( )	MassDEP EPH CAM IV A ( )	8151 Herbicides CAM V C ( )	8330 Explosives CAM VIII A ( )	TO-15 VOC CAM IX B ( )
6010 Metals CAM III A (X)	6020 Metals CAM III D ( )	8082 PCB CAM V A (X)	9014 Total Cyanide/PAC CAM VI A ( )	6860 Perchlorate CAM VIII B ( )	

Affirmative response to Questions A throughF is required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☑ Yes	☐ No[1]
B	Were the analytical method(s) and all associated QC requirements specificed in the selected CAM protocol(s) followed?	☑ Yes	☐ No[1]
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☑ Yes	☐ No[1]
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, Quality Assurance and Quality Control Guidlines for the Acquisition and Reporting of Analytical Data?	☑ Yes	☐ No[1]
E a	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	☐ Yes	☐ No[1]
E b	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes	☐ No[1]
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all No responses to Qestions A through E)?	☑ Yes	☐ No[1]

A response to questions G, H and I below is required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☑ Yes	☐ No[1]

<u>Data User Note:</u> Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were all QC perfomance standards specified in the CAM protocol(s) achieved?	☐ Yes	☑ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes	☑ No[1]

[1] *All Negative responses must be addressed in an attached Environmental Laboratory case narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:  Position: Project Manager

Printed Name: Lisa A. Worthington Date: 05/03/17

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

June 21, 2017

Joe Spencer
Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960

Project Location: 18 Howley St.
Client Job Number:
Project Number: 2160299
Laboratory Work Order Number: 17F0707

Enclosed are results of analyses for samples received by the laboratory on June 14, 2017. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Meghan E. Kelley
Project Manager

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Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 6/21/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: 2160299

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17F0707

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 18 Howley St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
Disposal Characterization	17F0707-01	Soil		SM 2540G SW-846 1311 SW-846 6010C-D	

con-test® ANALYTICAL LABORATORY
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CASE NARRATIVE SUMMARY

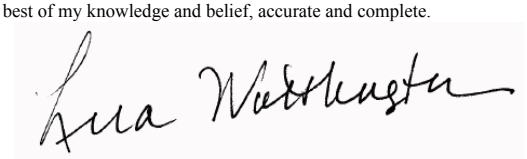
All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

REVISED REPORT - 6/21/17 - TCLP Cr added to 17F0707-01.

SW-846 6010C/D SW-846 6020A/B

For NC, Metals methods SW-846 6010D and SW-846 6020B are followed, and for all other states methods SW-846 6010C and SW-846 6020A are followed.

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Lisa A. Worthington
Project Manager

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 18 Howley St. Sample Description: Work Order: 17F0707

Date Received: 6/14/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17F0707-01

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
% Solids	70.6		% Wt	1		SM 2540G	4/27/17	6/16/17 10:00	FWD

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 18 Howley St. Sample Description: Work Order: 17F0707

Date Received: 6/14/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 12:05

Sample ID: 17F0707-01

Sample Matrix: Soil

TCLP - Metals Analyses

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Chromium	0.35	0.010	mg/L	1		SW-846 6010C-D	6/15/17	6/16/17 11:36	SHN
Lead	0.40	0.010	mg/L	1		SW-846 6010C-D	6/15/17	6/16/17 11:36	SHN

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Sample Extraction Data

Prep Method: % Solids-SM 2540G

Lab Number [Field ID]	Batch	Date
17F0707-01 [Disposal Characterization]	B175514	04/27/17

Prep Method: SW-846 3010A-SW-846 6010C-D **Leachates were extracted on 6/14/2017 per SW-846 1311 in Batch B179247**

Lab Number [Field ID]	Batch	Initial [mL]	Final [mL]	Date
17F0707-01 [Disposal Characterization]	B179322	50.0	50.0	06/15/17

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QUALITY CONTROL

TCLP - Metals Analyses - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B179322 - SW-846 3010A										
Blank (B179322-BLK1)				Prepared: 06/15/17 Analyzed: 06/16/17						
Chromium	ND	0.010	mg/L							
Lead	ND	0.010	mg/L							
LCS (B179322-BS1)				Prepared: 06/15/17 Analyzed: 06/16/17						
Chromium	0.523	0.010	mg/L	0.500		105	80-120			
Lead	0.517	0.010	mg/L	0.500		103	80-120			
LCS Dup (B179322-BSD1)				Prepared: 06/15/17 Analyzed: 06/16/17						
Chromium	0.511	0.010	mg/L	0.500		102	80-120	2.17	20	
Lead	0.519	0.010	mg/L	0.500		104	80-120	0.353	20	

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
ND	Not Detected
RL	Reporting Limit
DL	Method Detection Limit
MCL	Maximum Contaminant Level

Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.

No results have been blank subtracted unless specified in the case narrative section.

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 6010C-D in Water	
Chromium	NY,CT,ME,NC,NH,VA
Lead	NY,CT,ME,NC,NH,VA

The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC - ISO17025:2005	100033	02/1/2018
MA	Massachusetts DEP	M-MA100	06/30/2018
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2017
NY	New York State Department of Health	10899 NELAP	04/1/2018
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2018
RI	Rhode Island Department of Health	LAO00112	12/30/2017
NC	North Carolina Div. of Water Quality	652	12/31/2017
NJ	New Jersey DEP	MA007 NELAP	06/30/2018
FL	Florida Department of Health	E871027 NELAP	06/30/2018
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2017
ME	State of Maine	2011028	06/9/2019
VA	Commonwealth of Virginia	460217	12/14/2017
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2017
VT-DW	Vermont Department of Health Drinking Water	VT-255716	06/12/2018

CHAIN OF CUSTODY RECORD

con-test® ANALYTICAL LABORATORY
Phone: 413-525-2332
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Email: info@contestlabs.com
www.contestlabs.com
39 Spruce Street
East longmeadow, MA 01028

PP1128 MK

Rev 04.05.12

PFO707

Company Name: Weston + Sampson
Address: 5 Centennial Drive
Peabody, MA
Attention: Joe Spencer
Project Location: 18 Howley St
Sampled By: Taylor Smith

Telephone: 978-532-1900
Project #: 160291
Client PO#:

Project Proposal Provided? (for billing purposes)
○ yes _____ proposal date

DATA DELIVERY (check all that apply)
○ FAX ☒ EMAIL ○ WEBSITE
Fax #:
Email: spencerJ@WSEinc.com
Format: ○ PDF ☒ EXCEL ○ GIS
○ OTHER _____
○ "Enhanced Data Package"

Con-Test Lab ID (laboratory use only)	Client Sample ID / Description	Collection Beginning Date/Time	Collection Ending Date/Time	Composite	Grab	*Matrix Code	Conc Code	# of Containers	** Preservation	***Container Code	MCP-14	VOCs	Hexavalent Chromium	Disposal Char.	8021 TCLP
1	SP-1 (0-1)	4/25	12:00		X	S		1	H	A	X		X		
2	SP-1 (2-5)	↓	11:55		X	↓	H	1	H	A	X	X	X		
3	SP-2 (0-1)		11:00		X			1	H	A	X		X		
4	SP-2 (2-5)	↓	12:10		X	↓		1	H	A	X		X		
(X) 5	01 Disposal Char.		12:05	X				1	M	A		[illegible]	[illegible]	X	X

Disposal list= RCRA-8 metals, 8082, 8270, 8100, pH, conductivity, reactivity and ignitability. Also run PAHs on samples -01 through -04 per Joe S - MEK 4/26/17

(X) Activate for TCLPs per Joe S. - MEK 4/26/17

Comments: 18 Howley St VSR SP-1 (2-5) VOCs as disposal (characterization)

ANALYSIS REQUESTED

Dissolved Metals
○ Field Filtered
○ Lab to Filter

***Cont. Code:
A=amber glass
G=glass
P=plastic
ST=sterile
V=vial
S=summa can
T=tedlar bag
O=Other

**Preservation
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium bisulfate
X = Na hydroxide
T = Na thiosulfate
O = Other

*Matrix Code:
GW= groundwater
WW= wastewater
DW= drinking water
A = air
S = soil/solid
SL = sludge
O = other

Please use the following codes to let Con-Test know if a specific sample may be high in concentration in Matrix/Conc. Code Box:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

Relinquished by: (signature)		Date/Time: 4/25
Received by: (signature)		Date/Time: 4:40
Relinquished by: (signature)		Date/Time: 7:20
Received by: (signature)	4/25/17	Date/Time: 920

Turnaround #
☐ 7-Day
☐ 10-Day
☒ Other Sday
RUSH †
☒ †24-Hr ☐ †48-Hr
☐ †72-Hr ☐ †4-Day
† Require lab approval

Detection Limit Requirements
Massachusetts: MCP + Disposal Char
Connecticut:
Other:

Is your project MCP or RCP ?
☒ MCP Form Required
○ RCP Form Required
○ MA State DW Form Required PWSID # _____

NELAC & AIHA-LAP, LLC Accredited
WBE/DBE Certified

TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR IS INCORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

PLEASE BE CAREFUL NOT TO CONTAMINATE THIS DOCUMENT

Table of Contents

39 Spruce St.
East Longmeadow, MA. 01028
P: 413-525-2332
F: 413-525-6405
www.contestlabs.com

con-test ANALYTICAL LABORATORY

Sample Receipt Checklist

CLIENT NAME: Weston & Sampson RECEIVED BY: JM DATE: 4/25/17

1) Was the chain(s) of custody relinquished and signed? Yes X No ____ No COC Incl.

2) Does the chain agree with the samples? Yes X No ____
If not, explain:

3) Are all the samples in good condition? Yes X No ____
If not, explain:

4) How were the samples received:

On Ice X Direct from Sampling ____ Ambient ____ In Cooler(s) X

Were the samples received in Temperature Compliance of (2-6°C)? Yes X No ____ N/A ____

Temperature °C by Temp blank ____ # ____ Temperature °C by Temp gun 5.1 # 7

5) Are there Dissolved samples for the lab to filter? Yes ____ No X

Who was notified ____ Date ____ Time ____

6) Are there any RUSH or SHORT HOLDING TIME samples? Yes X No ____

Who was notified ____ Date ____ Time ____

7) Location where samples are stored:

Permission to subcontract samples? Yes No
(Walk-in clients only) If not already approved
Client Signature: ____

8) Do all samples have the proper Acid pH: Yes ____ No ____ N/A X

9) Do all samples have the proper Base pH: Yes ____ No ____ N/A X

10) Was the PC notified of any discrepancies with the CoC vs the samples: Yes ____ N/A X

Containers received at Con-Test

	# of containers		# of containers
1 Liter Amber		16 oz amber	
500 mL Amber		8 oz amber/clear jar	5
250 mL Amber (8oz amber)		4 oz amber/clear jar	4
1 Liter Plastic		2 oz amber/clear jar	
500 mL Plastic		Plastic Bag / Ziploc	
250 mL plastic		SOC Kit	
40 mL Vial - type listed below	3	Perchlorate Kit	
Colisure / bacteria bottle		Flashpoint bottle	
Dissolved Oxygen bottle		Other glass jar	
Encore		Other	

40 mL vials: # HCl ____ # Methanol 1 Time and Date Frozen:

Bisulfate 2 # DI Water ____

Thiosulfate ____ Unpreserved ____

Login Sample Receipt Checklist

(Rejection Criteria Listing - Using Sample Acceptance Policy)

Any False statement will be brought to the attention of Client

Question	Answer (True/False) T/F/NA	Comment
1) The cooler's custody seal, if present, is intact.	NA	
2) The cooler or samples do not appear to have been compromised or tampered with.	T	
3) Samples were received on ice.	T	
4) Cooler Temperature is acceptable.	T	
5) Cooler Temperature is recorded.	T	
6) COC is filled out in ink and legible.	T	
7) COC is filled out with all pertinent information.	T	
8) Field Sampler's name present on COC.	T	
9) There are no discrepancies between the sample IDs on the container and the COC.	T	
10) Samples are received within Holding Time.	T	
11) Sample containers have legible labels.	T	
12) Containers are not broken or leaking.	T	
13) Air Cassettes are not broken/open.	NA	
14) Sample collection date/times are provided.	T	
15) Appropriate sample containers are used.	T	
16) Proper collection media used.	T	
17) No headspace sample bottles are completely filled.	NA	
18) There is sufficient volume for all requsted analyses, including any requested MS/MSDs.	T	
19) Trip blanks provided if applicable.	NA	
20) VOA sample vials do not have head space or bubble is <6mm (1/4") in diameter.	NA	
21) Samples do not require splitting or compositing.	T	

Who notified of False statements? **Date/Time:**

Doc #277 Rev. 4 August 2013 **Log-In Technician Initials:** JM **Date/Time:** 4/25/17 1920

MADEP MCP Analytical Method Report Certification Form

Laboratory Name:	Con-Test Analytical Laboratory	Project #:	17F0707
Project Location:	18 Howley St.	RTN:	

This Form provides certifications for the following data set: [list Laboratory Sample ID Number(s)]

17F0707-01

Matrices: Soil

CAM Protocol (check all that below)

8260 VOC CAM II A ( )	7470/7471 Hg CAM IIIB ( )	MassDEP VPH CAM IV A ( )	8081 Pesticides CAM V B ( )	7196 Hex Cr CAM VI B ( )	MassDEP APH CAM IX A ( )
8270 SVOC CAM II B ( )	7010 Metals CAM III C ( )	MassDEP EPH CAM IV A ( )	8151 Herbicides CAM V C ( )	8330 Explosives CAM VIII A ( )	TO-15 VOC CAM IX B ( )
6010 Metals CAM III A (X)	6020 Metals CAM III D ( )	8082 PCB CAM V A ( )	9014 Total Cyanide/PAC CAM VI A ( )	6860 Perchlorate CAM VIII B ( )	

Affirmative response to Questions A throughF is required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☑ Yes	☐ No[1]
B	Were the analytical method(s) and all associated QC requirements specificed in the selected CAM protocol(s) followed?	☑ Yes	☐ No[1]
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☑ Yes	☐ No[1]
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, Quality Assurance and Quality Control Guidlines for the Acquisition and Reporting of Analytical Data?	☑ Yes	☐ No[1]
E a	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	☐ Yes	☐ No[1]
E b	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes	☐ No[1]
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all No responses to Qestions A through E)?	☑ Yes	☐ No[1]

A response to questions G, H and I below is required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☑ Yes	☐ No[1]

<u>Data User Note:</u> Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were all QC perfomance standards specified in the CAM protocol(s) achieved?	☑ Yes	☐ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes	☑ No[1]

[1] *All Negative responses must be addressed in an attached Environmental Laboratory case narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:  Position: Project Manager

Printed Name: Lisa A. Worthington Date: 06/16/17

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

June 26, 2017

Mr. Brendan Callahan
Department of Community Development and Planning
24 Lowell Street
Peabody, Massachusetts 01960

Re: Limited Subsurface Site Investigation
North River Corridor Riverwalk
20 Howley Street
Peabody, Massachusetts

Dear Mr. Callahan:

Weston & Sampson is pleased to submit this Limited Subsurface Site Investigation Letter Report for the portion of 20 Howley Street located adjacent to the North River Canal in Peabody, Massachusetts. Specifically, this assessment evaluated an approximate 10-foot wide strip of land abutting the south side of the North River in Peabody, Massachusetts (the Site). The assessment was performed as part of a multi-parcel limited assessment in support of the proposed Riverwalk project along the North River Corridor. Weston & Sampson performed the following tasks as part of the Limited Subsurface Site Investigation:

- Site reconnaissance and review of previous investigations conducted at the Site;
- Soil boring advancement; and,
- Soil sampling and analysis.

See attached Figures 1 and 2 for a Site Locus Map and a Site Plan (with soil sampling locations), respectively.

SITE BACKGROUND

In support of the City of Peabody's (the City's) desire to construct a Riverwalk along the North River Corridor, the City is evaluating potential property acquisition and/or easement takings at selected properties along the corridor. Specifically, the City is interested in purchasing a portion of the property located at 20 Howley Street (Parcel ID 086-162). The Site, which was regulated under the Massachusetts Contingency Plan (MCP), has a documented history of environmental releases under Release Tracking Number (RTN) 3-17492. The property was closed under a Class B-2 RAO using an Activity Use Limitation (AUL) to restrict future use and development. The AUL is not applicable to the entire parcel and is located on the northern portion of the parcel and is approximately 31,800 square feet of the 38,385-square foot total parcel area, which includes all of the Site.

Under the AUL, the bituminous pavement and building foundations must remain in good condition as a barrier to prevent exposures to underlying impacted soils. Semi-annual inspections are required to be performed to confirm and document the barriers to exposure are being maintained.

The primary contaminants of concern at the Site are metals (i.e., arsenic, chromium and lead) and polycyclic aromatic hydrocarbons (PAHs). Historical fill has been observed at the site to depths of approximately six (6) feet below grade surface (bgs).

SUBSURFACE INVESTIGATION

Weston & Sampson performed a Limited Subsurface Investigation at the Site on April 25, 2017, to evaluate the quality of the surficial and near surficial soils. The investigation, which included the advancement of two (2) soil borings and the collection and analysis of four (4) soil samples, was limited to the area of the proposed Riverwalk only. A detailed summary of the investigation is provided below. See Figure 2 for sampling locations. A summary of laboratory analytical results is provided in Tables 1 and 2.

Soil Boring Advancement

On April 25, 2017, Weston & Sampson oversaw the advancement of two (2) soil borings (SP-1 and SP-2) at the Site. The borings were advanced by New England Geotech, LLC, of Jamestown, Rhode Island, to depths of 5 feet below ground surface (bgs) using direct-push methods. Boring locations were selected by Weston & Sampson based on documented historical Site use and a review of previous Site investigations, and were spatially distributed to obtain a representative evaluation of the conditions of the proposed Riverwalk area.

Soil Sampling and Analysis

A Weston & Sampson representative screened each soil boring at continuous depth intervals and logged soil descriptions using a modified Burmeister Soil Classification System. Each sample was field-screened for visual and olfactory evidence of impacts, as well as total volatile organic compounds (VOCs) using a photoionization detector (PID) in accordance with the Massachusetts Department of Environmental Protection (MassDEP) jar headspace screening method. Field screening results are included in the soil boring logs Attachment A.

Two (2) soil samples from each boring, one at the 0-1 foot interval, and one at the 2-5 foot interval, were submitted to Con-Test Analytical Laboratory of East Longmeadow, Massachusetts (Con-Test) for analysis of hexavalent chromium, selenium, silver, and PAHs. Analysis of additional metals and PCBs was not required because those analytes were included in previous investigations.

Weston & Sampson also composited soil from both soil boring locations, and submitted the composite sample (Comp-1) for analysis of typical disposal characterization parameters. The disposal characterization was conducted in accordance with the MassDEP Policy # COMM-97-001: Reuse and Disposal of Contaminated Soil in Massachusetts and included the following analyses: total petroleum hydrocarbons (TPH); Resource Conservation and Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver); VOCs; semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); pH; ignitability; specific conductivity; and reactivity.

SUBSURFACE INVESTIGATION RESULTS

In general, the following shallow geologic conditions were encountered during the subsurface soil investigation program:

Fill Material: Light brown to dark brown fine to coarse sand matrix containing variable amounts of fractured rocks and organics. Note the borings were not advanced deeper than five (5) feet below ground surface.

Bedrock was not encountered during the investigation.

Field Screening Results

As shown in the attached boring logs, PID field screening of soil samples collected from soil borings SP-1 and SP-2 did not identify detectable VOCs. Soil boring logs are included in Attachment A.

Soil Analytical Results

As shown in Table 1, analysis of soil samples identified concentrations of PAHs below applicable MCP Method 1 S-1/GW-2 and S-1/GW-3 standards in SP-1 (2-5) and SP-2 0-1). Hexavalent chromium, selenium, and silver were not detected in any samples. The results of historical investigations completed by others are included in Table 3. As shown in Table 3, arsenic, chromium, lead, and total petroleum hydrocarbons (TPH) are present at the Site above the applicable MCP Method 1 standards.

The results of the disposal characterization analyses are presented in Table 3. The results were compared to the COMM-97-001 requirements for reuse at Massachusetts lined and unlined landfills and the MCP RCS-1 thresholds. As shown in Table 3, soil analytical results indicate that only arsenic concentrations exceed the RCS-1 thresholds; however, arsenic and all other parameters are below the COMM-97-001 Reuse level for In-State Lined and Unlined Landfills. These exceedances are not reportable because they are consistent with concentrations of arsenic documented in the RAO for the Site.

CONCLUSIONS & COST ESTIMATES

In summary, no new reportable conditions under the MCP were encountered; however, the concentrations indicate that:

- In general, contaminant concentrations are similar in the 0-1 and 2-5 feet depth intervals;
- Excavation will require soil management under the MCP; and
- Surplus soil will require disposal at an appropriate facility and documentation by a Licensed Site Professional (LSP).

The Method 3 Risk Characterization presented in the RAO for the Site includes exposure scenarios consistent with the City's planned future for the Riverwalk. Specifically, the AUL permits use, without limitation as a residential facility and education facility, and permits "Such other activities or uses which, in the Opinion of a[n]… LSP…shall present no greater risk of harm to health, safety, public welfare or the environment than the activities and uses set forth in this Paragraph." Given that the newly collected data is consistent with the previous data and findings of the RAO, an updated Method 3 Risk Characterization for the proposed Riverwalk (i.e. easement) area will not be necessary. However, activities inconsistent with the AUL including "excavation activities which include the removal and/or the disturbance of the bituminous pavement…within the AUL Area and/or the disturbance of arsenic, chromium, or PAH contaminated soils," are likely to occur during redevelopment and will require a Release Abatement Measure (RAM) Plan to be filed with MassDEP, along with a Soil Management Plan (SMP) and Health and Safety Plan (HASP). Additionally, following the work, if the risk or exposure scenario changes, the existing AUL may be modified either to exclude the Site or amended to document the new conditions.

In summary, to construct the Riverwalk, soils will likely be excavated and disposed of at an appropriate facility. Clean fill will be used to construct the Riverwalk pathways. A new risk characterization will not be required for the Riverwalk area and redevelopment is unlikely to require a separate AUL or Permanent Solution Statement.

Assuming only the Riverwalk portion of the property were to be obtained through an easement, potential obligations to the City to construct a river walk along the corridor at the 21 Caller Street Property may include the following:

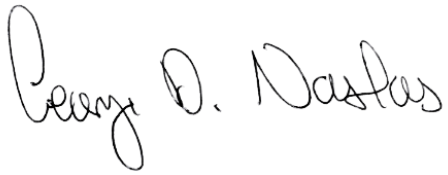
- MCP compliance costs for soil disturbance / construction activities ~ $17,000
  - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
  - RAM Status Report
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
  - AUL Modifications (excludes survey)
- Construction Specifications ~ $5,000
- Construction Administration, Coordination & Oversight ~ $5,000
- Soil removal and out-of-state disposal of approximately 160 tons (assumed to be an area measuring 130 feet long by 10 feet wide and a depth of 2 feet) of impacted soil from the Riverwalk ~ $7,200

Estimated TOTAL = $34,200* (not including permitting or associated Riverwalk construction costs). *Note: Given the existing condition of the canal wall along the property, further structural evaluations may conclude that additional soils require removal as part of wall repair alternatives.

We look forward to discussing these findings with you in greater detail and working with the City to make your visions for the Riverwalk a reality. If you have any comments or questions, please contact us at 978-532-1900.

Very truly yours,

WESTON & SAMPSON ENGINEERS, INC.



George D. Naslas, PG, LSP
Vice President

Attachments: Figures
Tables
Attachment A – Soil Boring Logs
Attachment B – Laboratory Analytical Report

O:\Peabody MA\North River Corridor Due Diligence\18 & 20 Howley St\Subsurface Investigation\20 Howley\20 Howley Site Investigation Summary.docx

FIGURES



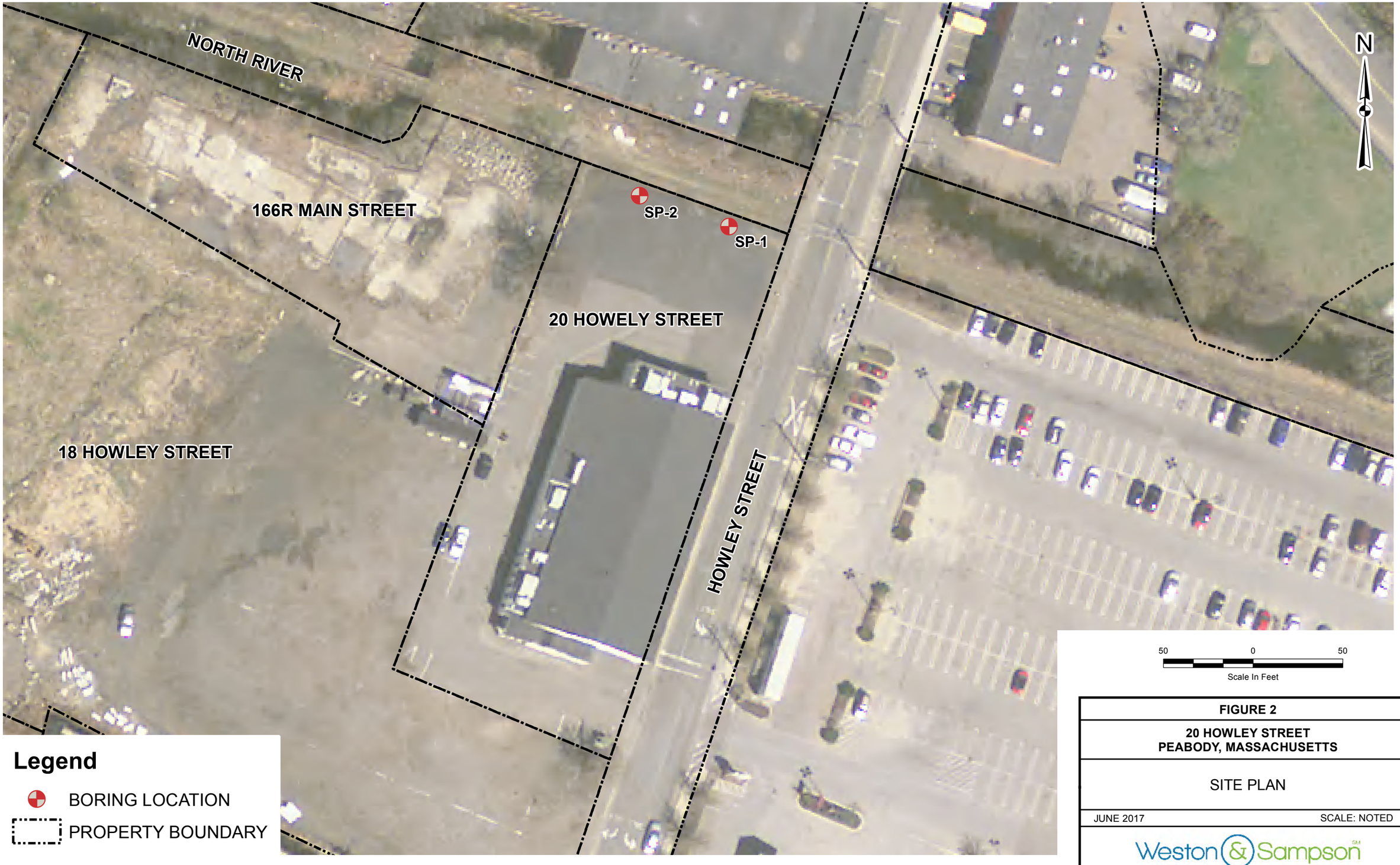
FIGURE 1
20 HOWLEY STREET
PEABODY, MASSACHUSETTS

LOCUS MAP

0 2,000 4,000 **Feet**

Weston & Sampson

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Legend

- BORING LOCATION
- PROPERTY BOUNDARY

FIGURE 2

20 HOWLEY STREET
PEABODY, MASSACHUSETTS

SITE PLAN

JUNE 2017 SCALE: NOTED

Weston & Sampson

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TABLES

Table 1
Summary of Laboratory Analytical Results - Soil Borings
20 Howley Street
Peabody, Massachusetts
April 25, 2017

Parameter	Units	Method 1 Cleanup Standards (1)		Sample Location, Depth, and Date			
		S-1/GW-2	S-1/GW-3	SP-1 (0-1)	SP-1 (2-5)	SP-2 (0-1)	SP-2 (2-5)
				0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet
Metals							
HEXAVALENT CHROMIUM	mg/kg	100	100	<0.33	<1.9	<0.34	<0.51
SELENIUM	mg/kg	400	400	<5.0	<5.8	<5.3	<7.5
SILVER	mg/kg	100	100	<0.50	<0.58	<0.53	<0.75
PAHs							
ACENAPHTHENE	mg/kg	1000	1000	<0.18	<0.20	<0.18	<0.27
ACENAPHTHYLENE	mg/kg	600	10	<0.18	<0.20	<0.18	<0.27
ANTHRACENE	mg/kg	1000	1000	<0.18	<0.20	<0.18	<0.27
BENZO(A)ANTHRACENE	mg/kg	7	7	<0.18	**0.3**	**0.33**	<0.27
BENZO(A)PYRENE	mg/kg	2	2	<0.18	**0.27**	**0.35**	<0.27
BENZO(B)FLUORANTHENE	mg/kg	7	7	<0.18	**0.49**	**0.45**	<0.27
BENZO(G,H,I)PERYLENE	mg/kg	1000	1000	<0.18	<0.20	**0.19**	<0.27
BENZO(K)FLUORANTHENE	mg/kg	70	70	<0.18	<0.20	<0.18	<0.27
CHRYSENE	mg/kg	70	70	<0.18	**0.38**	**0.35**	<0.27
DIBENZ(A,H)ANTHRACENE	mg/kg	0.7	0.7	<0.18	<0.20	<0.18	<0.27
FLUORANTHENE	mg/kg	1000	1000	<0.18	**0.64**	**0.69**	<0.27
FLUORENE	mg/kg	1000	1000	<0.18	<0.20	<0.18	<0.27
INDENO(1,2,3-CD)PYRENE	mg/kg	7	7	<0.18	0.24	**0.24**	<0.27
2-METHYLNAPHTHALENE	mg/kg	80	300	<0.18	<0.20	<0.18	<0.27
NAPHTHALENE	mg/kg	20	500	<0.18	<0.20	<0.18	<0.27
PHENANTHRENE	mg/kg	500	500	<0.18	**0.28**	**0.24**	<0.27
PYRENE	mg/kg	1000	1000	<0.18	**0.57**	**0.73**	<0.27

QC by JRS 6/9/17

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard
MCP = Massachusetts Contingency Plan
mg/kg = milligram per killiogram

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

Table 2
Summary of Laboratory Analytical Results - Disposal Characterization
20 Howley Street
Peabody, Massachusetts
April 25, 2017

Parameter	Units	Reportable Concentrations[1]	COMM-97-001 In-State Disposal/Reuse Levels		Sample Location, Depth, and Date
		RCS-1	Unlined	Lined	Disposal Characterization
Metals					
ARSENIC	mg/kg	20	40	40	**26**
BARIUM	mg/kg	1000	NS	NS	**62**
CADMIUM	mg/kg	70	30	80	**1.3**
CHROMIUM	mg/kg	100	1000	1000	**62**
LEAD	mg/kg	200	1000	2000	**77**
MERCURY	mg/kg	20	10	10	**1.0**
SELENIUM	mg/kg	400	NS	NS	<6.0
SILVER	mg/kg	100	NS	NS	<0.60
PCBs					
Total PCBs	mg/kg	1	<2	<2	ND
TPH					
TPH	mg/kg	1000	2500	5000	**360**
VOCs					
Total VOCs	mg/kg	NS	4	10	ND
SVOCs					
Total SVOCs	mg/kg	NS	100	100	ND
General Chemistry					
% Solids	%Wt	NS	NS	NS	**81.3**
SPECIFIC CONDUCTANCE	(µmhos/cm)	NS	4000	8000	**4.4**
IGNITABILITY	(present/absent)	NS	Absent	Absent	Absent
REACTIVE CYANIDE	mg/kg	NS	ND	ND	<4.0
REACTIVE SULFIDE	mg/kg	NS	ND	ND	<20
PH	pH Units	NS	>2 and <12	>2 and <12	**6.8**

QC by JRS 6/9/17

C:\Users\SpencerJ\Desktop\New folder\20 Howley\Tables\[Table 1 - 20 Howley Street.xls]Soil Borings

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
BOLD Parameter exceeds the COMM-97-001 standard for reuse at In-State landfills
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

Table 3
Summary of Laboratory Analytical Results - Historical Data
20 Howley Street
Peabody, Massachusetts

Parameter	Units	Method 1 Cleanup Standards (1)		Sample Location, Depth, and Date												
		S-1/GW-2	S-1/GW-3	B-31-SS-01	B-31-SS-02	B-32-SS-01	B-32-SS-02	B-32-SS-02D	B-33-SS-01	B-33-SS-2	P-9 (0-5)	P-9 (5-10)	P-10 (0-5)	P-10 (5-10)	K-13 (0-3) (FD of P-13)	P-13 (0-3)	P-13 (5-7)
				10/21/2005	10/21/2005	10/21/2005	10/21/2005	10/21/2005	10/21/2005	10/21/2005	5/29/2009	5/29/2009	5/29/2009	5/29/2009	9/15/2009	9/15/2009	9/15/2009
Metals																	
ANTIMONY	mg/kg	20	20	NA	NA	NA	NA	NA	NA	NA	**8.28**	<7.81	<6.16	<10.7	<5.12	<5.12	<7.41
ARSENIC	mg/kg	20	20	**53.4**	**43.8**	**112**	**11**	**6**	**233**	**59.3**	**312**	**231**	**41.8**	**31.1**	**15.1**	**17**	<9.26
TCLP ARSENIC	mg/L			NA	NA	NA	NA	NA	NA	NA	**1.2**	**0.74**	NA	NA	<0.25	<0.25	<0.25
BARIUM	mg/kg	1000	1000	NA	NA	NA	NA	NA	NA	NA	**168**	**98.3**	**60.8**	**67.9**	**61.5**	**86.6**	<37.1
BERYLLIUM	mg/kg	90	90	NA	NA	NA	NA	NA	NA	NA	**0.402**	<0.488	**0.469**	**0.72**	<0.320	<0.320	**0.704**
CADMIUM	mg/kg	70	70	**1.18**	**0.98**	**2.76**	**1.05**	**0.6**	**3.53**	**1.21**	**2.41**	**1.23**	<0.77	<1.34	<0.640	<0.639	<0.926
TRIVALENT CHROMIUM	mg/kg	1000	1000	NA	NA	**890**	NA	NA	NA	NA	**1450**	**535**	**45.4**	**40.6**	**958**	**326**	**46.5**
HEXAVALENT CHROMIUM[2]	mg/kg	100	100	**55**	**32**	NA	**23.2**	**14.9**	**402**	**91.7**	<2.3	<3.4	<2.5	<4.6	**3.7**	<8.6	<6.4
TCLP TOTAL CHROMIUM	mg/L	NS	NS	NA	NA	NA	NA	NA	NA	NA	<0.1	<0.1	NA	NA	<0.1	<0.1	<0.1
LEAD	mg/kg	200	200	**122**	**69.3**	**102**	**26.5**	**20.2**	**299**	**74.5**	**191**	**154**	**103**	**72.9**	**36.9**	**26.4**	**8.33**
TCLP LEAD	mg/L	NS	NS	NA	NA	NA	NA	NA	NA	NA	<0.25	<0.25	<0.25	NA	<0.25	<0.25	<0.25
MERCURY	mg/kg	20	20	NA	NA	NA	NA	NA	NA	NA	**0.292**	**0.363**	**0.277**	**0.333**	<0.0480	**0.074**	<0.0775
NICKEL	mg/kg	600	600	NA	NA	NA	NA	NA	NA	NA	**21.5**	**16.4**	**19.4**	**25.6**	**28.9**	**18.3**	**24.8**
SELENIUM	mg/kg	400	400	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SILVER	mg/kg	100	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
THALLIUM	mg/kg	8	8	NA	NA	NA	NA	NA	NA	NA	<7.23	<9.76	<7.7	<13.4	<6.40	<6.39	<9.26
VANADIUM	mg/kg	400	400	NA	NA	NA	NA	NA	NA	NA	**39.8**	**27.9**	**31.9**	**44.4**	**73.7**	**65.7**	**35.3**
ZINC	mg/kg	1000	1000	NA	NA	NA	NA	NA	NA	NA	**688**	**250**	**99.8**	**79.1**	**73.8**	**70.5**	**53.6**
VOCs																	
ACETONE	mg/kg	50	400	NA	NA	NA	NA	NA	NA	NA	<0.021	**0.11**	<0.300	<0.850	<0.200	<170	<0.41
BENZENE	mg/kg	40	40	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.030	<0.085	<0.020	<0.017	<0.041
CHLOROMETHANE	mg/kg	NS	NS	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.061	<0.170	<0.040	<35	<0.082
ETHYLBENZENE	mg/kg	500	500	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.030	<0.085	**0.084**	**0.07**	<0.041
METHYLENE CHLORIDE	mg/kg	20	200	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.035	<0.061	<0.170	**0.15**	**0.057**	<0.082
NAPHTHALENE	mg/kg	20	500	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.061	<0.170	**0.26**	**0.067**	<0.082
TETRACHLOROETHYLENE	mg/kg	10	30	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.030	<0.085	<0.020	<0.017	<0.041
TOLUENE	mg/kg	500	500	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.030	<0.085	**0.22**	**0.17**	<0.041
M/P-XYLENE	mg/kg	100	500	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.030	<0.085	**0.12**	**0.1**	<0.041
O-XYLENE	mg/kg	100	500	NA	NA	NA	NA	NA	NA	NA	<0.0051	<0.0089	<0.030	<0.085	**0.35**	**0.28**	<0.041
SVOCs																	
ACENAPHTHYLENE	mg/kg	600	10	NA	NA	NA	NA	NA	NA	NA	NA	<0.42	NA	<0.058	<2.5	<2.6	NA
ANTHRACENE	mg/kg	1000	1000	NA	NA	NA	NA	NA	NA	NA	NA	**0.69**	NA	<0.058	<2.5	<2.6	NA
BENZO(A)ANTHRACENE	mg/kg	7	7	NA	NA	NA	NA	NA	NA	NA	NA	**1.6**	NA	<0.058	**4.1**	**2.7**	NA
BENZO(A)PYRENE	mg/kg	2	2	NA	NA	NA	NA	NA	NA	NA	NA	**1.7**	NA	<0.058	**4**	**2.8**	NA
BENZO(B)FLUORANTHENE	mg/kg	7	7	NA	NA	NA	NA	NA	NA	NA	NA	**1.4**	NA	<0.058	**5.8**	**4**	NA
BENZO(G,H,I)PERYLENE	mg/kg	1000	1000	NA	NA	NA	NA	NA	NA	NA	NA	<420	NA	<0.058	<2.5	<2.6	NA
BENZO(K)FLUORANTHENE	mg/kg	70	70	NA	NA	NA	NA	NA	NA	NA	NA	**1.4**	NA	<0.058	<2.5	<2.6	NA
CHRYSENE	mg/kg	70	70	NA	NA	NA	NA	NA	NA	NA	NA	**1.7**	NA	<0.058	**4.5**	**3.2**	NA
DIBENZ(A,H)ANTHRACENE	mg/kg	0.7	0.7	NA	NA	NA	NA	NA	NA	NA	NA	<420	NA	<0.058	<2.5	<2.6	NA
FLUORANTHENE	mg/kg	1000	1000	NA	NA	NA	NA	NA	NA	NA	NA	**3.8**	NA	<0.058	**9.8**	**6.7**	NA
INDENO(1,2,3-CD)PYRENE	mg/kg	7	7	NA	NA	NA	NA	NA	NA	NA	NA	**1.1**	NA	<0.058	<2.5	<2.6	NA
NAPHTHALENE	mg/kg	20	500	NA	NA	NA	NA	NA	NA	NA	NA	**0.66**	NA	<0.058	<2.5	<2.6	NA
PHENANTHRENE	mg/kg	500	500	NA	NA	NA	NA	NA	NA	NA	NA	**2.3**	NA	<0.058	<2.5	**3.1**	NA
PYRENE	mg/kg	1000	1000	NA	NA	NA	NA	NA	NA	NA	NA	**3.3**	NA	<0.058	**7.8**	**5.6**	NA
PCBs																	
AROCLOR 1268	mg/kg	1	1	NA	NA	NA	NA	NA	NA	NA	<0.028	<0.042	<0.031	<0.056	<0.025	<0.025	<0.040
AROCLOR 1016	mg/kg	1	1	NA	NA	NA	NA	NA	NA	NA	<0.028	<0.042	<0.031	<0.056	**0.051**	**0.068**	<0.040
AROCLOR 1232	mg/kg	1	1	NA	NA	NA	NA	NA	NA	NA	<0.028	<0.042	<0.031	<0.056	<0.025	<0.025	<0.040
TPH																	
Diesel Range Organics	mg/kg	1000	1000	NA	NA	NA	NA	NA	NA	NA	**290**	**270**	**81**	**150**	**1500**	**1400**	**240**
General Chemistry																	
% Solids	%Wt	NS	NS	NA	NA	NA	NA	NA	NA	NA	**14.3**	**14.3**	**32.8**	**32.8**	**3.3**	**2.5**	**38.1**
IGNITABILITY	(present/absent)	NS	NS	NA	NA	NA	NA	NA	NA	NA	>200	>200	>200	>200	>200	>200	>200
REACTIVE CYANIDE	mg/kg	NS	NS	NA	NA	NA	NA	NA	NA	NA	<23	<23	<30	<30	<20	<20	<32
REACTIVE SULFIDE	mg/kg	NS	NS	NA	NA	NA	NA	NA	NA	NA	<110	<110	<150	<150	<100	<100	<160
PH	pH Units	NS	NS	NA	NA	NA	NA	NA	NA	NA	**7.2**	**7.2**	**6.2**	**6.2**	**7.4**	**7.3**	**6.6**

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard
MCP = Massachusetts Contingency Plan
mg/kg = milligram per killiogram

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated Janurary 2015).
2 = Assumed to be the hexavalent form in the absence of speciation analysis

ATTACHEMNT A
Soil Boring Logs

Weston & Sampson	PROJECT 20 Howley St (Peabody Riverwalk)	REPORT OF BORING No. SB-1 SHEET 1 OF 1 Project No. 2160299 CHKD BY

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 4/25/17	DATE END 4/25/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher

CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (in)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			8/12	0-2	0-2	0	Brown to grey fine to coarse SAND with little silt		SAND FILL
			18/36	2-5	2-5	0	Brown to dark grey fine to coarse SAND with little silt		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-1

Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-2
20 Howley St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 4/25/17	DATE END 4/25/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher

CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (in)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			8/12	0-2	0-2	0	Dark grey to light grey fine to coarse SAND		SAND FILL
			18/36	2-5	2-5	0.1	Dark grey fine to coarse SAND; trace brick and peat		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THIS BORING LOG. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS ARE MADE.

BORING No. SB-2

ATTACHMENT B
Laboratory Analytical Reports

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

May 3, 2017

Joe Spencer
Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960

Project Location: 20 Howley St.
Client Job Number:
Project Number: 2160299
Laboratory Work Order Number: 17D1127

Enclosed are results of analyses for samples received by the laboratory on April 25, 2017. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Meghan E. Kelley
Project Manager

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 5/3/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: 2160299

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17D1127

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 20 Howley St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
SP1 (0-1)	17D1127-01	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-1 (2-5)	17D1127-02	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (0-1)	17D1127-03	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (2-5)	17D1127-04	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 8270D	
				SW-846 9045C	
Disposal Characterization	17D1127-05	Soil		SM 2540G	
				SM21-22 2510B Modified	
				SW-846 1030	
				SW-846 6010C-D	
				SW-846 7471B	
				SW-846 8082A	
				SW-846 8100 Modified	
				SW-846 8260C	
				SW-846 8270D	
				SW-846 9014	
				SW-846 9030A	
				SW-846 9045C	

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CASE NARRATIVE SUMMARY

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

For method 8270, 17D1127-01,02,03,04 only PAHs were requested and reported.

For method 6010, only a select list of metals were requested and reported.

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SW-846 7196A

Qualifications:

DL-03

Elevated reporting limit due to matrix.

Analyte & Samples(s) Qualified:

Hexavalent Chromium
17D1127-01[SP1 (0-1)], 17D1127-03[SP-2 (0-1)], 17D1127-04[SP-2 (2-5)]

MS-16

For solid method SW846-7196A, the matrix spike is outside of control limits. pH and ORP results were indicative of reducing conditions. Reanalysis is not required. Analysis is in control based on LCS recoveries.

Analyte & Samples(s) Qualified:

Hexavalent Chromium
17D1127-01[SP1 (0-1)], 17D1127-02[SP-1 (2-5)], B175501-MS1, B175501-MS2, B175501-MSD1, B175749-MS3, B175749-MSD1

W-06

Elevated method reporting limit due to intense color of sample

Analyte & Samples(s) Qualified:

Hexavalent Chromium
17D1127-02[SP-1 (2-5)], B175749-MS3, B175749-MSD1

SW-846 8082A

Qualifications:

O-32

A dilution was performed as part of the standard analytical procedure.

Analyte & Samples(s) Qualified:

17D1127-05[Disposal Characterization]

SW-846 8100 Modified

Qualifications:

S-01

The surrogate recovery for this sample is not available due to sample dilution below the surrogate reporting limit required from high analyte concentration and/or matrix interferences.

Analyte & Samples(s) Qualified:

o-Terphenyl
17D1127-05[Disposal Characterization]

SW-846 8260C

Qualifications:

L-07

Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.

Analyte & Samples(s) Qualified:

Hexachlorobutadiene
B175403-BS1

V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

Dichlorodifluoromethane (Freon 1
17D1127-05[Disposal Characterization], B175403-BLK1, B175403-BS1, B175403-BSD1

Naphthalene
17D1127-05[Disposal Characterization], B175403-BLK1, B175403-BS1, B175403-BSD1

V-16

Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.

Analyte & Samples(s) Qualified:

1,4-Dioxane
17D1127-05[Disposal Characterization], B175403-BLK1, B175403-BS1, B175403-BSD1

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SW-846 8270D

Qualifications:

L-04

Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

Aniline

17D1127-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

2,4-Dinitrophenol

17D1127-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

Benzo(b)fluoranthene

17D1127-01[SP1 (0-1)], 17D1127-02[SP-1 (2-5)], 17D1127-03[SP-2 (0-1)], 17D1127-04[SP-2 (2-5)]

Benzo(k)fluoranthene

17D1127-01[SP1 (0-1)], 17D1127-02[SP-1 (2-5)], 17D1127-03[SP-2 (0-1)], 17D1127-04[SP-2 (2-5)]

Pentachlorophenol

17D1127-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

V-20

Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.

Analyte & Samples(s) Qualified:

Benzo(g,h,i)perylene

B175339-BLK1, B175339-BS1, B175339-BSD1

Dibenz(a,h)anthracene

B175339-BLK1, B175339-BS1, B175339-BSD1

Hexachlorobutadiene

17D1127-05[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

Indeno(1,2,3-cd)pyrene

B175339-BLK1, B175339-BS1, B175339-BSD1

SW-846 6010C/D SW-846 6020A/B

For NC, Metals methods SW-846 6010D and SW-846 6020B are followed, and for all other states methods SW-846 6010C and SW-846 6020A are followed.

SW-846 8100 Modified

TPH (C9-C36) is quantitated against a calibration made with a diesel standard.

SW-846 8260C

Laboratory control sample recoveries for required MCP Data Enhancement 8260 compounds were all within limits specified by the method except for “difficult analytes” where recovery control limits of 40-160% are used and/or unless otherwise listed in this narrative. Difficult analytes: MIBK, MEK, acetone, 1,4-dioxane, chloromethane, dichlorodifluoromethane, 2-hexanone, and bromomethane.

SW-846 8270D

Laboratory control sample recoveries for required MCP Data Enhancement 8270 compounds were all within control limits specified by the method, 40-140% for base/neutrals and 30-130% for acids except for “difficult analytes” listed below and/or otherwise listed in this narrative. Difficult analytes limits are 15 and 140%: 2,4-dinitrophenol, 4-chloroaniline, 4-nitrophenol, and phenol.

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Lisa A. Worthington
Project Manager

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP1 (0-1) Sampled: 4/25/2017 09:25

Sample ID: 17D1127-01

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Acenaphthylene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Anthracene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Benzo(a)anthracene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Benzo(a)pyrene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Benzo(b)fluoranthene	ND	0.18	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Benzo(g,h,i)perylene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Benzo(k)fluoranthene	ND	0.18	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Chrysene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Dibenz(a,h)anthracene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Fluoranthene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Fluorene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Indeno(1,2,3-cd)pyrene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
2-Methylnaphthalene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Naphthalene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Phenanthrene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC
Pyrene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:26	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	40.8	30-130		5/1/17 17:26
2-Fluorobiphenyl	43.7	30-130		5/1/17 17:26
p-Terphenyl-d14	40.6	30-130		5/1/17 17:26

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP1 (0-1) Sampled: 4/25/2017 09:25

Sample ID: 17D1127-01

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	5.0	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:14	SHN
Silver	ND	0.50	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:14	SHN

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Project Location: 20 Howley St. | Sample Description: | Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP1 (0-1) | Sampled: 4/25/2017 09:25

Sample ID: 17D1127-01

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.33	mg/Kg dry	2	DL-03, MS-16	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	120		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @25.4°C	7.6		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	93.8		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 09:35

Sample ID: 17D1127-02

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Acenaphthylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Benzo(a)anthracene	0.30	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Benzo(a)pyrene	0.27	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Benzo(b)fluoranthene	0.49	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Benzo(g,h,i)perylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Benzo(k)fluoranthene	ND	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Chrysene	0.38	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Dibenz(a,h)anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Fluoranthene	0.64	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Fluorene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Indeno(1,2,3-cd)pyrene	0.24	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
2-Methylnaphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Naphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Phenanthrene	0.28	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC
Pyrene	0.57	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 17:50	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	45.3	30-130		5/1/17 17:50
2-Fluorobiphenyl	45.2	30-130		5/1/17 17:50
p-Terphenyl-d14	52.8	30-130		5/1/17 17:50

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 09:35

Sample ID: 17D1127-02

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	5.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:10	SHN
Silver	ND	0.58	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:10	SHN

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 09:35

Sample ID: 17D1127-02

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	1.9	mg/Kg dry	10	MS-16, W-06	SW-846 7196A	5/1/17	5/2/17 12:15	LL
Oxidation/Reduction Potential	100		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @22.8°C	7.0		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	84.2		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 10:00

Sample ID: 17D1127-03

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Acenaphthylene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Anthracene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Benzo(a)anthracene	0.33	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Benzo(a)pyrene	0.35	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Benzo(b)fluoranthene	0.45	0.18	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Benzo(g,h,i)perylene	0.19	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Benzo(k)fluoranthene	ND	0.18	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Chrysene	0.35	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Dibenz(a,h)anthracene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Fluoranthene	0.69	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Fluorene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Indeno(1,2,3-cd)pyrene	0.24	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
2-Methylnaphthalene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Naphthalene	ND	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Phenanthrene	0.24	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC
Pyrene	0.73	0.18	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:15	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	75.0	30-130		5/1/17 18:15
2-Fluorobiphenyl	78.2	30-130		5/1/17 18:15
p-Terphenyl-d14	99.2	30-130		5/1/17 18:15

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 10:00

Sample ID: 17D1127-03

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	5.3	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:05	SHN
Silver	ND	0.53	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:05	SHN

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 10:00

Sample ID: 17D1127-03

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.34	mg/Kg dry	2	DL-03	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	120		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @22.3°C	8.1		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	93.7		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 10:05

Sample ID: 17D1127-04

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Acenaphthylene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Anthracene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Benzo(a)anthracene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Benzo(a)pyrene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Benzo(b)fluoranthene	ND	0.27	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Benzo(g,h,i)perylene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Benzo(k)fluoranthene	ND	0.27	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Chrysene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Dibenz(a,h)anthracene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Fluoranthene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Fluorene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Indeno(1,2,3-cd)pyrene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
2-Methylnaphthalene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Naphthalene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Phenanthrene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC
Pyrene	ND	0.27	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 18:39	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	50.5	30-130		5/1/17 18:39
2-Fluorobiphenyl	51.4	30-130		5/1/17 18:39
p-Terphenyl-d14	51.4	30-130		5/1/17 18:39

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 10:05

Sample ID: 17D1127-04

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Selenium	ND	7.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:43	SHN
Silver	ND	0.75	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:43	SHN

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 10:05

Sample ID: 17D1127-04

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.51	mg/Kg dry	2	DL-03	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	120		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @21.7°C	6.4		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	62.6		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acetone	ND	0.14	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
tert-Amyl Methyl Ether (TAME)	ND	0.0014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Benzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Bromobenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Bromochloromethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Bromodichloromethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Bromoform	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Bromomethane	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
2-Butanone (MEK)	ND	0.058	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
n-Butylbenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
sec-Butylbenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
tert-Butylbenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
tert-Butyl Ethyl Ether (TBEE)	ND	0.0014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Carbon Disulfide	ND	0.0087	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Carbon Tetrachloride	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Chlorobenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Chlorodibromomethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Chloroethane	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Chloroform	ND	0.0058	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Chloromethane	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
2-Chlorotoluene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
4-Chlorotoluene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0058	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2-Dibromoethane (EDB)	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Dibromomethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2-Dichlorobenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,3-Dichlorobenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,4-Dichlorobenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Dichlorodifluoromethane (Freon 12)	ND	0.014	mg/Kg dry	1	V-05	SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,1-Dichloroethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2-Dichloroethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,1-Dichloroethylene	ND	0.0058	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
cis-1,2-Dichloroethylene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
trans-1,2-Dichloroethylene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2-Dichloropropane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,3-Dichloropropane	ND	0.0014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
2,2-Dichloropropane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,1-Dichloropropene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
cis-1,3-Dichloropropene	ND	0.0014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
trans-1,3-Dichloropropene	ND	0.0014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Diethyl Ether	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Diisopropyl Ether (DIPE)	ND	0.0014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,4-Dioxane	ND	0.29	mg/Kg dry	1	V-16	SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Ethylbenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexachlorobutadiene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
2-Hexanone (MBK)	ND	0.029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Isopropylbenzene (Cumene)	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
p-Isopropyltoluene (p-Cymene)	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Methyl tert-Butyl Ether (MTBE)	ND	0.0058	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Methylene Chloride	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
4-Methyl-2-pentanone (MIBK)	ND	0.029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Naphthalene	ND	0.014	mg/Kg dry	1	V-05	SW-846 8260C	4/26/17	4/26/17 13:09	MFF
n-Propylbenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Styrene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,1,1,2-Tetrachloroethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,1,2,2-Tetrachloroethane	ND	0.0014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Tetrachloroethylene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Tetrahydrofuran	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Toluene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2,3-Trichlorobenzene	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2,4-Trichlorobenzene	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,1,1-Trichloroethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,1,2-Trichloroethane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Trichloroethylene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Trichlorofluoromethane (Freon 11)	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2,3-Trichloropropane	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,2,4-Trimethylbenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
1,3,5-Trimethylbenzene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
Vinyl Chloride	ND	0.014	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
m+p Xylene	ND	0.0058	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF
o-Xylene	ND	0.0029	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:09	MFF

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
1,2-Dichloroethane-d4	104	70-130		4/26/17 13:09
Toluene-d8	95.1	70-130		4/26/17 13:09
4-Bromofluorobenzene	88.1	70-130		4/26/17 13:09

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Acenaphthylene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Acetophenone	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Aniline	ND	0.42	mg/Kg dry	1	L-04	SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Benzo(a)anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Benzo(a)pyrene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Benzo(b)fluoranthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Benzo(g,h,i)perylene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Benzo(k)fluoranthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Bis(2-chloroethoxy)methane	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Bis(2-chloroethyl)ether	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Bis(2-chloroisopropyl)ether	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Bis(2-Ethylhexyl)phthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
4-Bromophenylphenylether	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Butylbenzylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
4-Chloroaniline	ND	0.81	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2-Chloronaphthalene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2-Chlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Chrysene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Dibenz(a,h)anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Dibenzofuran	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Di-n-butylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
1,2-Dichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
1,3-Dichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
1,4-Dichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
3,3-Dichlorobenzidine	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2,4-Dichlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Diethylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2,4-Dimethylphenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Dimethylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2,4-Dinitrophenol	ND	0.81	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2,4-Dinitrotoluene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2,6-Dinitrotoluene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Di-n-octylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Fluoranthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Fluorene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Hexachlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Hexachlorobutadiene	ND	0.42	mg/Kg dry	1	V-20	SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Hexachloroethane	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Indeno(1,2,3-cd)pyrene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Isophorone	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2-Methylnaphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
2-Methylphenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
3/4-Methylphenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Naphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Nitrobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2-Nitrophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
4-Nitrophenol	ND	0.81	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Pentachlorophenol	ND	0.42	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Phenanthrene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Phenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
Pyrene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
1,2,4-Trichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2,4,5-Trichlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL
2,4,6-Trichlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 19:36	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
2-Fluorophenol	44.7	30-130		5/1/17 19:36
Phenol-d6	48.3	30-130		5/1/17 19:36
Nitrobenzene-d5	57.7	30-130		5/1/17 19:36
2-Fluorobiphenyl	53.6	30-130		5/1/17 19:36
2,4,6-Tribromophenol	49.9	30-130		5/1/17 19:36
p-Terphenyl-d14	54.9	30-130		5/1/17 19:36

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Sample Flags: O-32

Polychlorinated Biphenyls By GC/ECD

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1221 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1232 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1242 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1248 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1254 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1260 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1262 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL
Aroclor-1268 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	5/1/17 10:10	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	94.6	30-150		5/1/17 10:10
Decachlorobiphenyl [2]	95.6	30-150		5/1/17 10:10
Tetrachloro-m-xylene [1]	103	30-150		5/1/17 10:10
Tetrachloro-m-xylene [2]	102	30-150		5/1/17 10:10

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Petroleum Hydrocarbons Analyses

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
TPH (C9-C36)	360	200	mg/Kg dry	20		SW-846 8100 Modified	4/27/17	5/2/17 0:11	PJG

Surrogates	% Recovery	Recovery Limits	Flag/Qual				
o-Terphenyl	*	40-140	S-01				5/2/17 0:11

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Arsenic	26	3.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:48	SHN
Barium	62	3.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:48	SHN
Cadmium	1.3	0.30	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:48	SHN
Chromium	62	0.60	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:48	SHN
Lead	77	0.90	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:48	SHN
Mercury	1.0	0.15	mg/Kg dry	5		SW-846 7471B	4/27/17	4/27/17 13:05	TJK
Selenium	ND	6.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:48	SHN
Silver	ND	0.60	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 17:48	SHN

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Project Location: 20 Howley St. Sample Description: Work Order: 17D1127

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 09:40

Sample ID: 17D1127-05

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Ignitability	Absent		present/absent	1		SW-846 1030	4/27/17	4/27/17 15:20	DCF
pH @22.8°C	6.8		pH Units	1		SW-846 9045C	4/26/17	4/26/17 8:45	LL
Reactive Cyanide	ND	4.0	mg/Kg	1		SW-846 9014	4/27/17	4/28/17 8:35	LL
Reactive Sulfide	ND	20	mg/Kg	1		SW-846 9030A	4/27/17	4/28/17 8:20	LL
Specific conductance	4.4	2.0	µmhos/cm	1		SM21-22 2510B Modified	5/2/17	5/2/17 10:15	EC
% Solids	81.3		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Sample Extraction Data

Prep Method: % Solids-SM 2540G

Lab Number [Field ID]	Batch	Date
17D1127-01 [SP1 (0-1)]	B175514	04/27/17
17D1127-02 [SP-1 (2-5)]	B175514	04/27/17
17D1127-03 [SP-2 (0-1)]	B175514	04/27/17
17D1127-04 [SP-2 (2-5)]	B175514	04/27/17
17D1127-05 [Disposal Characterization]	B175514	04/27/17

SM21-22 2510B Modified

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1127-05 [Disposal Characterization]	B175829	1.00	05/02/17

SM2580 A

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1127-01 [SP1 (0-1)]	B175351	20.0	04/26/17
17D1127-02 [SP-1 (2-5)]	B175351	20.0	04/26/17
17D1127-03 [SP-2 (0-1)]	B175351	20.0	04/26/17
17D1127-04 [SP-2 (2-5)]	B175351	20.0	04/26/17

SW-846 1030

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1127-05 [Disposal Characterization]	B175571	50.0	04/27/17

Prep Method: SW-846 3050B-SW-846 6010C-D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-04 [SP-2 (2-5)]	B175526	1.07	50.0	04/27/17
17D1127-05 [Disposal Characterization]	B175526	1.03	50.0	04/27/17

Prep Method: SW-846 3051-SW-846 6010C-D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-01 [SP1 (0-1)]	B175609	1.07	50.0	04/28/17
17D1127-02 [SP-1 (2-5)]	B175609	1.02	50.0	04/28/17
17D1127-03 [SP-2 (0-1)]	B175609	1.00	50.0	04/28/17

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-01 [SP1 (0-1)]	B175501	2.58	100	04/27/17
17D1127-03 [SP-2 (0-1)]	B175501	2.53	100	04/27/17
17D1127-04 [SP-2 (2-5)]	B175501	2.52	100	04/27/17

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Sample Extraction Data

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-02 [SP-1 (2-5)]	B175749	2.51	100	05/01/17

Prep Method: SW-846 7471-SW-846 7471B

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-05 [Disposal Characterization]	B175482	0.611	50.0	04/27/17

Prep Method: SW-846 3546-SW-846 8082A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-05 [Disposal Characterization]	B175466	10.0	10.0	04/27/17

Prep Method: SW-846 3546-SW-846 8100 Modified

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-05 [Disposal Characterization]	B175469	30.0	1.00	04/27/17

Prep Method: SW-846 5035-SW-846 8260C

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-05 [Disposal Characterization]	B175403	4.26	10.0	04/26/17

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-01 [SP1 (0-1)]	B175339	30.0	1.00	04/26/17
17D1127-02 [SP-1 (2-5)]	B175339	30.0	1.00	04/26/17
17D1127-03 [SP-2 (0-1)]	B175339	30.0	1.00	04/26/17
17D1127-04 [SP-2 (2-5)]	B175339	30.0	1.00	04/26/17

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-05 [Disposal Characterization]	B175467	30.0	1.00	04/27/17

SW-846 9014

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-05 [Disposal Characterization]	B175566	25.3	250	04/27/17

SW-846 9030A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1127-05 [Disposal Characterization]	B175577	25.3	250	04/27/17

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Sample Extraction Data

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1127-01 [SP1 (0-1)]	B175358	20.0	04/26/17
17D1127-02 [SP-1 (2-5)]	B175358	20.0	04/26/17
17D1127-03 [SP-2 (0-1)]	B175358	20.0	04/26/17
17D1127-04 [SP-2 (2-5)]	B175358	20.0	04/26/17

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1127-05 [Disposal Characterization]	B175376	20.0	04/26/17

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175403 - SW-846 5035										
Blank (B175403-BLK1)				Prepared & Analyzed: 04/26/17						
Acetone	ND	0.10	mg/Kg wet							
tert-Amyl Methyl Ether (TAME)	ND	0.0010	mg/Kg wet							
Benzene	ND	0.0020	mg/Kg wet							
Bromobenzene	ND	0.0020	mg/Kg wet							
Bromochloromethane	ND	0.0020	mg/Kg wet							
Bromodichloromethane	ND	0.0020	mg/Kg wet							
Bromoform	ND	0.0020	mg/Kg wet							
Bromomethane	ND	0.010	mg/Kg wet							
2-Butanone (MEK)	ND	0.040	mg/Kg wet							
n-Butylbenzene	ND	0.0020	mg/Kg wet							
sec-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butyl Ethyl Ether (TBEE)	ND	0.0010	mg/Kg wet							
Carbon Disulfide	ND	0.0060	mg/Kg wet							
Carbon Tetrachloride	ND	0.0020	mg/Kg wet							
Chlorobenzene	ND	0.0020	mg/Kg wet							
Chlorodibromomethane	ND	0.0010	mg/Kg wet							
Chloroethane	ND	0.010	mg/Kg wet							
Chloroform	ND	0.0040	mg/Kg wet							
Chloromethane	ND	0.010	mg/Kg wet							
2-Chlorotoluene	ND	0.0020	mg/Kg wet							
4-Chlorotoluene	ND	0.0020	mg/Kg wet							
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0020	mg/Kg wet							
1,2-Dibromoethane (EDB)	ND	0.0010	mg/Kg wet							
Dibromomethane	ND	0.0020	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.0020	mg/Kg wet							
Dichlorodifluoromethane (Freon 12)	ND	0.010	mg/Kg wet							V-05
1,1-Dichloroethane	ND	0.0020	mg/Kg wet							
1,2-Dichloroethane	ND	0.0020	mg/Kg wet							
1,1-Dichloroethylene	ND	0.0040	mg/Kg wet							
cis-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
trans-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
1,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,3-Dichloropropane	ND	0.0010	mg/Kg wet							
2,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,1-Dichloropropene	ND	0.0020	mg/Kg wet							
cis-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
trans-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
Diethyl Ether	ND	0.010	mg/Kg wet							
Diisopropyl Ether (DIPE)	ND	0.0010	mg/Kg wet							
1,4-Dioxane	ND	0.10	mg/Kg wet							V-16
Ethylbenzene	ND	0.0020	mg/Kg wet							
Hexachlorobutadiene	ND	0.0020	mg/Kg wet							
2-Hexanone (MBK)	ND	0.020	mg/Kg wet							
Isopropylbenzene (Cumene)	ND	0.0020	mg/Kg wet							
p-Isopropyltoluene (p-Cymene)	ND	0.0020	mg/Kg wet							
Methyl tert-Butyl Ether (MTBE)	ND	0.0040	mg/Kg wet							
Methylene Chloride	ND	0.010	mg/Kg wet							
4-Methyl-2-pentanone (MIBK)	ND	0.020	mg/Kg wet							
Naphthalene	ND	0.0040	mg/Kg wet							V-05

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035											
Blank (B175403-BLK1)				Prepared & Analyzed: 04/26/17							
n-Propylbenzene	ND	0.0020	mg/Kg wet								
Styrene	ND	0.0020	mg/Kg wet								
1,1,1,2-Tetrachloroethane	ND	0.0020	mg/Kg wet								
1,1,2,2-Tetrachloroethane	ND	0.0010	mg/Kg wet								
Tetrachloroethylene	ND	0.0020	mg/Kg wet								
Tetrahydrofuran	ND	0.010	mg/Kg wet								
Toluene	ND	0.0020	mg/Kg wet								
1,2,3-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,2,4-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,1,1-Trichloroethane	ND	0.0020	mg/Kg wet								
1,1,2-Trichloroethane	ND	0.0020	mg/Kg wet								
Trichloroethylene	ND	0.0020	mg/Kg wet								
Trichlorofluoromethane (Freon 11)	ND	0.010	mg/Kg wet								
1,2,3-Trichloropropane	ND	0.0020	mg/Kg wet								
1,2,4-Trimethylbenzene	ND	0.0020	mg/Kg wet								
1,3,5-Trimethylbenzene	ND	0.0020	mg/Kg wet								
Vinyl Chloride	ND	0.010	mg/Kg wet								
m+p Xylene	ND	0.0040	mg/Kg wet								
o-Xylene	ND	0.0020	mg/Kg wet								
Surrogate: 1,2-Dichloroethane-d4	*0.0537*		mg/Kg wet	0.0500		107	70-130				
Surrogate: Toluene-d8	*0.0492*		mg/Kg wet	0.0500		98.5	70-130				
Surrogate: 4-Bromofluorobenzene	*0.0472*		mg/Kg wet	0.0500		94.4	70-130				
LCS (B175403-BS1)				Prepared & Analyzed: 04/26/17							
Acetone	0.155	0.10	mg/Kg wet	0.200		77.4	40-160				†
tert-Amyl Methyl Ether (TAME)	0.0183	0.0010	mg/Kg wet	0.0200		91.6	70-130				
Benzene	0.0202	0.0020	mg/Kg wet	0.0200		101	70-130				
Bromobenzene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130				
Bromochloromethane	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130				
Bromodichloromethane	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130				
Bromoform	0.0246	0.0020	mg/Kg wet	0.0200		123	70-130				
Bromomethane	0.0136	0.010	mg/Kg wet	0.0200		68.0	40-160			L-14	†
2-Butanone (MEK)	0.167	0.040	mg/Kg wet	0.200		83.7	40-160				†
n-Butylbenzene	0.0242	0.0020	mg/Kg wet	0.0200		121	70-130				
sec-Butylbenzene	0.0231	0.0020	mg/Kg wet	0.0200		116	70-130				
tert-Butylbenzene	0.0223	0.0020	mg/Kg wet	0.0200		112	70-130				
tert-Butyl Ethyl Ether (TBEE)	0.0182	0.0010	mg/Kg wet	0.0200		91.2	70-130				
Carbon Disulfide	0.0232	0.0060	mg/Kg wet	0.0200		116	70-130				
Carbon Tetrachloride	0.0234	0.0020	mg/Kg wet	0.0200		117	70-130				
Chlorobenzene	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130				
Chlorodibromomethane	0.0235	0.0010	mg/Kg wet	0.0200		117	70-130				
Chloroethane	0.0167	0.010	mg/Kg wet	0.0200		83.3	70-130				
Chloroform	0.0218	0.0040	mg/Kg wet	0.0200		109	70-130				
Chloromethane	0.0132	0.010	mg/Kg wet	0.0200		66.0	40-160			L-14	†
2-Chlorotoluene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130				
4-Chlorotoluene	0.0221	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dibromo-3-chloropropane (DBCP)	0.0192	0.0020	mg/Kg wet	0.0200		96.1	70-130				
1,2-Dibromoethane (EDB)	0.0207	0.0010	mg/Kg wet	0.0200		103	70-130				
Dibromomethane	0.0221	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dichlorobenzene	0.0235	0.0020	mg/Kg wet	0.0200		118	70-130				
1,3-Dichlorobenzene	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130				
1,4-Dichlorobenzene	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035												
LCS (B175403-BS1)				Prepared & Analyzed: 04/26/17								
Dichlorodifluoromethane (Freon 12)	0.00998	0.010	mg/Kg wet	0.0200		49.9		40-160			L-14, V-05	†
1,1-Dichloroethane	0.0222	0.0020	mg/Kg wet	0.0200		111		70-130				
1,2-Dichloroethane	0.0237	0.0020	mg/Kg wet	0.0200		118		70-130				
1,1-Dichloroethylene	0.0215	0.0040	mg/Kg wet	0.0200		108		70-130				
cis-1,2-Dichloroethylene	0.0217	0.0020	mg/Kg wet	0.0200		108		70-130				
trans-1,2-Dichloroethylene	0.0207	0.0020	mg/Kg wet	0.0200		104		70-130				
1,2-Dichloropropane	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,3-Dichloropropane	0.0210	0.0010	mg/Kg wet	0.0200		105		70-130				
2,2-Dichloropropane	0.0209	0.0020	mg/Kg wet	0.0200		104		70-130				
1,1-Dichloropropene	0.0212	0.0020	mg/Kg wet	0.0200		106		70-130				
cis-1,3-Dichloropropene	0.0191	0.0010	mg/Kg wet	0.0200		95.5		70-130				
trans-1,3-Dichloropropene	0.0200	0.0010	mg/Kg wet	0.0200		100		70-130				
Diethyl Ether	0.0180	0.010	mg/Kg wet	0.0200		90.2		70-130				
Diisopropyl Ether (DIPE)	0.0198	0.0010	mg/Kg wet	0.0200		99.2		70-130				
1,4-Dioxane	0.196	0.10	mg/Kg wet	0.200		97.9		40-160			V-16	†
Ethylbenzene	0.0222	0.0020	mg/Kg wet	0.0200		111		70-130				
Hexachlorobutadiene	0.0275	0.0020	mg/Kg wet	0.0200		**138**	*	70-130			L-07	
2-Hexanone (MBK)	0.173	0.020	mg/Kg wet	0.200		86.4		40-160				†
Isopropylbenzene (Cumene)	0.0238	0.0020	mg/Kg wet	0.0200		119		70-130				
p-Isopropyltoluene (p-Cymene)	0.0236	0.0020	mg/Kg wet	0.0200		118		70-130				
Methyl tert-Butyl Ether (MTBE)	0.0188	0.0040	mg/Kg wet	0.0200		94.2		70-130				
Methylene Chloride	0.0218	0.010	mg/Kg wet	0.0200		109		70-130				
4-Methyl-2-pentanone (MIBK)	0.200	0.020	mg/Kg wet	0.200		99.8		40-160				†
Naphthalene	0.0166	0.0040	mg/Kg wet	0.0200		83.0		70-130			V-05	
n-Propylbenzene	0.0226	0.0020	mg/Kg wet	0.0200		113		70-130				
Styrene	0.0214	0.0020	mg/Kg wet	0.0200		107		70-130				
1,1,1,2-Tetrachloroethane	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,1,2,2-Tetrachloroethane	0.0215	0.0010	mg/Kg wet	0.0200		108		70-130				
Tetrachloroethylene	0.0253	0.0020	mg/Kg wet	0.0200		126		70-130				
Tetrahydrofuran	0.0187	0.010	mg/Kg wet	0.0200		93.6		70-130				
Toluene	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,2,3-Trichlorobenzene	0.0194	0.0020	mg/Kg wet	0.0200		97.0		70-130				
1,2,4-Trichlorobenzene	0.0191	0.0020	mg/Kg wet	0.0200		95.3		70-130				
1,1,1-Trichloroethane	0.0226	0.0020	mg/Kg wet	0.0200		113		70-130				
1,1,2-Trichloroethane	0.0215	0.0020	mg/Kg wet	0.0200		107		70-130				
Trichloroethylene	0.0220	0.0020	mg/Kg wet	0.0200		110		70-130				
Trichlorofluoromethane (Freon 11)	0.0197	0.010	mg/Kg wet	0.0200		98.5		70-130				
1,2,3-Trichloropropane	0.0213	0.0020	mg/Kg wet	0.0200		107		70-130				
1,2,4-Trimethylbenzene	0.0217	0.0020	mg/Kg wet	0.0200		108		70-130				
1,3,5-Trimethylbenzene	0.0228	0.0020	mg/Kg wet	0.0200		114		70-130				
Vinyl Chloride	0.0147	0.010	mg/Kg wet	0.0200		73.5		70-130				
m+p Xylene	0.0440	0.0040	mg/Kg wet	0.0400		110		70-130				
o-Xylene	0.0209	0.0020	mg/Kg wet	0.0200		104		70-130				
Surrogate: 1,2-Dichloroethane-d4	*0.0521*		mg/Kg wet	0.0500		104		70-130				
Surrogate: Toluene-d8	*0.0481*		mg/Kg wet	0.0500		96.3		70-130				
Surrogate: 4-Bromofluorobenzene	*0.0492*		mg/Kg wet	0.0500		98.4		70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035											
LCS Dup (B175403-BSD1)				Prepared & Analyzed: 04/26/17							
Acetone	0.158	0.10	mg/Kg wet	0.200		78.8	40-160	1.78	20		†
tert-Amyl Methyl Ether (TAME)	0.0184	0.0010	mg/Kg wet	0.0200		92.1	70-130	0.544	20		
Benzene	0.0200	0.0020	mg/Kg wet	0.0200		99.9	70-130	1.19	20		
Bromobenzene	0.0205	0.0020	mg/Kg wet	0.0200		102	70-130	6.15	20		
Bromochloromethane	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130	0.0849	20		
Bromodichloromethane	0.0235	0.0020	mg/Kg wet	0.0200		117	70-130	2.59	20		
Bromoform	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	9.52	20		
Bromomethane	0.0145	0.010	mg/Kg wet	0.0200		72.6	40-160	6.54	20		†
2-Butanone (MEK)	0.171	0.040	mg/Kg wet	0.200		85.5	40-160	2.14	20		†
n-Butylbenzene	0.0228	0.0020	mg/Kg wet	0.0200		114	70-130	6.12	20		
sec-Butylbenzene	0.0221	0.0020	mg/Kg wet	0.0200		111	70-130	4.33	20		
tert-Butylbenzene	0.0211	0.0020	mg/Kg wet	0.0200		105	70-130	5.80	20		
tert-Butyl Ethyl Ether (TBEE)	0.0186	0.0010	mg/Kg wet	0.0200		93.0	70-130	1.95	20		
Carbon Disulfide	0.0231	0.0060	mg/Kg wet	0.0200		115	70-130	0.778	20		
Carbon Tetrachloride	0.0229	0.0020	mg/Kg wet	0.0200		115	70-130	1.99	20		
Chlorobenzene	0.0211	0.0020	mg/Kg wet	0.0200		105	70-130	1.51	20		
Chlorodibromomethane	0.0231	0.0010	mg/Kg wet	0.0200		116	70-130	1.46	20		
Chloroethane	0.0156	0.010	mg/Kg wet	0.0200		77.9	70-130	6.70	20		
Chloroform	0.0217	0.0040	mg/Kg wet	0.0200		108	70-130	0.644	20		
Chloromethane	0.0129	0.010	mg/Kg wet	0.0200		64.7	40-160	1.99	20	L-14	†
2-Chlorotoluene	0.0219	0.0020	mg/Kg wet	0.0200		110	70-130	0.457	20		
4-Chlorotoluene	0.0217	0.0020	mg/Kg wet	0.0200		108	70-130	1.83	20		
1,2-Dibromo-3-chloropropane (DBCP)	0.0192	0.0020	mg/Kg wet	0.0200		96.2	70-130	0.104	20		
1,2-Dibromoethane (EDB)	0.0211	0.0010	mg/Kg wet	0.0200		106	70-130	2.11	20		
Dibromomethane	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130	3.56	20		
1,2-Dichlorobenzene	0.0217	0.0020	mg/Kg wet	0.0200		109	70-130	7.95	20		
1,3-Dichlorobenzene	0.0227	0.0020	mg/Kg wet	0.0200		114	70-130	3.80	20		
1,4-Dichlorobenzene	0.0213	0.0020	mg/Kg wet	0.0200		106	70-130	7.25	20		
Dichlorodifluoromethane (Freon 12)	0.0102	0.010	mg/Kg wet	0.0200		50.8	40-160	1.79	20	L-14, V-05	†
1,1-Dichloroethane	0.0223	0.0020	mg/Kg wet	0.0200		111	70-130	0.0899	20		
1,2-Dichloroethane	0.0244	0.0020	mg/Kg wet	0.0200		122	70-130	2.92	20		
1,1-Dichloroethylene	0.0214	0.0040	mg/Kg wet	0.0200		107	70-130	0.465	20		
cis-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	3.28	20		
trans-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	1.44	20		
1,2-Dichloropropane	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	4.09	20		
1,3-Dichloropropane	0.0212	0.0010	mg/Kg wet	0.0200		106	70-130	0.950	20		
2,2-Dichloropropane	0.0208	0.0020	mg/Kg wet	0.0200		104	70-130	0.384	20		
1,1-Dichloropropene	0.0216	0.0020	mg/Kg wet	0.0200		108	70-130	2.06	20		
cis-1,3-Dichloropropene	0.0197	0.0010	mg/Kg wet	0.0200		98.5	70-130	3.09	20		
trans-1,3-Dichloropropene	0.0197	0.0010	mg/Kg wet	0.0200		98.5	70-130	1.71	20		
Diethyl Ether	0.0173	0.010	mg/Kg wet	0.0200		86.5	70-130	4.19	20		
Diisopropyl Ether (DIPE)	0.0199	0.0010	mg/Kg wet	0.0200		99.4	70-130	0.201	20		
1,4-Dioxane	0.227	0.10	mg/Kg wet	0.200		114	40-160	14.8	20	V-16	†
Ethylbenzene	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130	1.08	20		
Hexachlorobutadiene	0.0254	0.0020	mg/Kg wet	0.0200		127	70-130	8.08	20		
2-Hexanone (MBK)	0.173	0.020	mg/Kg wet	0.200		86.3	40-160	0.127	20		†
Isopropylbenzene (Cumene)	0.0234	0.0020	mg/Kg wet	0.0200		117	70-130	1.61	20		
p-Isopropyltoluene (p-Cymene)	0.0223	0.0020	mg/Kg wet	0.0200		111	70-130	5.75	20		
Methyl tert-Butyl Ether (MTBE)	0.0190	0.0040	mg/Kg wet	0.0200		95.2	70-130	1.06	20		
Methylene Chloride	0.0213	0.010	mg/Kg wet	0.0200		106	70-130	2.23	20		
4-Methyl-2-pentanone (MIBK)	0.200	0.020	mg/Kg wet	0.200		99.8	40-160	0.0601	20		†
Naphthalene	0.0158	0.0040	mg/Kg wet	0.0200		79.2	70-130	4.69	20	V-05	

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175403 - SW-846 5035										
LCS Dup (B175403-BSD1)				Prepared & Analyzed: 04/26/17						
n-Propylbenzene	0.0217	0.0020	mg/Kg wet	0.0200		108	70-130	4.42	20	
Styrene	0.0206	0.0020	mg/Kg wet	0.0200		103	70-130	4.00	20	
1,1,1,2-Tetrachloroethane	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	2.87	20	
1,1,2,2-Tetrachloroethane	0.0209	0.0010	mg/Kg wet	0.0200		105	70-130	2.82	20	
Tetrachloroethylene	0.0251	0.0020	mg/Kg wet	0.0200		125	70-130	0.874	20	
Tetrahydrofuran	0.0206	0.010	mg/Kg wet	0.0200		103	70-130	9.56	20	
Toluene	0.0209	0.0020	mg/Kg wet	0.0200		105	70-130	1.44	20	
1,2,3-Trichlorobenzene	0.0186	0.0020	mg/Kg wet	0.0200		93.0	70-130	4.21	20	
1,2,4-Trichlorobenzene	0.0184	0.0020	mg/Kg wet	0.0200		92.0	70-130	3.52	20	
1,1,1-Trichloroethane	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130	3.05	20	
1,1,2-Trichloroethane	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	0.186	20	
Trichloroethylene	0.0225	0.0020	mg/Kg wet	0.0200		113	70-130	2.33	20	
Trichlorofluoromethane (Freon 11)	0.0195	0.010	mg/Kg wet	0.0200		97.3	70-130	1.23	20	
1,2,3-Trichloropropane	0.0182	0.0020	mg/Kg wet	0.0200		91.1	70-130	15.7	20	
1,2,4-Trimethylbenzene	0.0207	0.0020	mg/Kg wet	0.0200		104	70-130	4.72	20	
1,3,5-Trimethylbenzene	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	1.77	20	
Vinyl Chloride	0.0143	0.010	mg/Kg wet	0.0200		71.5	70-130	2.76	20	
m+p Xylene	0.0427	0.0040	mg/Kg wet	0.0400		107	70-130	3.04	20	
o-Xylene	0.0213	0.0020	mg/Kg wet	0.0200		107	70-130	1.99	20	
Surrogate: 1,2-Dichloroethane-d4	*0.0518*		mg/Kg wet	0.0500		104	70-130			
Surrogate: Toluene-d8	*0.0503*		mg/Kg wet	0.0500		101	70-130			
Surrogate: 4-Bromofluorobenzene	*0.0482*		mg/Kg wet	0.0500		96.5	70-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175339 - SW-846 3546										
Blank (B175339-BLK1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							V-20
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							V-20
Fluoranthene	ND	0.17	mg/Kg wet							
Fluorene	ND	0.17	mg/Kg wet							
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet							V-20
2-Methylnaphthalene	ND	0.17	mg/Kg wet							
Naphthalene	ND	0.17	mg/Kg wet							
Phenanthrene	ND	0.17	mg/Kg wet							
Pyrene	ND	0.17	mg/Kg wet							
Surrogate: Nitrobenzene-d5	*3.04*		mg/Kg wet	3.33		91.3	30-130			
Surrogate: 2-Fluorobiphenyl	*3.18*		mg/Kg wet	3.33		95.4	30-130			
Surrogate: p-Terphenyl-d14	*3.61*		mg/Kg wet	3.33		108	30-130			
LCS (B175339-BS1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	1.28	0.17	mg/Kg wet	1.67		76.7	40-140			
Acenaphthylene	1.22	0.17	mg/Kg wet	1.67		73.0	40-140			
Anthracene	1.37	0.17	mg/Kg wet	1.67		82.2	40-140			
Benzo(a)anthracene	1.43	0.17	mg/Kg wet	1.67		85.7	40-140			
Benzo(a)pyrene	1.42	0.17	mg/Kg wet	1.67		85.1	40-140			
Benzo(b)fluoranthene	1.39	0.17	mg/Kg wet	1.67		83.4	40-140			
Benzo(g,h,i)perylene	1.72	0.17	mg/Kg wet	1.67		103	40-140			V-20
Benzo(k)fluoranthene	1.45	0.17	mg/Kg wet	1.67		86.8	40-140			
Chrysene	1.40	0.17	mg/Kg wet	1.67		83.9	40-140			
Dibenz(a,h)anthracene	1.80	0.17	mg/Kg wet	1.67		108	40-140			V-20
Fluoranthene	1.46	0.17	mg/Kg wet	1.67		87.5	40-140			
Fluorene	1.32	0.17	mg/Kg wet	1.67		79.5	40-140			
Indeno(1,2,3-cd)pyrene	1.83	0.17	mg/Kg wet	1.67		110	40-140			V-20
2-Methylnaphthalene	1.29	0.17	mg/Kg wet	1.67		77.5	40-140			
Naphthalene	1.17	0.17	mg/Kg wet	1.67		70.4	40-140			
Phenanthrene	1.37	0.17	mg/Kg wet	1.67		82.5	40-140			
Pyrene	1.43	0.17	mg/Kg wet	1.67		85.7	40-140			
Surrogate: Nitrobenzene-d5	*2.73*		mg/Kg wet	3.33		82.0	30-130			
Surrogate: 2-Fluorobiphenyl	*2.88*		mg/Kg wet	3.33		86.3	30-130			
Surrogate: p-Terphenyl-d14	*3.35*		mg/Kg wet	3.33		101	30-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175339 - SW-846 3546										
LCS Dup (B175339-BSD1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	1.21	0.17	mg/Kg wet	1.67		72.7	40-140	5.35	30	
Acenaphthylene	1.17	0.17	mg/Kg wet	1.67		70.3	40-140	3.77	30	
Anthracene	1.32	0.17	mg/Kg wet	1.67		79.1	40-140	3.89	30	
Benzo(a)anthracene	1.35	0.17	mg/Kg wet	1.67		81.2	40-140	5.42	30	
Benzo(a)pyrene	1.37	0.17	mg/Kg wet	1.67		82.2	40-140	3.42	30	
Benzo(b)fluoranthene	1.30	0.17	mg/Kg wet	1.67		78.0	40-140	6.72	30	
Benzo(g,h,i)perylene	1.70	0.17	mg/Kg wet	1.67		102	40-140	1.68	30	V-20
Benzo(k)fluoranthene	1.34	0.17	mg/Kg wet	1.67		80.6	40-140	7.33	30	
Chrysene	1.31	0.17	mg/Kg wet	1.67		78.7	40-140	6.32	30	
Dibenz(a,h)anthracene	1.76	0.17	mg/Kg wet	1.67		105	40-140	2.27	30	V-20
Fluoranthene	1.40	0.17	mg/Kg wet	1.67		84.2	40-140	3.89	30	
Fluorene	1.24	0.17	mg/Kg wet	1.67		74.2	40-140	6.79	30	
Indeno(1,2,3-cd)pyrene	1.73	0.17	mg/Kg wet	1.67		104	40-140	5.54	30	V-20
2-Methylnaphthalene	1.29	0.17	mg/Kg wet	1.67		77.2	40-140	0.336	30	
Naphthalene	1.14	0.17	mg/Kg wet	1.67		68.5	40-140	2.68	30	
Phenanthrene	1.30	0.17	mg/Kg wet	1.67		78.1	40-140	5.38	30	
Pyrene	1.30	0.17	mg/Kg wet	1.67		78.0	40-140	9.38	30	
Surrogate: Nitrobenzene-d5	*2.60*		mg/Kg wet	3.33		77.9	30-130			
Surrogate: 2-Fluorobiphenyl	*2.63*		mg/Kg wet	3.33		79.0	30-130			
Surrogate: p-Terphenyl-d14	*3.00*		mg/Kg wet	3.33		90.0	30-130			
Batch B175467 - SW-846 3546										
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Acetophenone	ND	0.34	mg/Kg wet							
Aniline	ND	0.34	mg/Kg wet							L-04
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Bis(2-chloroethoxy)methane	ND	0.34	mg/Kg wet							
Bis(2-chloroethyl)ether	ND	0.34	mg/Kg wet							
Bis(2-chloroisopropyl)ether	ND	0.34	mg/Kg wet							
Bis(2-Ethylhexyl)phthalate	ND	0.34	mg/Kg wet							
4-Bromophenylphenylether	ND	0.34	mg/Kg wet							
Butylbenzylphthalate	ND	0.34	mg/Kg wet							
4-Chloroaniline	ND	0.66	mg/Kg wet							
2-Chloronaphthalene	ND	0.34	mg/Kg wet							
2-Chlorophenol	ND	0.34	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							
Dibenzofuran	ND	0.34	mg/Kg wet							
Di-n-butylphthalate	ND	0.34	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.34	mg/Kg wet							
3,3-Dichlorobenzidine	ND	0.17	mg/Kg wet							
2,4-Dichlorophenol	ND	0.34	mg/Kg wet							
Diethylphthalate	ND	0.34	mg/Kg wet							

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes
Batch B175467 - SW-846 3546											
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17							
2,4-Dimethylphenol	ND	0.34	mg/Kg wet								
Dimethylphthalate	ND	0.34	mg/Kg wet								
2,4-Dinitrophenol	ND	0.66	mg/Kg wet								V-05
2,4-Dinitrotoluene	ND	0.34	mg/Kg wet								
2,6-Dinitrotoluene	ND	0.34	mg/Kg wet								
Di-n-octylphthalate	ND	0.34	mg/Kg wet								
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.34	mg/Kg wet								
Fluoranthene	ND	0.17	mg/Kg wet								
Fluorene	ND	0.17	mg/Kg wet								
Hexachlorobenzene	ND	0.34	mg/Kg wet								
Hexachlorobutadiene	ND	0.34	mg/Kg wet								V-20
Hexachloroethane	ND	0.34	mg/Kg wet								
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet								
Isophorone	ND	0.34	mg/Kg wet								
2-Methylnaphthalene	ND	0.17	mg/Kg wet								
2-Methylphenol	ND	0.34	mg/Kg wet								
3/4-Methylphenol	ND	0.34	mg/Kg wet								
Naphthalene	ND	0.17	mg/Kg wet								
Nitrobenzene	ND	0.34	mg/Kg wet								
2-Nitrophenol	ND	0.34	mg/Kg wet								
4-Nitrophenol	ND	0.66	mg/Kg wet								
Pentachlorophenol	ND	0.34	mg/Kg wet								V-05
Phenanthrene	ND	0.17	mg/Kg wet								
Phenol	ND	0.34	mg/Kg wet								
Pyrene	ND	0.17	mg/Kg wet								
1,2,4-Trichlorobenzene	ND	0.34	mg/Kg wet								
2,4,5-Trichlorophenol	ND	0.34	mg/Kg wet								
2,4,6-Trichlorophenol	ND	0.34	mg/Kg wet								
Surrogate: 2-Fluorophenol	*4.00*		mg/Kg wet	6.73		59.4		30-130			
Surrogate: Phenol-d6	*4.09*		mg/Kg wet	6.67		61.3		30-130			
Surrogate: Nitrobenzene-d5	*2.14*		mg/Kg wet	3.33		64.1		30-130			
Surrogate: 2-Fluorobiphenyl	*2.24*		mg/Kg wet	3.33		67.1		30-130			
Surrogate: 2,4,6-Tribromophenol	*5.53*		mg/Kg wet	6.67		83.0		30-130			
Surrogate: p-Terphenyl-d14	*2.66*		mg/Kg wet	3.33		79.7		30-130			
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17							
Acenaphthene	0.968	0.17	mg/Kg wet	1.67		58.1		40-140			
Acenaphthylene	0.945	0.17	mg/Kg wet	1.67		56.7		40-140			
Acetophenone	1.04	0.34	mg/Kg wet	1.67		62.7		40-140			
Aniline	0.629	0.34	mg/Kg wet	1.67		**37.8**	*	40-140			L-04
Anthracene	1.02	0.17	mg/Kg wet	1.67		61.1		40-140			
Benzo(a)anthracene	1.08	0.17	mg/Kg wet	1.67		64.9		40-140			
Benzo(a)pyrene	1.11	0.17	mg/Kg wet	1.67		66.5		40-140			
Benzo(b)fluoranthene	1.06	0.17	mg/Kg wet	1.67		63.6		40-140			
Benzo(g,h,i)perylene	1.03	0.17	mg/Kg wet	1.67		61.8		40-140			
Benzo(k)fluoranthene	1.04	0.17	mg/Kg wet	1.67		62.5		40-140			
Bis(2-chloroethoxy)methane	0.955	0.34	mg/Kg wet	1.67		57.3		40-140			
Bis(2-chloroethyl)ether	0.921	0.34	mg/Kg wet	1.67		55.3		40-140			
Bis(2-chloroisopropyl)ether	1.02	0.34	mg/Kg wet	1.67		61.5		40-140			
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		61.8		40-140			
4-Bromophenylphenylether	1.19	0.34	mg/Kg wet	1.67		71.3		40-140			
Butylbenzylphthalate	1.08	0.34	mg/Kg wet	1.67		64.7		40-140			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546											
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17							
4-Chloroaniline	0.680	0.66	mg/Kg wet	1.67		40.8	15-140				†
2-Chloronaphthalene	0.954	0.34	mg/Kg wet	1.67		57.3	40-140				
2-Chlorophenol	0.985	0.34	mg/Kg wet	1.67		59.1	30-130				
Chrysene	0.967	0.17	mg/Kg wet	1.67		58.0	40-140				
Dibenz(a,h)anthracene	1.08	0.17	mg/Kg wet	1.67		65.1	40-140				
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		67.1	40-140				
Di-n-butylphthalate	0.987	0.34	mg/Kg wet	1.67		59.2	40-140				
1,2-Dichlorobenzene	0.944	0.34	mg/Kg wet	1.67		56.6	40-140				
1,3-Dichlorobenzene	0.918	0.34	mg/Kg wet	1.67		55.1	40-140				
1,4-Dichlorobenzene	0.937	0.34	mg/Kg wet	1.67		56.2	40-140				
3,3-Dichlorobenzidine	0.844	0.17	mg/Kg wet	1.67		50.6	40-140				
2,4-Dichlorophenol	1.15	0.34	mg/Kg wet	1.67		68.7	30-130				
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		65.9	40-140				
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.4	30-130				
Dimethylphthalate	1.13	0.34	mg/Kg wet	1.67		67.8	40-140				
2,4-Dinitrophenol	0.612	0.66	mg/Kg wet	1.67		36.7	15-140			V-05	†
2,4-Dinitrotoluene	1.15	0.34	mg/Kg wet	1.67		68.8	40-140				
2,6-Dinitrotoluene	1.18	0.34	mg/Kg wet	1.67		70.8	40-140				
Di-n-octylphthalate	1.00	0.34	mg/Kg wet	1.67		60.2	40-140				
1,2-Diphenylhydrazine (as Azobenzene)	1.01	0.34	mg/Kg wet	1.67		60.7	40-140				
Fluoranthene	1.03	0.17	mg/Kg wet	1.67		61.6	40-140				
Fluorene	1.04	0.17	mg/Kg wet	1.67		62.5	40-140				
Hexachlorobenzene	1.20	0.34	mg/Kg wet	1.67		71.9	40-140				
Hexachlorobutadiene	1.35	0.34	mg/Kg wet	1.67		80.9	40-140			V-20	
Hexachloroethane	0.983	0.34	mg/Kg wet	1.67		59.0	40-140				
Indeno(1,2,3-cd)pyrene	1.09	0.17	mg/Kg wet	1.67		65.5	40-140				
Isophorone	1.03	0.34	mg/Kg wet	1.67		61.7	40-140				
2-Methylnaphthalene	1.14	0.17	mg/Kg wet	1.67		68.1	40-140				
2-Methylphenol	0.974	0.34	mg/Kg wet	1.67		58.4	30-130				
3/4-Methylphenol	1.02	0.34	mg/Kg wet	1.67		61.3	30-130				
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6	40-140				
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		62.8	40-140				
2-Nitrophenol	1.00	0.34	mg/Kg wet	1.67		60.0	30-130				
4-Nitrophenol	1.21	0.66	mg/Kg wet	1.67		72.6	15-140				†
Pentachlorophenol	0.639	0.34	mg/Kg wet	1.67		38.3	30-130			V-05	
Phenanthrene	1.03	0.17	mg/Kg wet	1.67		61.6	40-140				
Phenol	1.02	0.34	mg/Kg wet	1.67		61.2	15-140				†
Pyrene	1.09	0.17	mg/Kg wet	1.67		65.7	40-140				
1,2,4-Trichlorobenzene	1.09	0.34	mg/Kg wet	1.67		65.6	40-140				
2,4,5-Trichlorophenol	1.18	0.34	mg/Kg wet	1.67		71.0	30-130				
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.0	30-130				
Surrogate: 2-Fluorophenol	*4.19*		mg/Kg wet	6.73		62.3	30-130				
Surrogate: Phenol-d6	*4.42*		mg/Kg wet	6.67		66.3	30-130				
Surrogate: Nitrobenzene-d5	*2.29*		mg/Kg wet	3.33		68.6	30-130				
Surrogate: 2-Fluorobiphenyl	*2.43*		mg/Kg wet	3.33		72.9	30-130				
Surrogate: 2,4,6-Tribromophenol	*5.60*		mg/Kg wet	6.67		83.9	30-130				
Surrogate: p-Terphenyl-d14	*2.53*		mg/Kg wet	3.33		76.0	30-130				

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546												
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17								
Acenaphthene	0.958	0.17	mg/Kg wet	1.67		57.5		40-140	1.07	30		
Acenaphthylene	0.950	0.17	mg/Kg wet	1.67		57.0		40-140	0.528	30		
Acetophenone	1.05	0.34	mg/Kg wet	1.67		62.9		40-140	0.414	30		
Aniline	0.655	0.34	mg/Kg wet	1.67		**39.3**	*	40-140	3.95	30	L-04	
Anthracene	1.05	0.17	mg/Kg wet	1.67		63.0		40-140	3.03	30		
Benzo(a)anthracene	1.11	0.17	mg/Kg wet	1.67		66.6		40-140	2.46	30		
Benzo(a)pyrene	1.12	0.17	mg/Kg wet	1.67		67.3		40-140	1.29	30		
Benzo(b)fluoranthene	1.08	0.17	mg/Kg wet	1.67		65.0		40-140	2.24	30		
Benzo(g,h,i)perylene	1.05	0.17	mg/Kg wet	1.67		63.2		40-140	2.27	30		
Benzo(k)fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.6		40-140	3.30	30		
Bis(2-chloroethoxy)methane	0.980	0.34	mg/Kg wet	1.67		58.8		40-140	2.65	30		
Bis(2-chloroethyl)ether	0.901	0.34	mg/Kg wet	1.67		54.1		40-140	2.23	30		
Bis(2-chloroisopropyl)ether	1.04	0.34	mg/Kg wet	1.67		62.2		40-140	1.16	30		
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		62.0		40-140	0.355	30		
4-Bromophenylphenylether	1.20	0.34	mg/Kg wet	1.67		72.1		40-140	1.14	30		
Butylbenzylphthalate	1.07	0.34	mg/Kg wet	1.67		64.0		40-140	1.03	30		
4-Chloroaniline	0.689	0.66	mg/Kg wet	1.67		41.3		15-140	1.36	30		†
2-Chloronaphthalene	0.951	0.34	mg/Kg wet	1.67		57.1		40-140	0.315	30		
2-Chlorophenol	0.981	0.34	mg/Kg wet	1.67		58.9		30-130	0.373	30		
Chrysene	0.972	0.17	mg/Kg wet	1.67		58.3		40-140	0.516	30		
Dibenz(a,h)anthracene	1.09	0.17	mg/Kg wet	1.67		65.5		40-140	0.582	30		
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		66.9		40-140	0.269	30		
Di-n-butylphthalate	1.02	0.34	mg/Kg wet	1.67		60.9		40-140	2.86	30		
1,2-Dichlorobenzene	0.972	0.34	mg/Kg wet	1.67		58.3		40-140	2.92	30		
1,3-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	2.26	30		
1,4-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	0.213	30		
3,3-Dichlorobenzidine	0.880	0.17	mg/Kg wet	1.67		52.8		40-140	4.21	30		
2,4-Dichlorophenol	1.13	0.34	mg/Kg wet	1.67		67.9		30-130	1.26	30		
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		66.1		40-140	0.303	30		
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.0		30-130	0.654	30		
Dimethylphthalate	1.14	0.34	mg/Kg wet	1.67		68.6		40-140	1.23	30		
2,4-Dinitrophenol	0.602	0.66	mg/Kg wet	1.67		36.1		15-140	1.59	30	V-05	†
2,4-Dinitrotoluene	1.13	0.34	mg/Kg wet	1.67		67.9		40-140	1.43	30		
2,6-Dinitrotoluene	1.19	0.34	mg/Kg wet	1.67		71.3		40-140	0.816	30		
Di-n-octylphthalate	1.04	0.34	mg/Kg wet	1.67		62.6		40-140	3.87	30		
1,2-Diphenylhydrazine (as Azobenzene)	1.02	0.34	mg/Kg wet	1.67		61.4		40-140	1.11	30		
Fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.5		40-140	4.63	30		
Fluorene	1.05	0.17	mg/Kg wet	1.67		62.8		40-140	0.542	30		
Hexachlorobenzene	1.22	0.34	mg/Kg wet	1.67		73.0		40-140	1.49	30		
Hexachlorobutadiene	1.34	0.34	mg/Kg wet	1.67		80.3		40-140	0.695	30	V-20	
Hexachloroethane	1.00	0.34	mg/Kg wet	1.67		60.3		40-140	2.15	30		
Indeno(1,2,3-cd)pyrene	1.10	0.17	mg/Kg wet	1.67		66.2		40-140	1.09	30		
Isophorone	1.03	0.34	mg/Kg wet	1.67		62.0		40-140	0.420	30		
2-Methylnaphthalene	1.11	0.17	mg/Kg wet	1.67		66.5		40-140	2.38	30		
2-Methylphenol	0.950	0.34	mg/Kg wet	1.67		57.0		30-130	2.46	30		
3/4-Methylphenol	1.03	0.34	mg/Kg wet	1.67		61.5		30-130	0.456	30		
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6		40-140	0.0990	30		
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		63.0		40-140	0.286	30		
2-Nitrophenol	1.02	0.34	mg/Kg wet	1.67		60.9		30-130	1.49	30		
4-Nitrophenol	1.26	0.66	mg/Kg wet	1.67		75.5		15-140	3.94	30		†
Pentachlorophenol	0.614	0.34	mg/Kg wet	1.67		36.8		30-130	4.04	30	V-05	
Phenanthrene	1.04	0.17	mg/Kg wet	1.67		62.5		40-140	1.51	30		

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175467 - SW-846 3546										
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Phenol	0.991	0.34	mg/Kg wet	1.67		59.5	15-140	2.82	30	†
Pyrene	1.14	0.17	mg/Kg wet	1.67		68.5	40-140	4.26	30	
1,2,4-Trichlorobenzene	1.11	0.34	mg/Kg wet	1.67		66.8	40-140	1.84	30	
2,4,5-Trichlorophenol	1.27	0.34	mg/Kg wet	1.67		76.2	30-130	7.12	30	
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.2	30-130	0.242	30	
Surrogate: 2-Fluorophenol	*4.13*		mg/Kg wet	6.73		61.3	30-130			
Surrogate: Phenol-d6	*4.35*		mg/Kg wet	6.67		65.2	30-130			
Surrogate: Nitrobenzene-d5	*2.27*		mg/Kg wet	3.33		68.0	30-130			
Surrogate: 2-Fluorobiphenyl	*2.54*		mg/Kg wet	3.33		76.2	30-130			
Surrogate: 2,4,6-Tribromophenol	*5.48*		mg/Kg wet	6.67		82.2	30-130			
Surrogate: p-Terphenyl-d14	*2.59*		mg/Kg wet	3.33		77.8	30-130			

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QUALITY CONTROL

Polychlorinated Biphenyls By GC/ECD - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175466 - SW-846 3546										
Blank (B175466-BLK1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	ND	0.020	mg/Kg wet							
Aroclor-1016 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1221	ND	0.020	mg/Kg wet							
Aroclor-1221 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1232	ND	0.020	mg/Kg wet							
Aroclor-1232 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1242	ND	0.020	mg/Kg wet							
Aroclor-1242 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1248	ND	0.020	mg/Kg wet							
Aroclor-1248 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1254	ND	0.020	mg/Kg wet							
Aroclor-1254 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1260	ND	0.020	mg/Kg wet							
Aroclor-1260 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1262	ND	0.020	mg/Kg wet							
Aroclor-1262 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1268	ND	0.020	mg/Kg wet							
Aroclor-1268 [2C]	ND	0.020	mg/Kg wet							
Surrogate: Decachlorobiphenyl	*0.196*		mg/Kg wet	0.200		98.1	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.4	30-150			
Surrogate: Tetrachloro-m-xylene	*0.193*		mg/Kg wet	0.200		96.4	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.180*		mg/Kg wet	0.200		90.1	30-150			
LCS (B175466-BS1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		100	40-140			
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		103	40-140			
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		89.8	40-140			
Aroclor-1260 [2C]	0.19	0.020	mg/Kg wet	0.200		96.7	40-140			
Surrogate: Decachlorobiphenyl	*0.197*		mg/Kg wet	0.200		98.3	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.7	30-150			
Surrogate: Tetrachloro-m-xylene	*0.200*		mg/Kg wet	0.200		99.9	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.187*		mg/Kg wet	0.200		93.4	30-150			
LCS Dup (B175466-BSD1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		102	40-140	1.17	30	
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		104	40-140	1.11	30	
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		91.2	40-140	1.57	30	
Aroclor-1260 [2C]	0.20	0.020	mg/Kg wet	0.200		98.5	40-140	1.92	30	
Surrogate: Decachlorobiphenyl	*0.199*		mg/Kg wet	0.200		99.5	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.192*		mg/Kg wet	0.200		96.0	30-150			
Surrogate: Tetrachloro-m-xylene	*0.201*		mg/Kg wet	0.200		100	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.189*		mg/Kg wet	0.200		94.3	30-150			

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QUALITY CONTROL

Petroleum Hydrocarbons Analyses - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175469 - SW-846 3546										
Blank (B175469-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	ND	8.3	mg/Kg wet							
Surrogate: o-Terphenyl	*3.07*		mg/Kg wet	3.33		92.0	40-140			
LCS (B175469-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	28.5	8.3	mg/Kg wet	33.3		85.6	40-140			
Surrogate: o-Terphenyl	*3.04*		mg/Kg wet	3.33		91.3	40-140			
LCS Dup (B175469-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	29.6	8.3	mg/Kg wet	33.3		88.8	40-140	3.66	30	
Surrogate: o-Terphenyl	*3.15*		mg/Kg wet	3.33		94.6	40-140			

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175482 - SW-846 7471										
Blank (B175482-BLK1)				Prepared & Analyzed: 04/27/17						
Mercury	ND	0.025	mg/Kg wet							
LCS (B175482-BS1)				Prepared & Analyzed: 04/27/17						
Mercury	9.48	1.9	mg/Kg wet	9.36		101	73.7-126.3			
LCS Dup (B175482-BSD1)				Prepared & Analyzed: 04/27/17						
Mercury	9.99	1.9	mg/Kg wet	9.36		107	73.7-126.3	5.20	30	
Batch B175526 - SW-846 3050B										
Blank (B175526-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Arsenic	ND	2.5	mg/Kg wet							
Barium	ND	2.5	mg/Kg wet							
Cadmium	ND	0.25	mg/Kg wet							
Chromium	ND	0.50	mg/Kg wet							
Lead	ND	0.75	mg/Kg wet							
Selenium	ND	5.0	mg/Kg wet							
Silver	ND	0.50	mg/Kg wet							
LCS (B175526-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Arsenic	54.1	5.0	mg/Kg wet	57.0		95.0	77.8-122.1			
Barium	94.3	5.0	mg/Kg wet	110		85.8	82-117.4			
Cadmium	75.3	0.50	mg/Kg wet	77.8		96.8	81.9-118.2			
Chromium	59.2	1.0	mg/Kg wet	65.0		91.1	78.7-120.6			
Lead	76.0	1.5	mg/Kg wet	85.6		88.8	82.4-117.8			
Selenium	75.1	10	mg/Kg wet	78.9		95.2	77.1-122.3			
Silver	51.2	1.0	mg/Kg wet	54.2		94.4	74.3-125.4			
LCS Dup (B175526-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Arsenic	53.4	4.9	mg/Kg wet	57.0		93.7	77.8-122.1	1.37	30	
Barium	101	4.9	mg/Kg wet	110		91.4	82-117.4	6.40	30	
Cadmium	73.3	0.49	mg/Kg wet	77.8		94.2	81.9-118.2	2.76	30	
Chromium	59.9	0.98	mg/Kg wet	65.0		92.1	78.7-120.6	1.15	30	
Lead	74.9	1.5	mg/Kg wet	85.6		87.5	82.4-117.8	1.47	30	
Selenium	74.5	9.8	mg/Kg wet	78.9		94.4	77.1-122.3	0.818	30	
Silver	51.2	0.98	mg/Kg wet	54.2		94.4	74.3-125.4	0.0109	30	
MRL Check (B175526-MRL1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Lead	0.693	0.74	mg/Kg wet	0.741		93.6	80-120			
Batch B175609 - SW-846 3051										
Blank (B175609-BLK1)				Prepared: 04/28/17 Analyzed: 05/02/17						
Selenium	ND	5.0	mg/Kg wet							
Silver	ND	0.50	mg/Kg wet							

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175609 - SW-846 3051										
LCS (B175609-BS1)				Prepared: 04/28/17 Analyzed: 05/02/17						
Selenium	79.1	10	mg/Kg wet	78.9		100	77.1-122.3			
Silver	52.2	1.0	mg/Kg wet	54.2		96.3	74.3-125.4			
LCS Dup (B175609-BSD1)				Prepared: 04/28/17 Analyzed: 05/02/17						
Selenium	80.7	10	mg/Kg wet	78.9		102	77.1-122.3	2.02	30	
Silver	52.0	1.0	mg/Kg wet	54.2		95.9	74.3-125.4	0.386	30	

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes
Batch B175358 - SW-846 9045C											
LCS (B175358-BS1)				Prepared & Analyzed: 04/26/17							
pH	6.05		pH Units	6.00		101		98.5-110			
LCS (B175358-BS2)				Prepared & Analyzed: 04/26/17							
pH	5.95		pH Units	6.00		99.2		98.5-110			
Batch B175376 - SW-846 9045C											
LCS (B175376-BS1)				Prepared & Analyzed: 04/26/17							
pH	6.05		pH Units	6.00		101		98.5-110			
Batch B175501 - SW-846 7196A											
Blank (B175501-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Hexavalent Chromium	ND	0.16	mg/Kg wet								
LCS (B175501-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Hexavalent Chromium	56	1.8	mg/Kg wet	64.0		87.5		80-120			
LCS Dup (B175501-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Hexavalent Chromium	58	1.8	mg/Kg wet	63.9		91.6		80-120	4.27	20	
Matrix Spike (B175501-MS1) Soluble MS		**Source: 17D1127-01**		Prepared: 04/27/17 Analyzed: 04/28/17							
Hexavalent Chromium	23	0.83	mg/Kg dry	41.6	ND	**55.2**	*	75-125			MS-16
Matrix Spike (B175501-MS2) PDMS		**Source: 17D1127-01**		Prepared: 04/27/17 Analyzed: 04/28/17							
Hexavalent Chromium	27	1.7	mg/Kg dry	41.3	ND	**65.2**	*	75-125			MS-16
Matrix Spike (B175501-MS3) Insoluble MS		**Source: 17D1127-01**		Prepared: 04/27/17 Analyzed: 04/28/17							
Hexavalent Chromium	570	17	mg/Kg dry	671	ND	85.6		75-125			
Matrix Spike Dup (B175501-MSD1) Soluble MS Dup		**Source: 17D1127-01**		Prepared: 04/27/17 Analyzed: 04/28/17							
Hexavalent Chromium	25	0.84	mg/Kg dry	42.1	ND	**59.8**	*	75-125	9.21	35	MS-16
Batch B175566 - SW-846 9014											
Blank (B175566-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Reactive Cyanide	ND	0.40	mg/Kg								
LCS (B175566-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Reactive Cyanide	9.0	0.40	mg/Kg	10.0		90.4		85.9-110			

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes
Batch B175577 - SW-846 9030A											
Blank (B175577-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Reactive Sulfide	ND	2.0	mg/Kg								
LCS (B175577-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17							
Reactive Sulfide	13	2.0	mg/Kg	14.8		86.5		64.5-120			
Batch B175749 - SW-846 7196A											
Blank (B175749-BLK1)				Prepared: 05/01/17 Analyzed: 05/02/17							
Hexavalent Chromium	ND	0.16	mg/Kg wet								
LCS (B175749-BS1)				Prepared: 05/01/17 Analyzed: 05/02/17							
Hexavalent Chromium	53	1.8	mg/Kg wet	64.3		83.1		80-120			
LCS Dup (B175749-BSD1)				Prepared: 05/01/17 Analyzed: 05/02/17							
Hexavalent Chromium	54	1.8	mg/Kg wet	64.2		84.9		80-120	2.01	20	
Matrix Spike (B175749-MS1) Soluble MS	**Source: 17D1127-02**			Prepared: 05/01/17 Analyzed: 05/02/17							
Hexavalent Chromium	35	0.92	mg/Kg dry	45.9	0.29	75.1		75-125			
Matrix Spike (B175749-MS2) PDMS	**Source: 17D1127-02**			Prepared: 05/01/17 Analyzed: 05/02/17							
Hexavalent Chromium	41	1.9	mg/Kg dry	47.4	ND	85.7		75-125			
Matrix Spike (B175749-MS3) Insoluble MS	**Source: 17D1127-02**			Prepared: 05/01/17 Analyzed: 05/02/17							
Hexavalent Chromium	420	19	mg/Kg dry	746	ND	**56.8**	*	75-125			MS-16, W-06
Matrix Spike Dup (B175749-MSD1) Soluble MS Dup	**Source: 17D1127-02**			Prepared: 05/01/17 Analyzed: 05/02/17							
Hexavalent Chromium	34	0.92	mg/Kg dry	46.2	0.29	**73.8**	*	75-125	1.11	35	MS-16, W-06
Batch B175829 - SM21-22 2510B Modified											
Blank (B175829-BLK1)				Prepared & Analyzed: 05/02/17							
Specific conductance	ND	2.0	µmhos/cm								
LCS (B175829-BS2)				Prepared & Analyzed: 05/02/17							
Specific conductance	230	2.0	µmhos/cm	234		97.0		89.2-110			

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS

Lab Sample ID: B175466-BS1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.19	5.4

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS Dup

Lab Sample ID: B175466-BSD1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.20	10.5

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
ND	Not Detected
RL	Reporting Limit
DL	Method Detection Limit
MCL	Maximum Contaminant Level
	Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.
	No results have been blank subtracted unless specified in the case narrative section.
DL-03	Elevated reporting limit due to matrix.
L-04	Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.
L-07	Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.
L-14	Compound classified by MA CAM as difficult with acceptable recoveries of 40-160%. Recovery does not meet 70-130% criteria but does meet difficult compound criteria.
MS-16	For solid method SW846-7196A, the matrix spike is outside of control limits. pH and ORP results were indicative of reducing conditions. Reanalysis is not required. Analysis is in control based on LCS recoveries.
O-32	A dilution was performed as part of the standard analytical procedure.
S-01	The surrogate recovery for this sample is not available due to sample dilution below the surrogate reporting limit required from high analyte concentration and/or matrix interferences.
V-05	Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.
V-16	Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.
V-20	Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.
W-06	Elevated method reporting limit due to intense color of sample

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 1030 in Soil	
Ignitability	NY,NH,CT,NC,ME,VA
SW-846 6010C-D in Soil	
Arsenic	CT,NH,NY,ME,VA,NC
Barium	CT,NH,NY,ME,VA,NC
Cadmium	CT,NH,NY,ME,VA,NC
Chromium	CT,NH,NY,ME,VA,NC
Lead	CT,NH,NY,AIHA,ME,VA,NC
Selenium	CT,NH,NY,ME,VA,NC
Silver	CT,NH,NY,ME,VA,NC
SW-846 7196A in Soil	
Hexavalent Chromium	NY,CT,NH,NC,ME,VA
SW-846 7471B in Soil	
Mercury	CT,NH,NY,NC,ME,VA
SW-846 8082A in Soil	
Aroclor-1016	CT,NH,NY,NC,ME,VA
Aroclor-1016 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1221	CT,NH,NY,NC,ME,VA
Aroclor-1221 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1232	CT,NH,NY,NC,ME,VA
Aroclor-1232 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1242	CT,NH,NY,NC,ME,VA
Aroclor-1242 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1248	CT,NH,NY,NC,ME,VA
Aroclor-1248 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1254	CT,NH,NY,NC,ME,VA
Aroclor-1254 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1260	CT,NH,NY,NC,ME,VA
Aroclor-1260 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1262	NH,NY,NC,ME,VA
Aroclor-1262 [2C]	NH,NY,NC,ME,VA
Aroclor-1268	NH,NY,NC,ME,VA
Aroclor-1268 [2C]	NH,NY,NC,ME,VA
SW-846 8260C in Soil	
Acetone	CT,NH,NY,ME
Benzene	CT,NH,NY,ME
Bromobenzene	NH,NY,ME
Bromochloromethane	NH,NY,ME
Bromodichloromethane	CT,NH,NY,ME
Bromoform	CT,NH,NY,ME
Bromomethane	CT,NH,NY,ME
2-Butanone (MEK)	CT,NH,NY,ME
n-Butylbenzene	CT,NH,NY,ME
sec-Butylbenzene	CT,NH,NY,ME
tert-Butylbenzene	CT,NH,NY,ME
Carbon Disulfide	CT,NH,NY,ME

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
Carbon Tetrachloride	CT,NH,NY,ME
Chlorobenzene	CT,NH,NY,ME
Chlorodibromomethane	CT,NH,NY,ME
Chloroethane	CT,NH,NY,ME
Chloroform	CT,NH,NY,ME
Chloromethane	CT,NH,NY,ME
2-Chlorotoluene	CT,NH,NY,ME
4-Chlorotoluene	CT,NH,NY,ME
Dibromomethane	NH,NY,ME
1,2-Dichlorobenzene	CT,NH,NY,ME
1,3-Dichlorobenzene	CT,NH,NY,ME
1,4-Dichlorobenzene	CT,NH,NY,ME
Dichlorodifluoromethane (Freon 12)	NY,ME
1,1-Dichloroethane	CT,NH,NY,ME
1,2-Dichloroethane	CT,NH,NY,ME
1,1-Dichloroethylene	CT,NH,NY,ME
cis-1,2-Dichloroethylene	CT,NH,NY,ME
trans-1,2-Dichloroethylene	CT,NH,NY,ME
1,2-Dichloropropane	CT,NH,NY,ME
1,3-Dichloropropane	NH,NY,ME
2,2-Dichloropropane	NH,NY,ME
1,1-Dichloropropene	NH,NY,ME
cis-1,3-Dichloropropene	CT,NH,NY,ME
trans-1,3-Dichloropropene	CT,NH,NY,ME
1,4-Dioxane	NY
Ethylbenzene	CT,NH,NY,ME
Hexachlorobutadiene	NH,NY,ME
2-Hexanone (MBK)	CT,NH,NY,ME
Isopropylbenzene (Cumene)	CT,NH,NY,ME
p-Isopropyltoluene (p-Cymene)	NH,NY
Methyl tert-Butyl Ether (MTBE)	NH,NY
Methylene Chloride	CT,NH,NY,ME
4-Methyl-2-pentanone (MIBK)	CT,NH,NY
Naphthalene	NH,NY,ME
n-Propylbenzene	NH,NY
Styrene	CT,NH,NY,ME
1,1,1,2-Tetrachloroethane	CT,NH,NY,ME
1,1,2,2-Tetrachloroethane	CT,NH,NY,ME
Tetrachloroethylene	CT,NH,NY,ME
Toluene	CT,NH,NY,ME
1,2,3-Trichlorobenzene	NY
1,2,4-Trichlorobenzene	NH,NY,ME
1,1,1-Trichloroethane	CT,NH,NY,ME
1,1,2-Trichloroethane	CT,NH,NY,ME
Trichloroethylene	CT,NH,NY,ME
Trichlorofluoromethane (Freon 11)	CT,NH,NY,ME
1,2,3-Trichloropropane	NH,NY,ME

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
1,2,4-Trimethylbenzene	CT,NH,NY,ME
1,3,5-Trimethylbenzene	CT,NH,NY,ME
Vinyl Chloride	CT,NH,NY,ME
m+p Xylene	CT,NH,NY,ME
o-Xylene	CT,NH,NY,ME
SW-846 8270D in Soil	
Acenaphthene	CT,NY,NH
Acenaphthene	CT,NY,NH,ME,NC,VA
Acenaphthylene	CT,NY,NH,ME,NC,VA
Acenaphthylene	CT,NY,NH
Acetophenone	NY,NH
Aniline	NY,NH
Anthracene	CT,NY,NH,ME,NC,VA
Anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH,ME,NC,VA
Benzo(a)pyrene	CT,NY,NH
Benzo(a)pyrene	CT,NY,NH,ME,NC,VA
Benzo(b)fluoranthene	CT,NY,NH,ME,NC,VA
Benzo(b)fluoranthene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH,ME,NC,VA
Benzo(g,h,i)perylene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH,ME,NC,VA
Bis(2-chloroethoxy)methane	CT,NY,NH
Bis(2-chloroethyl)ether	CT,NY,NH
Bis(2-chloroisopropyl)ether	CT,NY,NH
Bis(2-Ethylhexyl)phthalate	CT,NY,NH
4-Bromophenylphenylether	CT,NY,NH
Butylbenzylphthalate	CT,NY,NH
4-Chloroaniline	CT,NY,NH
2-Chloronaphthalene	CT,NY,NH
2-Chlorophenol	CT,NY,NH
Chrysene	CT,NY,NH
Chrysene	CT,NY,NH,ME,NC,VA
Dibenz(a,h)anthracene	CT,NY,NH
Dibenz(a,h)anthracene	CT,NY,NH,ME,NC,VA
Dibenzofuran	CT,NY,NH
Di-n-butylphthalate	CT,NY,NH
1,2-Dichlorobenzene	NY,NH
1,3-Dichlorobenzene	NY,NH
1,4-Dichlorobenzene	NY,NH
3,3-Dichlorobenzidine	CT,NY,NH
2,4-Dichlorophenol	CT,NY,NH
Diethylphthalate	CT,NY,NH
2,4-Dimethylphenol	CT,NY,NH

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8270D in Soil	
Dimethylphthalate	CT,NY,NH
2,4-Dinitrophenol	CT,NY,NH
2,4-Dinitrotoluene	CT,NY,NH
2,6-Dinitrotoluene	CT,NY,NH
Di-n-octylphthalate	CT,NY,NH
1,2-Diphenylhydrazine (as Azobenzene)	NY,NH
Fluoranthene	CT,NY,NH,ME,NC,VA
Fluoranthene	CT,NY,NH
Fluorene	CT,NY,NH,ME,NC,VA
Fluorene	NY,NH
Hexachlorobenzene	CT,NY,NH
Hexachlorobutadiene	CT,NY,NH
Hexachloroethane	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH,ME,NC,VA
Indeno(1,2,3-cd)pyrene	CT,NY,NH
Isophorone	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH,ME,NC,VA
2-Methylphenol	CT,NY,NH
3/4-Methylphenol	CT,NY,NH
Naphthalene	CT,NY,NH
Naphthalene	CT,NY,NH,ME,NC,VA
Nitrobenzene	CT,NY,NH
2-Nitrophenol	CT,NY,NH
4-Nitrophenol	CT,NY,NH
Pentachlorophenol	CT,NY,NH
Phenanthrene	CT,NY,NH
Phenanthrene	CT,NY,NH,ME,NC,VA
Phenol	CT,NY,NH
Pyrene	CT,NY,NH
Pyrene	CT,NY,NH,ME,NC,VA
1,2,4-Trichlorobenzene	CT,NY,NH
2,4,5-Trichlorophenol	CT,NY,NH
2,4,6-Trichlorophenol	CT,NY,NH

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC - ISO17025:2005	100033	02/1/2018
MA	Massachusetts DEP	M-MA100	06/30/2017
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2017
NY	New York State Department of Health	10899 NELAP	04/1/2018
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2018
RI	Rhode Island Department of Health	LAO00112	12/30/2017
NC	North Carolina Div. of Water Quality	652	12/31/2017
NJ	New Jersey DEP	MA007 NELAP	06/30/2017
FL	Florida Department of Health	E871027 NELAP	06/30/2017
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2017
ME	State of Maine	2011028	06/9/2017
VA	Commonwealth of Virginia	460217	12/14/2017
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2017

con-test® ANALYTICAL LABORATORY
Phone: 413-525-2332
Fax: 413-525-6405
Email: info@contestlabs.com
www.contestlabs.com
39 Spruce Street
East longmeadow, MA 01028

CHAIN OF CUSTODY RECORD

17D1127

Rev. 04.05.12

Company Name: Weston + Sampson
Address: 5 Centennial Drive Peabody, MA
Attention: Joe Spencer
Project Location: 20 Howley St
Sampled By: Taylor Smith

Project Proposal Provided? (for billing purposes)
○ yes _____ proposal date

Telephone: 978-532-1900
Project #: 2160299
Client PO#:

DATA DELIVERY (check all that apply)
○ FAX ☒ EMAIL ○ WEBSITE
Fax #:
Email: SpencerJ@WSEinc.com
Format: ☒ PDF ☒ EXCEL ○ GIS
○ OTHER _____
○ "Enhanced Data Package"

Con-Test Lab ID (laboratory use only)	Client Sample ID / Description	Collection Beginning Date/Time	Collection Ending Date/Time	Composite	Grab	*Matrix Code	Conc Code	# of Containers	** Preservation	***Container Code	MCP 14	VOCs	Hexavalent Chromium	Disposal Characterization
								4	6	A	A	1	4	
1	SP-1 (0-1)	4/25	9:25		x	S					x		x	
2	SP-1 (2-5)		~~9:30~~ AT 9:35		x						x		x	
3	SP-2 (0-1)		10:00		x						x		x	
4	SP-2 (2-5)		10:05		x						x		x	
5	Disposal Characterization (DC)		9:40	x								x		x

Disposal list - RCRA-8 metals, 8082, 8270, 8260, 8100, pH, conductivity, reactivity & ignitability. Also, run PAHs and Se & Ag only on samples -01 through -04 per Joe S - MEK 4/26/2017

ANALYSIS REQUESTED

Dissolved Metals
○ Field Filtered
○ Lab to Filter

***Cont. Code:**
A=amber glass
G=glass
P=plastic
ST=sterile
V= vial
S=summa can
T=tedlar bag
O=Other

****Preservation**
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium bisulfate
X = Na hydroxide
T = Na thiosulfate
O = Other _____

*Matrix Code:
GW= groundwater
WW= wastewater
DW= drinking water
A = air
S = soil/solid
SL = sludge
O = other _____

Comments: 20 Howley St

Please use the following codes to let Con-Test know if a specific sample may be high in concentration in Matrix/Conc. Code Box:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time: 4/25/17 4:40
Relinquished by: (signature)	Date/Time: 4/25/17 7:20
Received by: (signature)	Date/Time: 4/25/17 1920

Turnaround ††
☐ 7-Day
☐ 10-Day
☒ Other 5 day
RUSH †
☒ †24-Hr ☐ †48-Hr
☐ †72-Hr ☐ †4-Day
† Require lab approval

Detection Limit Requirements
Massachusetts: MCP + Disp. Char
Connecticut:
Other:

Is your project MCP or RCP ?
☒ MCP Form Required
○ RCP Form Required
○ MA State DW Form Required PWSID # _____

NELAC & AIHA-LAP, LLC Accredited
WBE/DBE Certified

TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR INCORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

PLEASE BE CAREFUL NOT TO CONTAMINATE THIS DOCUMENT

Table of Contents

39 Spruce St.
st Longmeadow, MA. 01028
P: 413-525-2332
F: 413-525-6405
www.contestlabs.com

con-test® ANALYTICAL LABORATORY

Sample Receipt Checklist

CLIENT NAME: Weston & Sampson **RECEIVED BY:** JM **DATE:** 4/25/17

1) **Was the chain(s) of custody relinquished and signed?** Yes X No ____ No COC Incl.

2) **Does the chain agree with the samples?** Yes X No ____
If not, explain:

3) **Are all the samples in good condition?** Yes X No ____
If not, explain:

4) **How were the samples received:**

On Ice X Direct from Sampling ____ Ambient ____ In Cooler(s) X

Were the samples received in Temperature Compliance of (2-6°C)? Yes X No ____ N/A ____

Temperature °C by Temp blank ____ # ____ Temperature °C by Temp gun 5.1 # 7

5) **Are there Dissolved samples for the lab to filter?** Yes ____ No X

Who was notified ____ Date ____ Time ____

6) **Are there any RUSH or SHORT HOLDING TIME samples?** Yes X No ____

Who was notified ____ Date ____ Time ____

7) **Location where samples are stored:**

Permission to subcontract samples? Yes No
(Walk-in clients only) if not already approved
Client Signature: ____

8) **Do all samples have the proper Acid pH:** Yes ____ No ____ N/A X

9) **Do all samples have the proper Base pH:** Yes ____ No ____ N/A X

10) **Was the PC notified of any discrepancies with the CoC vs the samples:** Yes ____ N/A X

Containers received at Con-Test

	# of containers		# of containers
1 Liter Amber		16 oz amber	
500 mL Amber		8 oz amber/clear jar	5
250 mL Amber (8oz amber)		4 oz amber/clear jar	4
1 Liter Plastic		2 oz amber/clear jar	
500 mL Plastic		Plastic Bag / Ziploc	
250 mL plastic		SOC Kit	
40 mL Vial - type listed below	2	Perchlorate Kit	
Colisure / bacteria bottle		Flashpoint bottle	
Dissolved Oxygen bottle		Other glass jar	
Encore		Other	

40 mL vials: # HCl ____ # Methanol 1

Bisulfate 1 # DI Water ____

Thiosulfate ____ Unpreserved ____

Time and Date Frozen:

Login Sample Receipt Checklist

(Rejection Criteria Listing - Using Sample Acceptance Policy)

Any False statement will be brought to the attention of Client

Question	Answer (True/False) T/F/NA	Comment
1) The cooler's custody seal, if present, is intact.	NA	
2) The cooler or samples do not appear to have been compromised or tampered with.	T	
3) Samples were received on ice.	T	
4) Cooler Temperature is acceptable.	T	
5) Cooler Temperature is recorded.	T	
6) COC is filled out in ink and legible.	T	
7) COC is filled out with all pertinent information.	T	
8) Field Sampler's name present on COC.	T	
9) There are no discrepancies between the sample IDs on the container and the COC.	T	
10) Samples are received within Holding Time.	T	
11) Sample containers have legible labels.	T	
12) Containers are not broken or leaking.	T	
13) Air Cassettes are not broken/open.	NA	
14) Sample collection date/times are provided.	T	
15) Appropriate sample containers are used.	T	
16) Proper collection media used.	T	
17) No headspace sample bottles are completely filled.	NA	
18) There is sufficient volume for all requsted analyses, including any requested MS/MSDs.	T	
19) Trip blanks provided if applicable.	NA	
20) VOA sample vials do not have head space or bubble is <6mm (1/4") in diameter.	NA	
21) Samples do not require splitting or compositing.	T	

Who notified of False statements? **Date/Time:**

Doc #277 Rev. 4 August 2013 **Log-In Technician Initials:** SM **Date/Time:** 4/25/17 1920

MADEP MCP Analytical Method Report Certification Form

Laboratory Name: Con-Test Analytical Laboratory	Project #: 17D1127
Project Location: 20 Howley St.	RTN:

This Form provides certifications for the following data set: [list Laboratory Sample ID Number(s)]

17D1127-01 thru 17D1127-05

Matrices: Soil

CAM Protocol (check all that below)

8260 VOC CAM II A (X)	7470/7471 Hg CAM IIIB (X)	MassDEP VPH CAM IV A ( )	8081 Pesticides CAM V B ( )	7196 Hex Cr CAM VI B (X)	MassDEP APH CAM IX A ( )
8270 SVOC CAM II B (X)	7010 Metals CAM III C ( )	MassDEP EPH CAM IV A ( )	8151 Herbicides CAM V C ( )	8330 Explosives CAM VIII A ( )	TO-15 VOC CAM IX B ( )
6010 Metals CAM III A (X)	6020 Metals CAM III D ( )	8082 PCB CAM V A (X)	9014 Total Cyanide/PAC CAM VI A ( )	6860 Perchlorate CAM VIII B ( )	

Affirmative response to Questions A throughF is required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☑ Yes	☐ No[1]
B	Were the analytical method(s) and all associated QC requirements specificed in the selected CAM protocol(s) followed?	☑ Yes	☐ No[1]
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☑ Yes	☐ No[1]
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, Quality Assurance and Quality Control Guidlines for the Acquisition and Reporting of Analytical Data?	☑ Yes	☐ No[1]
E a	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	☐ Yes	☐ No[1]
E b	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes	☐ No[1]
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all No responses to Qestions A through E)?	☑ Yes	☐ No[1]

A response to questions G, H and I below is required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☑ Yes	☐ No[1]

<u>Data User Note:</u> Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were all QC perfomance standards specified in the CAM protocol(s) achieved?	☐ Yes	☑ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes	☑ No[1]

[1] *All Negative responses must be addressed in an attached Environmental Laboratory case narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:  Position: Project Manager

Printed Name: Lisa A. Worthington Date: 05/03/17

Weston & Sampson

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

June 29, 2017

Mr. Brendan Callahan
Department of Community Development and Planning
24 Lowell Street
Peabody, Massachusetts 01960

Re: Subsurface Site Investigation
North River Corridor Riverwalk
21 Caller Street
Peabody, Massachusetts

Dear Mr. Callahan:

Weston & Sampson is pleased to submit this Limited Subsurface Site Investigation Letter Report for the portion of 21 Caller Street located adjacent to the North River Canal in Peabody, Massachusetts. Specifically, this assessment evaluated an approximate 10-foot wide area located between the North River Canal bank and a retaining wall along the northern edge of the property in Peabody, Massachusetts (the Site). The assessment was performed as part of a multi-parcel limited assessment in support of the Riverwalk project along the North River Corridor. Weston & Sampson performed the following tasks as part of the Limited Subsurface Site Investigation:

- Site reconnaissance and review of previous investigations conducted at the Site;
- Soil boring advancement; and,
- Soil sampling and analysis.

See attached Figures 1 and 2 for Site Locus Map and a Site Plan (with soil sampling locations), respectively.

SITE BACKGROUND

In support of the City of Peabody's (the City's) desire to construct a Riverwalk along the North River Corridor, the City is evaluating potential property acquisition and/or easement takings at the selected properties along the corridor. Specifically, the City is interested in purchasing a portion of the property located at 21 Caller Street (Parcel ID 086-151X). The property has a documented history of releases to the environment and was regulated under the Massachusetts Contingency Plan (MCP). 21 Caller Street [Release Tracking Number (RTN) 3-0577] is closed under a Permanent Solution Statement with Conditions that includes an Activity and Use Limitation (AUL), which restricts any activity or uses that involve the excavation, removal and/or disturbance of soils greater than 3 feet below grade. Additionally, the AUL prohibits the use of the property The AUL is applicable to the entire parcel but there has been limited assessment in the area of interest to the City.

Contaminants of concern are metals (i.e., cadmium, chromium and lead); however limited concentrations of Polycyclic Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs) and/or Extractable Petroleum Hydrocarbons (EPHs) have historically been detected at the property. Historical fill containing ash, cinders, brick, buffing dust, and/or leather scraps was also historically observed at approximately 1-8 feet below ground surface (bgs) across the property.

SUBSURFACE INVESTIGATION

A Limited Subsurface Site Investigation was conducted to evaluate the quality of the surficial and near surficial soils. The investigation was confined to the area of the proposed Riverwalk only. Weston & Sampson performed the subsurface investigation at the Site on April 25, 2017. The investigation included the advancement of three (3) soil borings and the collection and analysis of six (6) soil samples. A detailed summary of the investigation is provided below. See Figure 2 for sampling locations. A summary of laboratory analytical results is provided in Tables 1 and 2.

Soil Boring Advancement

On April 25, 2017, Weston & Sampson oversaw the advancement of three (3) soil borings (SP-1 through SP-3) at the Site. The borings were advanced by New England Geotech, LLC, of Jamestown, Rhode Island, to depths of five (5) feet below ground surface (bgs) using direct-push methods. Boring locations were selected by Weston & Sampson based on documented historical Site use and a review of previous Site investigations, and were spatially distributed to obtain a representative evaluation of the conditions of the proposed Riverwalk area.

Soil Sampling and Analysis

A Weston & Sampson representative screened each soil boring at continuous depth intervals and logged soil descriptions using a modified Burmeister Soil Classification System. Each sample was field-screened for visual and olfactory evidence of impacts, as well as total volatile organic compounds (VOCs) using a photoionization detector (PID) in accordance with the Massachusetts Department of Environmental Protection (MassDEP) jar headspace screening method. Field screening results are included in the soil boring logs Attachment A.

Two (2) soil samples from each boring, one at the 0-1 foot interval, and one at the 2-5 feet interval, were submitted to Con-Test Analytical Laboratory of East Longmeadow, Massachusetts (Con-Test) for analysis of MCP 14 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, nickel, lead, mercury, selenium, silver, thallium, vanadium, and zinc) and PAHs.

Weston & Sampson also composited soil from all three (3) soil boring locations, and submitted the composite sample (Comp-1) for analysis of typical disposal characterization parameters. The disposal characterization was conducted in accordance with MassDEP Policy # COMM-97-001: Reuse and Disposal of Contaminated Soil in Massachusetts and included the following analyses: total petroleum hydrocarbons (TPH); Resource Conservation and Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver); VOCs; semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); pH; ignitability; specific conductivity; and reactivity.

A copy of the laboratory analytical report is included as Attachment B.

SUBSURFACE INVESTIGATION RESULTS

In general, the following shallow geologic conditions were encountered during the subsurface soil investigation program:

Fill Material: Light brown to dark brown fine to coarse sand matrix containing variable amounts of fractured rocks and organics. Note that borings were not advanced deeper than five (5) feet below ground surface.

Bedrock was not encountered during the investigation.

Field Screening Results

As shown in the attached boring logs, PID field screening of soil samples collected from soil borings SP-1, SP-2, and SP-3, did not identify detectable VOCs. Soil boring logs are included in Attachment A.

Soil Analytical Results

As shown in Table 1, analysis of soil samples identified concentrations of metals above applicable MCP Method 1 S-1/GW-2 and S-1/GW-3 standards. The following is a summary of the exceedances identified:

- Arsenic was identified at concentrations exceeding the applicable Method 1 standards in sample SP-3 (2-5).

- Lead was identified at concentrations exceeding the applicable Method 1 standards in sample SP-3 (2-5).

No other analytes were detected in excess of the applicable Method 1 standards in soil borings SP-1 through SP-3.

The results of the disposal characterization analyses are presented in Table 2. The results were compared to the COMM-97-001 requirements for reuse at Massachusetts lined and unlined landfills. As shown in Table 2, soil analytical results indicate that no analyte concentrations exceed the RCS-1 thresholds; however, based on the history of the Site and the contaminant concentrations detected in SP-3 (2-5), surplus soils generated at the Site as part of the Riverwalk project will likely need to be handled as Remediation Waste or in accordance with MassDEP Policy #WSC 13-500: Similar Soils Provision Guidance.

CONCLUSIONS & COST ESTIMATES

The data is generally consistent with the findings in the PSS report filed for the Site under RTN 3-0577. Based on the data collected, no new reportable conditions under the MCP were encountered.

- In general, contaminant concentrations are similar in the 0-1 and 2-5 feet depth intervals, with the exception of 2-5 feet bgs soils at SP-3, which contains elevated concentrations of arsenic and lead;
- Excavation will require soil management under the MCP; and
- Surplus soil will require disposal at an appropriate facility and documentation by a Licensed Site Professional (LSP).

The Method 3 Risk Characterization presented in the PSS for the Site includes exposure scenarios consistent with the City's planned future for the Riverwalk. Specifically, "use of the [Site] without limitation to pedestrian and/or vehicle traffic" is permitted under the AUL. Furthermore, given that the newly collected data is consistent with the previous data and findings of the PSS, an updated Method 3 Risk Characterization for the proposed Riverwalk (i.e. easement) area will not be necessary. However, activities inconsistent with the AUL including "excavation, removal, and/or disturbance of subsurface soil greater than three (3) feet below ground surface" are likely to occur during redevelopment and will require a Release Abatement Measure (RAM) Plan to be filed with MassDEP, along with a Soil Management Plan (SMP) and Health and Safety Plan (HASP).

In summary, to construct the Riverwalk, soils will likely be excavated and disposed of at an appropriate facility. Clean fill will be used to construct the Riverwalk pathways. A new risk characterization will not be required for the Riverwalk area and redevelopment is unlikely to require a separate AUL or PSS.

Assuming only the Riverwalk portion of the property were to be obtained through an easement, potential obligations to the City to construct a river walk along the corridor at the 21 Caller Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $24,000
  - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
  - RAM Status Report
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Specifications ~ $5,000
- Construction Administration, Coordination & Oversight ~ $5,000
- Soil removal and out-of-state disposal of approximately 240 tons (assumed to be an area measuring 200 feet long by 10 feet wide and a depth of 2 feet) of impacted soil from the Riverwalk ~ $11,000

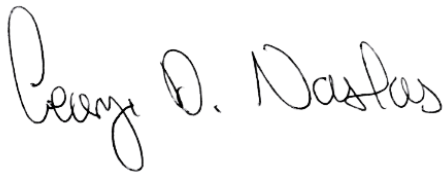
Estimated TOTAL = $45000* (not including permitting or associated Riverwalk construction costs).

*Note: Given the existing condition of the canal wall along the 21 Caller Street property, further structural evaluations may conclude that additional soils require removal as part of wall repair alternatives.

We look forward to discussing these findings with you in greater detail and working with the City to make your visions for the Riverwalk a reality. If you have any comments or questions, please contact us at 978-532-1900.

Very truly yours,

WESTON & SAMPSON ENGINEERS, INC.



George D. Naslas, PG, LSP
Vice President

Attachments: Figures
Tables
Attachment A – Soil Borings
Attachment B – Laboratory Analytical Report

Cc:

O:\Peabody MA\North River Corridor Due Diligence\21& 24 Caller St\Limited Subsurface Investigations\21 Caller\Summary Letter\21 Caller Site Investigation Summary.docx

FIGURES



FIGURE 1
21 CALLER STREET
PEABODY, MASSACHUSETTS

LOCUS MAP

0 2,000 4,000 **Feet**

Weston & Sampson

Path: C:\Users\SpencerJ\Documents\ArcGIS\Peabody\Locus Maps_06022017.mxd **User:** SpencerJ **Saved:** 6/2/2017 9:30:14 AM **Opened:** 6/2/2017 9:35:10 AM



Legend

- SOIL BORING LOCATION
- PROPERTY BOUNDARY

50 0 50

Scale In Feet

FIGURE 2

21 CALLER STREET
PEABODY, MASSACHUSETTS

SITE PLAN

JUNE 2017 SCALE: NOTED

Weston & Sampson℠

Path: C:\Users\Spencer.J\Documents\ArcGIS\Peabody\Site Plan_21 Caller_06022017.mxd User: SpencerJ Saved: 6/13/2017 1:07:56 PM Opened: 6/13/2017 1:08:13 PM

TABLES

Table 1
Summary of Laboratory Analytical Results - Soil Borings
21 Caller Street
Peabody, Massachusetts
April 25, 2017

Parameter	Units	Method 1 Cleanup Standards (1)		Sample Location, Depth, and Date					
		S-1/GW-2	S-1/GW-3	SP-1 (0-1)	SP-1 (2-5)	SP-2 (0-1)	SP-2 (2-5)	SP-3 (0-1)	SP-3 (2-5)
				0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet
Metals									
ANTIMONY	mg/kg	20	20	**4.5**	**4.9**	**3.2**	**2.8**	**4.2**	**14**
ARSENIC	mg/kg	20	20	**16**	**16**	**7.2**	**6.2**	**10**	**22**
BARIUM	mg/kg	1000	1000	**72**	**59**	**40**	**46**	**100**	**200**
BERYLLIUM	mg/kg	90	90	**0.42**	**0.53**	**0.42**	**0.34**	**0.38**	**0.63**
CADMIUM	mg/kg	70	70	**1.4**	**0.63**	**0.4**	**0.44**	**0.91**	**1.8**
TRIVALENT CHROMIUM	mg/kg	1000	1000	**58**	**31**	**20**	**21**	**36**	**88**
HEXAVALENT CHROMIUM	mg/kg	100	100	<0.91	<0.39	<0.40	<0.37	<0.37	<0.42
LEAD	mg/kg	200	200	**130**	**49**	**64**	**70**	**120**	**540**
MERCURY	mg/kg	20	20	**0.35**	**0.17**	**0.13**	**0.15**	**0.14**	**0.56**
NICKEL	mg/kg	600	600	**12**	**17**	**12**	**9.9**	**13**	**14**
SELENIUM	mg/kg	400	400	<5.3	<5.8	<6.3	<5.6	<5.4	<6.5
SILVER	mg/kg	100	100	<0.53	<0.58	<0.63	<0.56	<0.54	<0.65
THALLIUM	mg/kg	8	8	<2.7	<2.9	<3.2	**3.5**	<2.7	<3.3
VANADIUM	mg/kg	400	400	**21**	**22**	**17**	**17**	**31**	**21**
ZINC	mg/kg	1000	1000	**110**	**81**	**59**	**46**	**190**	**190**
PAHs									
ACENAPHTHENE	mg/kg	1000	1000	<0.20	<0.21	<0.22	<0.20	<0.20	<0.23
ACENAPHTHYLENE	mg/kg	600	10	<0.20	<0.21	<0.22	<0.20	<0.20	<0.23
ANTHRACENE	mg/kg	1000	1000	**0.28**	<0.21	<0.22	<0.20	**0.32**	<0.23
BENZO(A)ANTHRACENE	mg/kg	7	7	**1.2**	<0.21	<0.22	<0.20	**1.3**	<0.23
BENZO(A)PYRENE	mg/kg	2	2	**1.1**	<0.21	<0.22	<0.20	**1.5**	<0.23
BENZO(B)FLUORANTHENE	mg/kg	7	7	**1.3**	<0.21	<0.22	**0.24**	**1.8**	**0.32**
BENZO(G,H,I)PERYLENE	mg/kg	1000	1000	**0.61**	<0.21	<0.22	<0.20	**0.83**	<0.23
BENZO(K)FLUORANTHENE	mg/kg	70	70	**0.49**	<0.21	<0.22	<0.20	**0.65**	<0.23
CHRYSENE	mg/kg	70	70	**1.1**	<0.21	<0.22	<0.20	**1.3**	<0.23
DIBENZ(A,H)ANTHRACENE	mg/kg	0.7	0.7	<0.20	<0.21	<0.22	<0.20	**0.23**	<0.23
FLUORANTHENE	mg/kg	1000	1000	**2.2**	<0.21	<0.22	**0.37**	**2.4**	**0.35**
FLUORENE	mg/kg	1000	1000	<0.20	<0.21	<0.22	<0.20	<0.20	<0.23
INDENO(1,2,3-CD)PYRENE	mg/kg	7	7	**0.77**	<0.21	<0.22	<0.20	**1.1**	<0.23
2-METHYLNAPHTHALENE	mg/kg	80	300	<0.20	<0.21	<0.22	<0.20	<0.20	<0.23
NAPHTHALENE	mg/kg	20	500	<0.20	<0.21	<0.22	<0.20	<0.20	<0.23
PHENANTHRENE	mg/kg	500	500	**1**	<0.21	<0.22	**0.21**	**1.1**	<0.23
PYRENE	mg/kg	1000	1000	**2.3**	<0.21	<0.22	**0.35**	**2.5**	**0.28**

QC by 6/13/17

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard
MCP = Massachusetts Contingency Plan
mg/kg = milligram per killiogram

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

Table 2
Summary of Laboratory Analytical Results - Disposal Characterization
21 Caller Street
Peabody, Massachusetts
April 25, 2017

Parameter	Units	Reportable Concentrations[1]	COMM-97-001 In-State Disposal/Reuse Levels		Sample Location, Depth, and Date
		RCS-1	Unlined	Lined	Disposal Characterization
Metals					
ARSENIC	mg/kg	20	40	40	**8.1**
BARIUM	mg/kg	1000	NS	NS	**29**
CADMIUM	mg/kg	70	30	80	<0.30
CHROMIUM	mg/kg	100	1000	1000	**13**
LEAD	mg/kg	200	1000	2000	**37**
MERCURY	mg/kg	20	10	10	**0.12**
SELENIUM	mg/kg	400	NS	NS	<6.1
SILVER	mg/kg	100	NS	NS	<0.61
PCBs					
Total PCBs	mg/kg	1	2	2	ND
TPH					
TPH	mg/kg	1000	2500	5000	**110**
VOCs					
Total VOCs	mg/kg	NS	4	10	ND
SVOCs					
BENZO(A)ANTHRACENE	mg/kg	7	NS	NS	**0.32**
BENZO(A)PYRENE	mg/kg	2	NS	NS	**0.33**
BENZO(B)FLUORANTHENE	mg/kg	7	NS	NS	**0.38**
BENZO(G,H,I)PERYLENE	mg/kg	1000	NS	NS	**0.22**
CHRYSENE	mg/kg	70	NS	NS	**0.32**
FLUORANTHENE	mg/kg	1000	NS	NS	**0.51**
INDENO(1,2,3-CD)PYRENE	mg/kg	7	NS	NS	**0.23**
PHENANTHRENE	mg/kg	10	NS	NS	**0.25**
PYRENE	mg/kg	1000	NS	NS	**0.53**
Total SVOCs	mg/kg	NS	100	100	**3.09**
General Chemistry					
% Solids	%Wt	NS	NS	NS	**80.9**
SPECIFIC CONDUCTANCE	(µmhos/cm)	NS	4000	8000	**16**
IGNITABILITY	(present/absent)	NS	Absent	Absent	Absent
REACTIVE CYANIDE	mg/kg	NS	ND	ND	<4.0
REACTIVE SULFIDE	mg/kg	NS	ND	ND	<20
PH	pH Units	NS	>2 and <12	>2 and <12	**7.2**

QC by JRS 6/13/17

O:\Peabody MA\North River Corridor Due Diligence\21& 24 Caller St\Limited Subsurface Investigations\21 Caller\Tables\[Tables 1 & 2 - 21 Caller Street_rev.xls]Soil Borings

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
BOLD Parameter exceeds the COMM-97-001 standard for reuse at In-State landfills
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

ATTACHEMNT A
Soil Boring Logs

Weston & Sampson SM	PROJECT 21 Caller St (Peabody Riverwalk)	REPORT OF BORING No. SP-2 SHEET 1 OF 1 Project No. 2160299 CHKD BY JRS 6/9/17

BORING Co.	NE Geotech	BORING LOCATIO	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor	DATE START 4/25/17	DATE END 4/25/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 s.25 inch PVC liners w/o catcher

CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	SAMPLE REC/PEN (in)	SAMPLE DEPTH (ft)	SAMPLE PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			5/12	0-2	0-2	0	Dark brown to brown fine to coarse SAND, silt, fractured rocks		SAND FILL
			12/36	2-5	2-5	0	Brown fine to coarse SAND, silt, trace organics		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:

BORING No. SB-2

ATTACHMENT B
Laboratory Analytical Reports

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

May 3, 2017

Joe Spencer
Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960

Project Location: 21 Caller St.
Client Job Number:
Project Number: 2160299
Laboratory Work Order Number: 17D1129

Enclosed are results of analyses for samples received by the laboratory on April 25, 2017. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Meghan E. Kelley
Project Manager

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con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 5/3/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: 2160299

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17D1129

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 21 Caller St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
SP-1 (0-1)	17D1129-01	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
SP-1 (2-5)	17D1129-02	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (0-1)	17D1129-03	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
SP-2 (2-5)	17D1129-04	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
SP-3 (0-1)	17D1129-05	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Joe Spencer

REPORT DATE: 5/3/2017

PURCHASE ORDER NUMBER:

PROJECT NUMBER: 2160299

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 17D1129

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: 21 Caller St.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
SP-3 (2-5)	17D1129-06	Soil		SM 2540G	
				SM2580 A	
				SW-846 6010C-D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8270D	
				SW-846 9045C	
Disposal Characterization	17D1129-07	Soil		SM 2540G	
				SM21-22 2510B Modified	
				SW-846 1030	
				SW-846 6010C-D	
				SW-846 7471B	
				SW-846 8082A	
				SW-846 8100 Modified	
				SW-846 8260C	
				SW-846 8270D	
				SW-846 9014	
				SW-846 9030A	
				SW-846 9045C	

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

CASE NARRATIVE SUMMARY

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

For method 8270, 17D1129-01,02,03,04,05,06 only PAHs were requested and reported.

For method 6010, only RCRA 8 metals were requested and reported for sample -07.

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

SW-846 7196A

Qualifications:

DL-03

Elevated reporting limit due to matrix.

Analyte & Samples(s) Qualified:

Hexavalent Chromium
17D1129-02[SP-1 (2-5)], 17D1129-03[SP-2 (0-1)], 17D1129-04[SP-2 (2-5)], 17D1129-05[SP-3 (0-1)], 17D1129-06[SP-3 (2-5)]

W-06

Elevated method reporting limit due to intense color of sample

Analyte & Samples(s) Qualified:

Hexavalent Chromium
17D1129-01[SP-1 (0-1)]

SW-846 8082A

Qualifications:

O-32

A dilution was performed as part of the standard analytical procedure.

Analyte & Samples(s) Qualified:

17D1129-07[Disposal Characterization]

SW-846 8260C

Qualifications:

L-07

Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.

Analyte & Samples(s) Qualified:

Hexachlorobutadiene
B175403-BS1

V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

Dichlorodifluoromethane (Freon 1
17D1129-07[Disposal Characterization], B175403-BLK1, B175403-BS1, B175403-BSD1

Naphthalene
17D1129-07[Disposal Characterization], B175403-BLK1, B175403-BS1, B175403-BSD1

V-16

Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.

Analyte & Samples(s) Qualified:

1,4-Dioxane
17D1129-07[Disposal Characterization], B175403-BLK1, B175403-BS1, B175403-BSD1

SW-846 8270D

Qualifications:

L-04

Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

Aniline
17D1129-07[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

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V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.

Analyte & Samples(s) Qualified:

2,4-Dinitrophenol
17D1129-07[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

Benzo(b)fluoranthene
17D1129-01[SP-1 (0-1)], 17D1129-04[SP-2 (2-5)], 17D1129-05[SP-3 (0-1)]

Benzo(k)fluoranthene
17D1129-01[SP-1 (0-1)], 17D1129-04[SP-2 (2-5)], 17D1129-05[SP-3 (0-1)]

Pentachlorophenol
17D1129-07[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

V-20

Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.

Analyte & Samples(s) Qualified:

Benzo(g,h,i)perylene
17D1129-02[SP-1 (2-5)], 17D1129-03[SP-2 (0-1)], B175339-BLK1, B175339-BS1, B175339-BSD1

Dibenz(a,h)anthracene
17D1129-02[SP-1 (2-5)], 17D1129-03[SP-2 (0-1)], B175339-BLK1, B175339-BS1, B175339-BSD1

Hexachlorobutadiene
17D1129-07[Disposal Characterization], B175467-BLK1, B175467-BS1, B175467-BSD1

Indeno(1,2,3-cd)pyrene
17D1129-02[SP-1 (2-5)], 17D1129-03[SP-2 (0-1)], B175339-BLK1, B175339-BS1, B175339-BSD1

SW-846 6010C/D SW-846 6020A/B

For NC, Metals methods SW-846 6010D and SW-846 6020B are followed, and for all other states methods SW-846 6010C and SW-846 6020A are followed.

SW-846 8100 Modified

TPH (C9-C36) is quantitated against a calibration made with a diesel standard.

SW-846 8260C

Laboratory control sample recoveries for required MCP Data Enhancement 8260 compounds were all within limits specified by the method except for “difficult analytes” where recovery control limits of 40-160% are used and/or unless otherwise listed in this narrative. Difficult analytes: MIBK, MEK, acetone, 1,4-dioxane, chloromethane, dichlorodifluoromethane, 2-hexanone, and bromomethane.

SW-846 8270D

Laboratory control sample recoveries for required MCP Data Enhancement 8270 compounds were all within control limits specified by the method, 40-140% for base/neutrals and 30-130% for acids except for “difficult analytes” listed below and/or otherwise listed in this narrative. Difficult analytes limits are 15 and 140%: 2,4-dinitrophenol, 4-chloroaniline, 4-nitrophenol, and phenol.

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Lisa A. Worthington
Project Manager

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 21 Caller St. | Sample Description: | Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-1 (0-1) | Sampled: 4/25/2017 13:00

Sample ID: 17D1129-01

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Acenaphthylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Anthracene	0.28	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Benzo(a)anthracene	1.2	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Benzo(a)pyrene	1.1	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Benzo(b)fluoranthene	1.3	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Benzo(g,h,i)perylene	0.61	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Benzo(k)fluoranthene	0.49	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Chrysene	1.1	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Dibenz(a,h)anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Fluoranthene	2.2	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Fluorene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Indeno(1,2,3-cd)pyrene	0.77	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
2-Methylnaphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Naphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Phenanthrene	1.0	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC
Pyrene	2.3	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:17	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	52.3	30-130		5/1/17 20:17
2-Fluorobiphenyl	51.8	30-130		5/1/17 20:17
p-Terphenyl-d14	75.6	30-130		5/1/17 20:17

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-1 (0-1) Sampled: 4/25/2017 13:00

Sample ID: 17D1129-01

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	4.5	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Arsenic	16	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Barium	72	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Beryllium	0.42	0.27	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Cadmium	1.4	0.27	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Chromium	58	0.53	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Lead	130	0.80	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Mercury	0.35	0.029	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:46	TJK
Nickel	12	0.53	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Selenium	ND	5.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Silver	ND	0.53	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Thallium	ND	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Vanadium	21	1.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN
Zinc	110	1.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:19	SHN

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-1 (0-1) Sampled: 4/25/2017 13:00

Sample ID: 17D1129-01

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.91	mg/Kg dry	5	W-06	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	150		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @23.3°C	7.8		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	87.0		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 13:05

Sample ID: 17D1129-02

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Acenaphthylene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Benzo(a)anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Benzo(a)pyrene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Benzo(b)fluoranthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Benzo(g,h,i)perylene	ND	0.21	mg/Kg dry	1	V-20	SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Benzo(k)fluoranthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Chrysene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Dibenz(a,h)anthracene	ND	0.21	mg/Kg dry	1	V-20	SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Fluoranthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Fluorene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Indeno(1,2,3-cd)pyrene	ND	0.21	mg/Kg dry	1	V-20	SW-846 8270D	4/26/17	5/1/17 15:56	MJC
2-Methylnaphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Naphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Phenanthrene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC
Pyrene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 15:56	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	49.7	30-130		5/1/17 15:56
2-Fluorobiphenyl	54.0	30-130		5/1/17 15:56
p-Terphenyl-d14	57.9	30-130		5/1/17 15:56

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 13:05

Sample ID: 17D1129-02

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	4.9	2.9	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Arsenic	16	2.9	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Barium	59	2.9	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Beryllium	0.53	0.29	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Cadmium	0.63	0.29	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Chromium	31	0.58	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Lead	49	0.88	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Mercury	0.17	0.031	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:48	TJK
Nickel	17	0.58	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Selenium	ND	5.8	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Silver	ND	0.58	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Thallium	ND	2.9	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Vanadium	22	1.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN
Zinc	81	1.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:24	SHN

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-1 (2-5) Sampled: 4/25/2017 13:05

Sample ID: 17D1129-02

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.39	mg/Kg dry	2	DL-03	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	130		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @22.8°C	7.2		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	80.6		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 13:50

Sample ID: 17D1129-03

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Acenaphthylene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Anthracene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Benzo(a)anthracene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Benzo(a)pyrene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Benzo(b)fluoranthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Benzo(g,h,i)perylene	ND	0.22	mg/Kg dry	1	V-20	SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Benzo(k)fluoranthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Chrysene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Dibenz(a,h)anthracene	ND	0.22	mg/Kg dry	1	V-20	SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Fluoranthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Fluorene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Indeno(1,2,3-cd)pyrene	ND	0.22	mg/Kg dry	1	V-20	SW-846 8270D	4/26/17	5/1/17 16:18	MJC
2-Methylnaphthalene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Naphthalene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Phenanthrene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC
Pyrene	ND	0.22	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 16:18	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	55.2	30-130		5/1/17 16:18
2-Fluorobiphenyl	60.7	30-130		5/1/17 16:18
p-Terphenyl-d14	64.9	30-130		5/1/17 16:18

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 13:50

Sample ID: 17D1129-03

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	3.2	3.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Arsenic	7.2	3.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Barium	40	3.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Beryllium	0.42	0.32	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Cadmium	0.40	0.32	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Chromium	20	0.63	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Lead	64	0.95	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Mercury	0.13	0.032	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:49	TJK
Nickel	12	0.63	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Selenium	ND	6.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Silver	ND	0.63	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Thallium	ND	3.2	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Vanadium	17	1.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN
Zinc	59	1.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:49	SHN

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-2 (0-1) Sampled: 4/25/2017 13:50

Sample ID: 17D1129-03

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.40	mg/Kg dry	2	DL-03	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	100		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @22.4°C	7.3		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	77.4		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 21 Caller St. | Sample Description: | Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) | Sampled: 4/25/2017 14:00

Sample ID: 17D1129-04

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Acenaphthylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Benzo(a)anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Benzo(a)pyrene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Benzo(b)fluoranthene	0.24	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Benzo(g,h,i)perylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Benzo(k)fluoranthene	ND	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Chrysene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Dibenz(a,h)anthracene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Fluoranthene	0.37	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Fluorene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Indeno(1,2,3-cd)pyrene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
2-Methylnaphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Naphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Phenanthrene	0.21	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC
Pyrene	0.35	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 20:41	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	61.2	30-130		5/1/17 20:41
2-Fluorobiphenyl	58.2	30-130		5/1/17 20:41
p-Terphenyl-d14	75.8	30-130		5/1/17 20:41

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 14:00

Sample ID: 17D1129-04

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	2.8	2.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Arsenic	6.2	2.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Barium	46	2.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	QNW
Beryllium	0.34	0.28	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Cadmium	0.44	0.28	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Chromium	21	0.56	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Lead	70	0.84	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Mercury	0.15	0.029	mg/Kg dry	1		SW-846 7471B	5/1/17	5/2/17 9:38	TJK
Nickel	9.9	0.56	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Selenium	ND	5.6	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Silver	ND	0.56	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Thallium	3.5	2.8	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN
Vanadium	17	1.1	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	QNW
Zinc	46	1.1	mg/Kg dry	1		SW-846 6010C-D	4/28/17	5/2/17 9:50	SHN

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-2 (2-5) Sampled: 4/25/2017 14:00

Sample ID: 17D1129-04

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.37	mg/Kg dry	2	DL-03	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	100		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @22.2°C	7.4		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	85.1		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 21 Caller St. | Sample Description: | Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-3 (0-1) | Sampled: 4/25/2017 14:15

Sample ID: 17D1129-05

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Acenaphthylene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Anthracene	0.32	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Benzo(a)anthracene	1.3	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Benzo(a)pyrene	1.5	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Benzo(b)fluoranthene	1.8	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Benzo(g,h,i)perylene	0.83	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Benzo(k)fluoranthene	0.65	0.20	mg/Kg dry	1	V-05	SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Chrysene	1.3	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Dibenz(a,h)anthracene	0.23	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Fluoranthene	2.4	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Fluorene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Indeno(1,2,3-cd)pyrene	1.1	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
2-Methylnaphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Naphthalene	ND	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Phenanthrene	1.1	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC
Pyrene	2.5	0.20	mg/Kg dry	1		SW-846 8270D	4/26/17	5/1/17 21:06	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	65.5	30-130		5/1/17 21:06
2-Fluorobiphenyl	62.1	30-130		5/1/17 21:06
p-Terphenyl-d14	83.7	30-130		5/1/17 21:06

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-3 (0-1) Sampled: 4/25/2017 14:15

Sample ID: 17D1129-05

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	4.2	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Arsenic	10	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Barium	100	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Beryllium	0.38	0.27	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Cadmium	0.91	0.27	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Chromium	36	0.54	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Lead	120	0.81	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Mercury	0.14	0.028	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:50	TJK
Nickel	13	0.54	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Selenium	ND	5.4	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Silver	ND	0.54	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Thallium	ND	2.7	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Vanadium	31	1.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN
Zinc	190	1.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:54	SHN

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-3 (0-1) Sampled: 4/25/2017 14:15

Sample ID: 17D1129-05

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.37	mg/Kg dry	2	DL-03	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	150		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @23.7°C	7.9		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	85.3		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 21 Caller St. | Sample Description: | Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-3 (2-5) | Sampled: 4/25/2017 14:20

Sample ID: 17D1129-06

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Acenaphthylene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Anthracene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Benzo(a)anthracene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Benzo(a)pyrene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Benzo(b)fluoranthene	0.32	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Benzo(g,h,i)perylene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Benzo(k)fluoranthene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Chrysene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Dibenz(a,h)anthracene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Fluoranthene	0.35	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Fluorene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Indeno(1,2,3-cd)pyrene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
2-Methylnaphthalene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Naphthalene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Phenanthrene	ND	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC
Pyrene	0.28	0.23	mg/Kg dry	1		SW-846 8270D	4/26/17	5/2/17 17:13	MJC

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Nitrobenzene-d5	55.2	30-130		5/2/17 17:13
2-Fluorobiphenyl	54.8	30-130		5/2/17 17:13
p-Terphenyl-d14	56.3	30-130		5/2/17 17:13

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-3 (2-5) Sampled: 4/25/2017 14:20

Sample ID: 17D1129-06

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Antimony	14	3.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Arsenic	22	3.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Barium	200	3.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Beryllium	0.63	0.33	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Cadmium	1.8	0.33	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Chromium	88	0.65	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Lead	540	0.98	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Mercury	0.56	0.033	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:52	TJK
Nickel	14	0.65	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Selenium	ND	6.5	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Silver	ND	0.65	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Thallium	ND	3.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Vanadium	21	1.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN
Zinc	190	1.3	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 18:59	SHN

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: SP-3 (2-5) Sampled: 4/25/2017 14:20

Sample ID: 17D1129-06

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexavalent Chromium	ND	0.42	mg/Kg dry	2	DL-03	SW-846 7196A	4/27/17	4/28/17 12:00	LL
Oxidation/Reduction Potential	170		mV	1		SM2580 A	4/26/17	4/26/17 7:55	LL
pH @21.8°C	6.2		pH Units	1		SW-846 9045C	4/26/17	4/26/17 7:55	LL
% Solids	74.6		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acetone	ND	0.13	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
tert-Amyl Methyl Ether (TAME)	ND	0.0013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Benzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Bromobenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Bromochloromethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Bromodichloromethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Bromoform	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Bromomethane	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
2-Butanone (MEK)	ND	0.052	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
n-Butylbenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
sec-Butylbenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
tert-Butylbenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
tert-Butyl Ethyl Ether (TBEE)	ND	0.0013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Carbon Disulfide	ND	0.0078	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Carbon Tetrachloride	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Chlorobenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Chlorodibromomethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Chloroethane	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Chloroform	ND	0.0052	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Chloromethane	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
2-Chlorotoluene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
4-Chlorotoluene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0052	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2-Dibromoethane (EDB)	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Dibromomethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2-Dichlorobenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,3-Dichlorobenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,4-Dichlorobenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Dichlorodifluoromethane (Freon 12)	ND	0.013	mg/Kg dry	1	V-05	SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,1-Dichloroethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2-Dichloroethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,1-Dichloroethylene	ND	0.0052	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
cis-1,2-Dichloroethylene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
trans-1,2-Dichloroethylene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2-Dichloropropane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,3-Dichloropropane	ND	0.0013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
2,2-Dichloropropane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,1-Dichloropropene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
cis-1,3-Dichloropropene	ND	0.0013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
trans-1,3-Dichloropropene	ND	0.0013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Diethyl Ether	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Diisopropyl Ether (DIPE)	ND	0.0013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,4-Dioxane	ND	0.26	mg/Kg dry	1	V-16	SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Ethylbenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexachlorobutadiene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
2-Hexanone (MBK)	ND	0.026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Isopropylbenzene (Cumene)	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
p-Isopropyltoluene (p-Cymene)	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Methyl tert-Butyl Ether (MTBE)	ND	0.0052	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Methylene Chloride	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
4-Methyl-2-pentanone (MIBK)	ND	0.026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Naphthalene	ND	0.013	mg/Kg dry	1	V-05	SW-846 8260C	4/26/17	4/26/17 13:36	MFF
n-Propylbenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Styrene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,1,1,2-Tetrachloroethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,1,2,2-Tetrachloroethane	ND	0.0013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Tetrachloroethylene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Tetrahydrofuran	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Toluene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2,3-Trichlorobenzene	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2,4-Trichlorobenzene	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,1,1-Trichloroethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,1,2-Trichloroethane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Trichloroethylene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Trichlorofluoromethane (Freon 11)	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2,3-Trichloropropane	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,2,4-Trimethylbenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
1,3,5-Trimethylbenzene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
Vinyl Chloride	ND	0.013	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
m+p Xylene	ND	0.0052	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF
o-Xylene	ND	0.0026	mg/Kg dry	1		SW-846 8260C	4/26/17	4/26/17 13:36	MFF

Surrogates	% Recovery	Recovery Limits	Flag/Qual		
1,2-Dichloroethane-d4	108	70-130		4/26/17	13:36
Toluene-d8	95.8	70-130		4/26/17	13:36
4-Bromofluorobenzene	93.2	70-130		4/26/17	13:36

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Acenaphthylene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Acetophenone	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Aniline	ND	0.42	mg/Kg dry	1	L-04	SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Benzo(a)anthracene	0.32	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Benzo(a)pyrene	0.33	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Benzo(b)fluoranthene	0.38	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Benzo(g,h,i)perylene	0.22	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Benzo(k)fluoranthene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Bis(2-chloroethoxy)methane	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Bis(2-chloroethyl)ether	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Bis(2-chloroisopropyl)ether	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Bis(2-Ethylhexyl)phthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
4-Bromophenylphenylether	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Butylbenzylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
4-Chloroaniline	ND	0.82	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2-Chloronaphthalene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2-Chlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Chrysene	0.32	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Dibenz(a,h)anthracene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Dibenzofuran	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Di-n-butylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
1,2-Dichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
1,3-Dichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
1,4-Dichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
3,3-Dichlorobenzidine	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2,4-Dichlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Diethylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2,4-Dimethylphenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Dimethylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2,4-Dinitrophenol	ND	0.82	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2,4-Dinitrotoluene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2,6-Dinitrotoluene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Di-n-octylphthalate	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Fluoranthene	0.51	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Fluorene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Hexachlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Hexachlorobutadiene	ND	0.42	mg/Kg dry	1	V-20	SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Hexachloroethane	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Indeno(1,2,3-cd)pyrene	0.23	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Isophorone	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2-Methylnaphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
2-Methylphenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
3/4-Methylphenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Naphthalene	ND	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Nitrobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2-Nitrophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
4-Nitrophenol	ND	0.82	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Pentachlorophenol	ND	0.42	mg/Kg dry	1	V-05	SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Phenanthrene	0.25	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Phenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
Pyrene	0.53	0.21	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
1,2,4-Trichlorobenzene	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2,4,5-Trichlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL
2,4,6-Trichlorophenol	ND	0.42	mg/Kg dry	1		SW-846 8270D	4/27/17	5/1/17 20:30	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
2-Fluorophenol	57.9	30-130		5/1/17 20:30
Phenol-d6	59.7	30-130		5/1/17 20:30
Nitrobenzene-d5	64.3	30-130		5/1/17 20:30
2-Fluorobiphenyl	60.4	30-130		5/1/17 20:30
2,4,6-Tribromophenol	69.8	30-130		5/1/17 20:30
p-Terphenyl-d14	65.8	30-130		5/1/17 20:30

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Sample Flags: O-32

Polychlorinated Biphenyls By GC/ECD

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1221 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1232 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1242 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1248 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1254 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1260 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1262 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL
Aroclor-1268 [1]	ND	0.12	mg/Kg dry	5		SW-846 8082A	4/27/17	4/30/17 18:24	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	95.5	30-150		4/30/17 18:24
Decachlorobiphenyl [2]	97.2	30-150		4/30/17 18:24
Tetrachloro-m-xylene [1]	101	30-150		4/30/17 18:24
Tetrachloro-m-xylene [2]	104	30-150		4/30/17 18:24

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Petroleum Hydrocarbons Analyses

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
TPH (C9-C36)	110	51	mg/Kg dry	5		SW-846 8100 Modified	4/27/17	5/2/17 15:23	PJG

Surrogates	% Recovery	Recovery Limits	Flag/Qual				
o-Terphenyl	51.1	40-140					5/2/17 15:23

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Arsenic	8.1	3.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 19:04	SHN
Barium	29	3.0	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 19:04	SHN
Cadmium	ND	0.30	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 19:04	SHN
Chromium	13	0.61	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 19:04	SHN
Lead	37	0.91	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 19:04	SHN
Mercury	0.12	0.030	mg/Kg dry	1		SW-846 7471B	4/27/17	4/27/17 12:53	TJK
Selenium	ND	6.1	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 19:04	SHN
Silver	ND	0.61	mg/Kg dry	1		SW-846 6010C-D	4/27/17	5/1/17 19:04	SHN

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Project Location: 21 Caller St. Sample Description: Work Order: 17D1129

Date Received: 4/25/2017

Field Sample #: Disposal Characterization Sampled: 4/25/2017 14:25

Sample ID: 17D1129-07

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Ignitability	Absent		present/absent	1		SW-846 1030	4/27/17	4/27/17 15:20	DCF
pH @21.9°C	7.2		pH Units	1		SW-846 9045C	4/26/17	4/26/17 8:45	LL
Reactive Cyanide	ND	4.0	mg/Kg	1		SW-846 9014	4/27/17	4/28/17 8:35	LL
Reactive Sulfide	ND	20	mg/Kg	1		SW-846 9030A	4/27/17	4/28/17 8:20	LL
Specific conductance	16	2.0	µmhos/cm	1		SM21-22 2510B Modified	5/2/17	5/2/17 10:15	EC
% Solids	80.9		% Wt	1		SM 2540G	4/27/17	4/28/17 7:44	MRL

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Sample Extraction Data

Prep Method: % Solids-SM 2540G

Lab Number [Field ID]	Batch	Date
17D1129-01 [SP-1 (0-1)]	B175514	04/27/17
17D1129-02 [SP-1 (2-5)]	B175514	04/27/17
17D1129-03 [SP-2 (0-1)]	B175514	04/27/17
17D1129-04 [SP-2 (2-5)]	B175514	04/27/17
17D1129-05 [SP-3 (0-1)]	B175514	04/27/17
17D1129-06 [SP-3 (2-5)]	B175514	04/27/17
17D1129-07 [Disposal Characterization]	B175514	04/27/17

SM21-22 2510B Modified

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1129-07 [Disposal Characterization]	B175829	1.00	05/02/17

SM2580 A

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1129-01 [SP-1 (0-1)]	B175351	20.0	04/26/17
17D1129-02 [SP-1 (2-5)]	B175351	20.0	04/26/17
17D1129-03 [SP-2 (0-1)]	B175351	20.0	04/26/17
17D1129-04 [SP-2 (2-5)]	B175351	20.0	04/26/17
17D1129-05 [SP-3 (0-1)]	B175351	20.0	04/26/17
17D1129-06 [SP-3 (2-5)]	B175351	20.0	04/26/17

SW-846 1030

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1129-07 [Disposal Characterization]	B175571	50.0	04/27/17

Prep Method: SW-846 3050B-SW-846 6010C-D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-01 [SP-1 (0-1)]	B175526	1.08	50.0	04/27/17
17D1129-02 [SP-1 (2-5)]	B175526	1.06	50.0	04/27/17
17D1129-03 [SP-2 (0-1)]	B175526	1.02	50.0	04/27/17
17D1129-05 [SP-3 (0-1)]	B175526	1.08	50.0	04/27/17
17D1129-06 [SP-3 (2-5)]	B175526	1.03	50.0	04/27/17
17D1129-07 [Disposal Characterization]	B175526	1.02	50.0	04/27/17

Prep Method: SW-846 3050B-SW-846 6010C-D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-04 [SP-2 (2-5)]	B175646	1.05	50.0	04/28/17

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-01 [SP-1 (0-1)]	B175501	2.53	100	04/27/17

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Sample Extraction Data

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-02 [SP-1 (2-5)]	B175501	2.53	100	04/27/17
17D1129-03 [SP-2 (0-1)]	B175501	2.57	100	04/27/17
17D1129-04 [SP-2 (2-5)]	B175501	2.54	100	04/27/17
17D1129-05 [SP-3 (0-1)]	B175501	2.56	100	04/27/17
17D1129-06 [SP-3 (2-5)]	B175501	2.56	100	04/27/17

Prep Method: SW-846 7471-SW-846 7471B

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-01 [SP-1 (0-1)]	B175482	0.604	50.0	04/27/17
17D1129-02 [SP-1 (2-5)]	B175482	0.593	50.0	04/27/17
17D1129-03 [SP-2 (0-1)]	B175482	0.598	50.0	04/27/17
17D1129-05 [SP-3 (0-1)]	B175482	0.623	50.0	04/27/17
17D1129-06 [SP-3 (2-5)]	B175482	0.607	50.0	04/27/17
17D1129-07 [Disposal Characterization]	B175482	0.616	50.0	04/27/17

Prep Method: SW-846 7471-SW-846 7471B

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-04 [SP-2 (2-5)]	B175747	0.611	50.0	05/01/17

Prep Method: SW-846 3546-SW-846 8082A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-07 [Disposal Characterization]	B175466	10.0	10.0	04/27/17

Prep Method: SW-846 3546-SW-846 8100 Modified

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-07 [Disposal Characterization]	B175469	30.0	1.00	04/27/17

Prep Method: SW-846 5035-SW-846 8260C

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-07 [Disposal Characterization]	B175403	4.77	10.0	04/26/17

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-01 [SP-1 (0-1)]	B175339	30.0	1.00	04/26/17
17D1129-02 [SP-1 (2-5)]	B175339	30.0	1.00	04/26/17
17D1129-03 [SP-2 (0-1)]	B175339	30.0	1.00	04/26/17
17D1129-04 [SP-2 (2-5)]	B175339	30.0	1.00	04/26/17
17D1129-05 [SP-3 (0-1)]	B175339	30.0	1.00	04/26/17
17D1129-06 [SP-3 (2-5)]	B175339	30.0	1.00	04/26/17

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Sample Extraction Data

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-07 [Disposal Characterization]	B175467	30.0	1.00	04/27/17

SW-846 9014

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-07 [Disposal Characterization]	B175566	25.2	250	04/27/17

SW-846 9030A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
17D1129-07 [Disposal Characterization]	B175577	25.2	250	04/27/17

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1129-01 [SP-1 (0-1)]	B175358	20.0	04/26/17
17D1129-02 [SP-1 (2-5)]	B175358	20.0	04/26/17
17D1129-03 [SP-2 (0-1)]	B175358	20.0	04/26/17
17D1129-04 [SP-2 (2-5)]	B175358	20.0	04/26/17
17D1129-05 [SP-3 (0-1)]	B175358	20.0	04/26/17
17D1129-06 [SP-3 (2-5)]	B175358	20.0	04/26/17

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
17D1129-07 [Disposal Characterization]	B175376	20.0	04/26/17

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175403 - SW-846 5035										
Blank (B175403-BLK1)				Prepared & Analyzed: 04/26/17						
Acetone	ND	0.10	mg/Kg wet							
tert-Amyl Methyl Ether (TAME)	ND	0.0010	mg/Kg wet							
Benzene	ND	0.0020	mg/Kg wet							
Bromobenzene	ND	0.0020	mg/Kg wet							
Bromochloromethane	ND	0.0020	mg/Kg wet							
Bromodichloromethane	ND	0.0020	mg/Kg wet							
Bromoform	ND	0.0020	mg/Kg wet							
Bromomethane	ND	0.010	mg/Kg wet							
2-Butanone (MEK)	ND	0.040	mg/Kg wet							
n-Butylbenzene	ND	0.0020	mg/Kg wet							
sec-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butyl Ethyl Ether (TBEE)	ND	0.0010	mg/Kg wet							
Carbon Disulfide	ND	0.0060	mg/Kg wet							
Carbon Tetrachloride	ND	0.0020	mg/Kg wet							
Chlorobenzene	ND	0.0020	mg/Kg wet							
Chlorodibromomethane	ND	0.0010	mg/Kg wet							
Chloroethane	ND	0.010	mg/Kg wet							
Chloroform	ND	0.0040	mg/Kg wet							
Chloromethane	ND	0.010	mg/Kg wet							
2-Chlorotoluene	ND	0.0020	mg/Kg wet							
4-Chlorotoluene	ND	0.0020	mg/Kg wet							
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0020	mg/Kg wet							
1,2-Dibromoethane (EDB)	ND	0.0010	mg/Kg wet							
Dibromomethane	ND	0.0020	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.0020	mg/Kg wet							
Dichlorodifluoromethane (Freon 12)	ND	0.010	mg/Kg wet							V-05
1,1-Dichloroethane	ND	0.0020	mg/Kg wet							
1,2-Dichloroethane	ND	0.0020	mg/Kg wet							
1,1-Dichloroethylene	ND	0.0040	mg/Kg wet							
cis-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
trans-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
1,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,3-Dichloropropane	ND	0.0010	mg/Kg wet							
2,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,1-Dichloropropene	ND	0.0020	mg/Kg wet							
cis-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
trans-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
Diethyl Ether	ND	0.010	mg/Kg wet							
Diisopropyl Ether (DIPE)	ND	0.0010	mg/Kg wet							
1,4-Dioxane	ND	0.10	mg/Kg wet							V-16
Ethylbenzene	ND	0.0020	mg/Kg wet							
Hexachlorobutadiene	ND	0.0020	mg/Kg wet							
2-Hexanone (MBK)	ND	0.020	mg/Kg wet							
Isopropylbenzene (Cumene)	ND	0.0020	mg/Kg wet							
p-Isopropyltoluene (p-Cymene)	ND	0.0020	mg/Kg wet							
Methyl tert-Butyl Ether (MTBE)	ND	0.0040	mg/Kg wet							
Methylene Chloride	ND	0.010	mg/Kg wet							
4-Methyl-2-pentanone (MIBK)	ND	0.020	mg/Kg wet							
Naphthalene	ND	0.0040	mg/Kg wet							V-05

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035											
Blank (B175403-BLK1)				Prepared & Analyzed: 04/26/17							
n-Propylbenzene	ND	0.0020	mg/Kg wet								
Styrene	ND	0.0020	mg/Kg wet								
1,1,1,2-Tetrachloroethane	ND	0.0020	mg/Kg wet								
1,1,2,2-Tetrachloroethane	ND	0.0010	mg/Kg wet								
Tetrachloroethylene	ND	0.0020	mg/Kg wet								
Tetrahydrofuran	ND	0.010	mg/Kg wet								
Toluene	ND	0.0020	mg/Kg wet								
1,2,3-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,2,4-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,1,1-Trichloroethane	ND	0.0020	mg/Kg wet								
1,1,2-Trichloroethane	ND	0.0020	mg/Kg wet								
Trichloroethylene	ND	0.0020	mg/Kg wet								
Trichlorofluoromethane (Freon 11)	ND	0.010	mg/Kg wet								
1,2,3-Trichloropropane	ND	0.0020	mg/Kg wet								
1,2,4-Trimethylbenzene	ND	0.0020	mg/Kg wet								
1,3,5-Trimethylbenzene	ND	0.0020	mg/Kg wet								
Vinyl Chloride	ND	0.010	mg/Kg wet								
m+p Xylene	ND	0.0040	mg/Kg wet								
o-Xylene	ND	0.0020	mg/Kg wet								
Surrogate: 1,2-Dichloroethane-d4	*0.0537*		mg/Kg wet	0.0500		107	70-130				
Surrogate: Toluene-d8	*0.0492*		mg/Kg wet	0.0500		98.5	70-130				
Surrogate: 4-Bromofluorobenzene	*0.0472*		mg/Kg wet	0.0500		94.4	70-130				
LCS (B175403-BS1)				Prepared & Analyzed: 04/26/17							
Acetone	0.155	0.10	mg/Kg wet	0.200		77.4	40-160				†
tert-Amyl Methyl Ether (TAME)	0.0183	0.0010	mg/Kg wet	0.0200		91.6	70-130				
Benzene	0.0202	0.0020	mg/Kg wet	0.0200		101	70-130				
Bromobenzene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130				
Bromochloromethane	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130				
Bromodichloromethane	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130				
Bromoform	0.0246	0.0020	mg/Kg wet	0.0200		123	70-130				
Bromomethane	0.0136	0.010	mg/Kg wet	0.0200		68.0	40-160			L-14	†
2-Butanone (MEK)	0.167	0.040	mg/Kg wet	0.200		83.7	40-160				†
n-Butylbenzene	0.0242	0.0020	mg/Kg wet	0.0200		121	70-130				
sec-Butylbenzene	0.0231	0.0020	mg/Kg wet	0.0200		116	70-130				
tert-Butylbenzene	0.0223	0.0020	mg/Kg wet	0.0200		112	70-130				
tert-Butyl Ethyl Ether (TBEE)	0.0182	0.0010	mg/Kg wet	0.0200		91.2	70-130				
Carbon Disulfide	0.0232	0.0060	mg/Kg wet	0.0200		116	70-130				
Carbon Tetrachloride	0.0234	0.0020	mg/Kg wet	0.0200		117	70-130				
Chlorobenzene	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130				
Chlorodibromomethane	0.0235	0.0010	mg/Kg wet	0.0200		117	70-130				
Chloroethane	0.0167	0.010	mg/Kg wet	0.0200		83.3	70-130				
Chloroform	0.0218	0.0040	mg/Kg wet	0.0200		109	70-130				
Chloromethane	0.0132	0.010	mg/Kg wet	0.0200		66.0	40-160			L-14	†
2-Chlorotoluene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130				
4-Chlorotoluene	0.0221	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dibromo-3-chloropropane (DBCP)	0.0192	0.0020	mg/Kg wet	0.0200		96.1	70-130				
1,2-Dibromoethane (EDB)	0.0207	0.0010	mg/Kg wet	0.0200		103	70-130				
Dibromomethane	0.0221	0.0020	mg/Kg wet	0.0200		110	70-130				
1,2-Dichlorobenzene	0.0235	0.0020	mg/Kg wet	0.0200		118	70-130				
1,3-Dichlorobenzene	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130				
1,4-Dichlorobenzene	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035												
LCS (B175403-BS1)				Prepared & Analyzed: 04/26/17								
Dichlorodifluoromethane (Freon 12)	0.00998	0.010	mg/Kg wet	0.0200		49.9		40-160			L-14, V-05	†
1,1-Dichloroethane	0.0222	0.0020	mg/Kg wet	0.0200		111		70-130				
1,2-Dichloroethane	0.0237	0.0020	mg/Kg wet	0.0200		118		70-130				
1,1-Dichloroethylene	0.0215	0.0040	mg/Kg wet	0.0200		108		70-130				
cis-1,2-Dichloroethylene	0.0217	0.0020	mg/Kg wet	0.0200		108		70-130				
trans-1,2-Dichloroethylene	0.0207	0.0020	mg/Kg wet	0.0200		104		70-130				
1,2-Dichloropropane	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,3-Dichloropropane	0.0210	0.0010	mg/Kg wet	0.0200		105		70-130				
2,2-Dichloropropane	0.0209	0.0020	mg/Kg wet	0.0200		104		70-130				
1,1-Dichloropropene	0.0212	0.0020	mg/Kg wet	0.0200		106		70-130				
cis-1,3-Dichloropropene	0.0191	0.0010	mg/Kg wet	0.0200		95.5		70-130				
trans-1,3-Dichloropropene	0.0200	0.0010	mg/Kg wet	0.0200		100		70-130				
Diethyl Ether	0.0180	0.010	mg/Kg wet	0.0200		90.2		70-130				
Diisopropyl Ether (DIPE)	0.0198	0.0010	mg/Kg wet	0.0200		99.2		70-130				
1,4-Dioxane	0.196	0.10	mg/Kg wet	0.200		97.9		40-160			V-16	†
Ethylbenzene	0.0222	0.0020	mg/Kg wet	0.0200		111		70-130				
Hexachlorobutadiene	0.0275	0.0020	mg/Kg wet	0.0200		**138**	*	70-130			L-07	
2-Hexanone (MBK)	0.173	0.020	mg/Kg wet	0.200		86.4		40-160				†
Isopropylbenzene (Cumene)	0.0238	0.0020	mg/Kg wet	0.0200		119		70-130				
p-Isopropyltoluene (p-Cymene)	0.0236	0.0020	mg/Kg wet	0.0200		118		70-130				
Methyl tert-Butyl Ether (MTBE)	0.0188	0.0040	mg/Kg wet	0.0200		94.2		70-130				
Methylene Chloride	0.0218	0.010	mg/Kg wet	0.0200		109		70-130				
4-Methyl-2-pentanone (MIBK)	0.200	0.020	mg/Kg wet	0.200		99.8		40-160				†
Naphthalene	0.0166	0.0040	mg/Kg wet	0.0200		83.0		70-130			V-05	
n-Propylbenzene	0.0226	0.0020	mg/Kg wet	0.0200		113		70-130				
Styrene	0.0214	0.0020	mg/Kg wet	0.0200		107		70-130				
1,1,1,2-Tetrachloroethane	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,1,2,2-Tetrachloroethane	0.0215	0.0010	mg/Kg wet	0.0200		108		70-130				
Tetrachloroethylene	0.0253	0.0020	mg/Kg wet	0.0200		126		70-130				
Tetrahydrofuran	0.0187	0.010	mg/Kg wet	0.0200		93.6		70-130				
Toluene	0.0206	0.0020	mg/Kg wet	0.0200		103		70-130				
1,2,3-Trichlorobenzene	0.0194	0.0020	mg/Kg wet	0.0200		97.0		70-130				
1,2,4-Trichlorobenzene	0.0191	0.0020	mg/Kg wet	0.0200		95.3		70-130				
1,1,1-Trichloroethane	0.0226	0.0020	mg/Kg wet	0.0200		113		70-130				
1,1,2-Trichloroethane	0.0215	0.0020	mg/Kg wet	0.0200		107		70-130				
Trichloroethylene	0.0220	0.0020	mg/Kg wet	0.0200		110		70-130				
Trichlorofluoromethane (Freon 11)	0.0197	0.010	mg/Kg wet	0.0200		98.5		70-130				
1,2,3-Trichloropropane	0.0213	0.0020	mg/Kg wet	0.0200		107		70-130				
1,2,4-Trimethylbenzene	0.0217	0.0020	mg/Kg wet	0.0200		108		70-130				
1,3,5-Trimethylbenzene	0.0228	0.0020	mg/Kg wet	0.0200		114		70-130				
Vinyl Chloride	0.0147	0.010	mg/Kg wet	0.0200		73.5		70-130				
m+p Xylene	0.0440	0.0040	mg/Kg wet	0.0400		110		70-130				
o-Xylene	0.0209	0.0020	mg/Kg wet	0.0200		104		70-130				
Surrogate: 1,2-Dichloroethane-d4	*0.0521*		mg/Kg wet	0.0500		104		70-130				
Surrogate: Toluene-d8	*0.0481*		mg/Kg wet	0.0500		96.3		70-130				
Surrogate: 4-Bromofluorobenzene	*0.0492*		mg/Kg wet	0.0500		98.4		70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175403 - SW-846 5035											
LCS Dup (B175403-BSD1)				Prepared & Analyzed: 04/26/17							
Acetone	0.158	0.10	mg/Kg wet	0.200		78.8	40-160	1.78	20		†
tert-Amyl Methyl Ether (TAME)	0.0184	0.0010	mg/Kg wet	0.0200		92.1	70-130	0.544	20		
Benzene	0.0200	0.0020	mg/Kg wet	0.0200		99.9	70-130	1.19	20		
Bromobenzene	0.0205	0.0020	mg/Kg wet	0.0200		102	70-130	6.15	20		
Bromochloromethane	0.0236	0.0020	mg/Kg wet	0.0200		118	70-130	0.0849	20		
Bromodichloromethane	0.0235	0.0020	mg/Kg wet	0.0200		117	70-130	2.59	20		
Bromoform	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	9.52	20		
Bromomethane	0.0145	0.010	mg/Kg wet	0.0200		72.6	40-160	6.54	20		†
2-Butanone (MEK)	0.171	0.040	mg/Kg wet	0.200		85.5	40-160	2.14	20		†
n-Butylbenzene	0.0228	0.0020	mg/Kg wet	0.0200		114	70-130	6.12	20		
sec-Butylbenzene	0.0221	0.0020	mg/Kg wet	0.0200		111	70-130	4.33	20		
tert-Butylbenzene	0.0211	0.0020	mg/Kg wet	0.0200		105	70-130	5.80	20		
tert-Butyl Ethyl Ether (TBEE)	0.0186	0.0010	mg/Kg wet	0.0200		93.0	70-130	1.95	20		
Carbon Disulfide	0.0231	0.0060	mg/Kg wet	0.0200		115	70-130	0.778	20		
Carbon Tetrachloride	0.0229	0.0020	mg/Kg wet	0.0200		115	70-130	1.99	20		
Chlorobenzene	0.0211	0.0020	mg/Kg wet	0.0200		105	70-130	1.51	20		
Chlorodibromomethane	0.0231	0.0010	mg/Kg wet	0.0200		116	70-130	1.46	20		
Chloroethane	0.0156	0.010	mg/Kg wet	0.0200		77.9	70-130	6.70	20		
Chloroform	0.0217	0.0040	mg/Kg wet	0.0200		108	70-130	0.644	20		
Chloromethane	0.0129	0.010	mg/Kg wet	0.0200		64.7	40-160	1.99	20	L-14	†
2-Chlorotoluene	0.0219	0.0020	mg/Kg wet	0.0200		110	70-130	0.457	20		
4-Chlorotoluene	0.0217	0.0020	mg/Kg wet	0.0200		108	70-130	1.83	20		
1,2-Dibromo-3-chloropropane (DBCP)	0.0192	0.0020	mg/Kg wet	0.0200		96.2	70-130	0.104	20		
1,2-Dibromoethane (EDB)	0.0211	0.0010	mg/Kg wet	0.0200		106	70-130	2.11	20		
Dibromomethane	0.0229	0.0020	mg/Kg wet	0.0200		114	70-130	3.56	20		
1,2-Dichlorobenzene	0.0217	0.0020	mg/Kg wet	0.0200		109	70-130	7.95	20		
1,3-Dichlorobenzene	0.0227	0.0020	mg/Kg wet	0.0200		114	70-130	3.80	20		
1,4-Dichlorobenzene	0.0213	0.0020	mg/Kg wet	0.0200		106	70-130	7.25	20		
Dichlorodifluoromethane (Freon 12)	0.0102	0.010	mg/Kg wet	0.0200		50.8	40-160	1.79	20	L-14, V-05	†
1,1-Dichloroethane	0.0223	0.0020	mg/Kg wet	0.0200		111	70-130	0.0899	20		
1,2-Dichloroethane	0.0244	0.0020	mg/Kg wet	0.0200		122	70-130	2.92	20		
1,1-Dichloroethylene	0.0214	0.0040	mg/Kg wet	0.0200		107	70-130	0.465	20		
cis-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	3.28	20		
trans-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	1.44	20		
1,2-Dichloropropane	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	4.09	20		
1,3-Dichloropropane	0.0212	0.0010	mg/Kg wet	0.0200		106	70-130	0.950	20		
2,2-Dichloropropane	0.0208	0.0020	mg/Kg wet	0.0200		104	70-130	0.384	20		
1,1-Dichloropropene	0.0216	0.0020	mg/Kg wet	0.0200		108	70-130	2.06	20		
cis-1,3-Dichloropropene	0.0197	0.0010	mg/Kg wet	0.0200		98.5	70-130	3.09	20		
trans-1,3-Dichloropropene	0.0197	0.0010	mg/Kg wet	0.0200		98.5	70-130	1.71	20		
Diethyl Ether	0.0173	0.010	mg/Kg wet	0.0200		86.5	70-130	4.19	20		
Diisopropyl Ether (DIPE)	0.0199	0.0010	mg/Kg wet	0.0200		99.4	70-130	0.201	20		
1,4-Dioxane	0.227	0.10	mg/Kg wet	0.200		114	40-160	14.8	20	V-16	†
Ethylbenzene	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130	1.08	20		
Hexachlorobutadiene	0.0254	0.0020	mg/Kg wet	0.0200		127	70-130	8.08	20		
2-Hexanone (MBK)	0.173	0.020	mg/Kg wet	0.200		86.3	40-160	0.127	20		†
Isopropylbenzene (Cumene)	0.0234	0.0020	mg/Kg wet	0.0200		117	70-130	1.61	20		
p-Isopropyltoluene (p-Cymene)	0.0223	0.0020	mg/Kg wet	0.0200		111	70-130	5.75	20		
Methyl tert-Butyl Ether (MTBE)	0.0190	0.0040	mg/Kg wet	0.0200		95.2	70-130	1.06	20		
Methylene Chloride	0.0213	0.010	mg/Kg wet	0.0200		106	70-130	2.23	20		
4-Methyl-2-pentanone (MIBK)	0.200	0.020	mg/Kg wet	0.200		99.8	40-160	0.0601	20		†
Naphthalene	0.0158	0.0040	mg/Kg wet	0.0200		79.2	70-130	4.69	20	V-05	

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175403 - SW-846 5035										
LCS Dup (B175403-BSD1)				Prepared & Analyzed: 04/26/17						
n-Propylbenzene	0.0217	0.0020	mg/Kg wet	0.0200		108	70-130	4.42	20	
Styrene	0.0206	0.0020	mg/Kg wet	0.0200		103	70-130	4.00	20	
1,1,1,2-Tetrachloroethane	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	2.87	20	
1,1,2,2-Tetrachloroethane	0.0209	0.0010	mg/Kg wet	0.0200		105	70-130	2.82	20	
Tetrachloroethylene	0.0251	0.0020	mg/Kg wet	0.0200		125	70-130	0.874	20	
Tetrahydrofuran	0.0206	0.010	mg/Kg wet	0.0200		103	70-130	9.56	20	
Toluene	0.0209	0.0020	mg/Kg wet	0.0200		105	70-130	1.44	20	
1,2,3-Trichlorobenzene	0.0186	0.0020	mg/Kg wet	0.0200		93.0	70-130	4.21	20	
1,2,4-Trichlorobenzene	0.0184	0.0020	mg/Kg wet	0.0200		92.0	70-130	3.52	20	
1,1,1-Trichloroethane	0.0220	0.0020	mg/Kg wet	0.0200		110	70-130	3.05	20	
1,1,2-Trichloroethane	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	0.186	20	
Trichloroethylene	0.0225	0.0020	mg/Kg wet	0.0200		113	70-130	2.33	20	
Trichlorofluoromethane (Freon 11)	0.0195	0.010	mg/Kg wet	0.0200		97.3	70-130	1.23	20	
1,2,3-Trichloropropane	0.0182	0.0020	mg/Kg wet	0.0200		91.1	70-130	15.7	20	
1,2,4-Trimethylbenzene	0.0207	0.0020	mg/Kg wet	0.0200		104	70-130	4.72	20	
1,3,5-Trimethylbenzene	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	1.77	20	
Vinyl Chloride	0.0143	0.010	mg/Kg wet	0.0200		71.5	70-130	2.76	20	
m+p Xylene	0.0427	0.0040	mg/Kg wet	0.0400		107	70-130	3.04	20	
o-Xylene	0.0213	0.0020	mg/Kg wet	0.0200		107	70-130	1.99	20	
Surrogate: 1,2-Dichloroethane-d4	*0.0518*		mg/Kg wet	0.0500		104	70-130			
Surrogate: Toluene-d8	*0.0503*		mg/Kg wet	0.0500		101	70-130			
Surrogate: 4-Bromofluorobenzene	*0.0482*		mg/Kg wet	0.0500		96.5	70-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175339 - SW-846 3546										
Blank (B175339-BLK1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							V-20
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							V-20
Fluoranthene	ND	0.17	mg/Kg wet							
Fluorene	ND	0.17	mg/Kg wet							
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet							V-20
2-Methylnaphthalene	ND	0.17	mg/Kg wet							
Naphthalene	ND	0.17	mg/Kg wet							
Phenanthrene	ND	0.17	mg/Kg wet							
Pyrene	ND	0.17	mg/Kg wet							
Surrogate: Nitrobenzene-d5	*3.04*		mg/Kg wet	3.33		91.3	30-130			
Surrogate: 2-Fluorobiphenyl	*3.18*		mg/Kg wet	3.33		95.4	30-130			
Surrogate: p-Terphenyl-d14	*3.61*		mg/Kg wet	3.33		108	30-130			
LCS (B175339-BS1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	1.28	0.17	mg/Kg wet	1.67		76.7	40-140			
Acenaphthylene	1.22	0.17	mg/Kg wet	1.67		73.0	40-140			
Anthracene	1.37	0.17	mg/Kg wet	1.67		82.2	40-140			
Benzo(a)anthracene	1.43	0.17	mg/Kg wet	1.67		85.7	40-140			
Benzo(a)pyrene	1.42	0.17	mg/Kg wet	1.67		85.1	40-140			
Benzo(b)fluoranthene	1.39	0.17	mg/Kg wet	1.67		83.4	40-140			
Benzo(g,h,i)perylene	1.72	0.17	mg/Kg wet	1.67		103	40-140			V-20
Benzo(k)fluoranthene	1.45	0.17	mg/Kg wet	1.67		86.8	40-140			
Chrysene	1.40	0.17	mg/Kg wet	1.67		83.9	40-140			
Dibenz(a,h)anthracene	1.80	0.17	mg/Kg wet	1.67		108	40-140			V-20
Fluoranthene	1.46	0.17	mg/Kg wet	1.67		87.5	40-140			
Fluorene	1.32	0.17	mg/Kg wet	1.67		79.5	40-140			
Indeno(1,2,3-cd)pyrene	1.83	0.17	mg/Kg wet	1.67		110	40-140			V-20
2-Methylnaphthalene	1.29	0.17	mg/Kg wet	1.67		77.5	40-140			
Naphthalene	1.17	0.17	mg/Kg wet	1.67		70.4	40-140			
Phenanthrene	1.37	0.17	mg/Kg wet	1.67		82.5	40-140			
Pyrene	1.43	0.17	mg/Kg wet	1.67		85.7	40-140			
Surrogate: Nitrobenzene-d5	*2.73*		mg/Kg wet	3.33		82.0	30-130			
Surrogate: 2-Fluorobiphenyl	*2.88*		mg/Kg wet	3.33		86.3	30-130			
Surrogate: p-Terphenyl-d14	*3.35*		mg/Kg wet	3.33		101	30-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175339 - SW-846 3546										
LCS Dup (B175339-BSD1)				Prepared: 04/26/17 Analyzed: 04/27/17						
Acenaphthene	1.21	0.17	mg/Kg wet	1.67		72.7	40-140	5.35	30	
Acenaphthylene	1.17	0.17	mg/Kg wet	1.67		70.3	40-140	3.77	30	
Anthracene	1.32	0.17	mg/Kg wet	1.67		79.1	40-140	3.89	30	
Benzo(a)anthracene	1.35	0.17	mg/Kg wet	1.67		81.2	40-140	5.42	30	
Benzo(a)pyrene	1.37	0.17	mg/Kg wet	1.67		82.2	40-140	3.42	30	
Benzo(b)fluoranthene	1.30	0.17	mg/Kg wet	1.67		78.0	40-140	6.72	30	
Benzo(g,h,i)perylene	1.70	0.17	mg/Kg wet	1.67		102	40-140	1.68	30	V-20
Benzo(k)fluoranthene	1.34	0.17	mg/Kg wet	1.67		80.6	40-140	7.33	30	
Chrysene	1.31	0.17	mg/Kg wet	1.67		78.7	40-140	6.32	30	
Dibenz(a,h)anthracene	1.76	0.17	mg/Kg wet	1.67		105	40-140	2.27	30	V-20
Fluoranthene	1.40	0.17	mg/Kg wet	1.67		84.2	40-140	3.89	30	
Fluorene	1.24	0.17	mg/Kg wet	1.67		74.2	40-140	6.79	30	
Indeno(1,2,3-cd)pyrene	1.73	0.17	mg/Kg wet	1.67		104	40-140	5.54	30	V-20
2-Methylnaphthalene	1.29	0.17	mg/Kg wet	1.67		77.2	40-140	0.336	30	
Naphthalene	1.14	0.17	mg/Kg wet	1.67		68.5	40-140	2.68	30	
Phenanthrene	1.30	0.17	mg/Kg wet	1.67		78.1	40-140	5.38	30	
Pyrene	1.30	0.17	mg/Kg wet	1.67		78.0	40-140	9.38	30	
Surrogate: Nitrobenzene-d5	*2.60*		mg/Kg wet	3.33		77.9	30-130			
Surrogate: 2-Fluorobiphenyl	*2.63*		mg/Kg wet	3.33		79.0	30-130			
Surrogate: p-Terphenyl-d14	*3.00*		mg/Kg wet	3.33		90.0	30-130			
Batch B175467 - SW-846 3546										
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Acetophenone	ND	0.34	mg/Kg wet							
Aniline	ND	0.34	mg/Kg wet							L-04
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Bis(2-chloroethoxy)methane	ND	0.34	mg/Kg wet							
Bis(2-chloroethyl)ether	ND	0.34	mg/Kg wet							
Bis(2-chloroisopropyl)ether	ND	0.34	mg/Kg wet							
Bis(2-Ethylhexyl)phthalate	ND	0.34	mg/Kg wet							
4-Bromophenylphenylether	ND	0.34	mg/Kg wet							
Butylbenzylphthalate	ND	0.34	mg/Kg wet							
4-Chloroaniline	ND	0.66	mg/Kg wet							
2-Chloronaphthalene	ND	0.34	mg/Kg wet							
2-Chlorophenol	ND	0.34	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							
Dibenzofuran	ND	0.34	mg/Kg wet							
Di-n-butylphthalate	ND	0.34	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.34	mg/Kg wet							
3,3-Dichlorobenzidine	ND	0.17	mg/Kg wet							
2,4-Dichlorophenol	ND	0.34	mg/Kg wet							
Diethylphthalate	ND	0.34	mg/Kg wet							

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes
Batch B175467 - SW-846 3546											
Blank (B175467-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17							
2,4-Dimethylphenol	ND	0.34	mg/Kg wet								
Dimethylphthalate	ND	0.34	mg/Kg wet								
2,4-Dinitrophenol	ND	0.66	mg/Kg wet								V-05
2,4-Dinitrotoluene	ND	0.34	mg/Kg wet								
2,6-Dinitrotoluene	ND	0.34	mg/Kg wet								
Di-n-octylphthalate	ND	0.34	mg/Kg wet								
1,2-Diphenylhydrazine (as Azobenzene)	ND	0.34	mg/Kg wet								
Fluoranthene	ND	0.17	mg/Kg wet								
Fluorene	ND	0.17	mg/Kg wet								
Hexachlorobenzene	ND	0.34	mg/Kg wet								
Hexachlorobutadiene	ND	0.34	mg/Kg wet								V-20
Hexachloroethane	ND	0.34	mg/Kg wet								
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet								
Isophorone	ND	0.34	mg/Kg wet								
2-Methylnaphthalene	ND	0.17	mg/Kg wet								
2-Methylphenol	ND	0.34	mg/Kg wet								
3/4-Methylphenol	ND	0.34	mg/Kg wet								
Naphthalene	ND	0.17	mg/Kg wet								
Nitrobenzene	ND	0.34	mg/Kg wet								
2-Nitrophenol	ND	0.34	mg/Kg wet								
4-Nitrophenol	ND	0.66	mg/Kg wet								
Pentachlorophenol	ND	0.34	mg/Kg wet								V-05
Phenanthrene	ND	0.17	mg/Kg wet								
Phenol	ND	0.34	mg/Kg wet								
Pyrene	ND	0.17	mg/Kg wet								
1,2,4-Trichlorobenzene	ND	0.34	mg/Kg wet								
2,4,5-Trichlorophenol	ND	0.34	mg/Kg wet								
2,4,6-Trichlorophenol	ND	0.34	mg/Kg wet								
Surrogate: 2-Fluorophenol	*4.00*		mg/Kg wet	6.73		59.4		30-130			
Surrogate: Phenol-d6	*4.09*		mg/Kg wet	6.67		61.3		30-130			
Surrogate: Nitrobenzene-d5	*2.14*		mg/Kg wet	3.33		64.1		30-130			
Surrogate: 2-Fluorobiphenyl	*2.24*		mg/Kg wet	3.33		67.1		30-130			
Surrogate: 2,4,6-Tribromophenol	*5.53*		mg/Kg wet	6.67		83.0		30-130			
Surrogate: p-Terphenyl-d14	*2.66*		mg/Kg wet	3.33		79.7		30-130			
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17							
Acenaphthene	0.968	0.17	mg/Kg wet	1.67		58.1		40-140			
Acenaphthylene	0.945	0.17	mg/Kg wet	1.67		56.7		40-140			
Acetophenone	1.04	0.34	mg/Kg wet	1.67		62.7		40-140			
Aniline	0.629	0.34	mg/Kg wet	1.67		**37.8**	*	40-140			L-04
Anthracene	1.02	0.17	mg/Kg wet	1.67		61.1		40-140			
Benzo(a)anthracene	1.08	0.17	mg/Kg wet	1.67		64.9		40-140			
Benzo(a)pyrene	1.11	0.17	mg/Kg wet	1.67		66.5		40-140			
Benzo(b)fluoranthene	1.06	0.17	mg/Kg wet	1.67		63.6		40-140			
Benzo(g,h,i)perylene	1.03	0.17	mg/Kg wet	1.67		61.8		40-140			
Benzo(k)fluoranthene	1.04	0.17	mg/Kg wet	1.67		62.5		40-140			
Bis(2-chloroethoxy)methane	0.955	0.34	mg/Kg wet	1.67		57.3		40-140			
Bis(2-chloroethyl)ether	0.921	0.34	mg/Kg wet	1.67		55.3		40-140			
Bis(2-chloroisopropyl)ether	1.02	0.34	mg/Kg wet	1.67		61.5		40-140			
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		61.8		40-140			
4-Bromophenylphenylether	1.19	0.34	mg/Kg wet	1.67		71.3		40-140			
Butylbenzylphthalate	1.08	0.34	mg/Kg wet	1.67		64.7		40-140			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546											
LCS (B175467-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17							
4-Chloroaniline	0.680	0.66	mg/Kg wet	1.67		40.8	15-140				†
2-Chloronaphthalene	0.954	0.34	mg/Kg wet	1.67		57.3	40-140				
2-Chlorophenol	0.985	0.34	mg/Kg wet	1.67		59.1	30-130				
Chrysene	0.967	0.17	mg/Kg wet	1.67		58.0	40-140				
Dibenz(a,h)anthracene	1.08	0.17	mg/Kg wet	1.67		65.1	40-140				
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		67.1	40-140				
Di-n-butylphthalate	0.987	0.34	mg/Kg wet	1.67		59.2	40-140				
1,2-Dichlorobenzene	0.944	0.34	mg/Kg wet	1.67		56.6	40-140				
1,3-Dichlorobenzene	0.918	0.34	mg/Kg wet	1.67		55.1	40-140				
1,4-Dichlorobenzene	0.937	0.34	mg/Kg wet	1.67		56.2	40-140				
3,3-Dichlorobenzidine	0.844	0.17	mg/Kg wet	1.67		50.6	40-140				
2,4-Dichlorophenol	1.15	0.34	mg/Kg wet	1.67		68.7	30-130				
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		65.9	40-140				
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.4	30-130				
Dimethylphthalate	1.13	0.34	mg/Kg wet	1.67		67.8	40-140				
2,4-Dinitrophenol	0.612	0.66	mg/Kg wet	1.67		36.7	15-140			V-05	†
2,4-Dinitrotoluene	1.15	0.34	mg/Kg wet	1.67		68.8	40-140				
2,6-Dinitrotoluene	1.18	0.34	mg/Kg wet	1.67		70.8	40-140				
Di-n-octylphthalate	1.00	0.34	mg/Kg wet	1.67		60.2	40-140				
1,2-Diphenylhydrazine (as Azobenzene)	1.01	0.34	mg/Kg wet	1.67		60.7	40-140				
Fluoranthene	1.03	0.17	mg/Kg wet	1.67		61.6	40-140				
Fluorene	1.04	0.17	mg/Kg wet	1.67		62.5	40-140				
Hexachlorobenzene	1.20	0.34	mg/Kg wet	1.67		71.9	40-140				
Hexachlorobutadiene	1.35	0.34	mg/Kg wet	1.67		80.9	40-140			V-20	
Hexachloroethane	0.983	0.34	mg/Kg wet	1.67		59.0	40-140				
Indeno(1,2,3-cd)pyrene	1.09	0.17	mg/Kg wet	1.67		65.5	40-140				
Isophorone	1.03	0.34	mg/Kg wet	1.67		61.7	40-140				
2-Methylnaphthalene	1.14	0.17	mg/Kg wet	1.67		68.1	40-140				
2-Methylphenol	0.974	0.34	mg/Kg wet	1.67		58.4	30-130				
3/4-Methylphenol	1.02	0.34	mg/Kg wet	1.67		61.3	30-130				
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6	40-140				
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		62.8	40-140				
2-Nitrophenol	1.00	0.34	mg/Kg wet	1.67		60.0	30-130				
4-Nitrophenol	1.21	0.66	mg/Kg wet	1.67		72.6	15-140				†
Pentachlorophenol	0.639	0.34	mg/Kg wet	1.67		38.3	30-130			V-05	
Phenanthrene	1.03	0.17	mg/Kg wet	1.67		61.6	40-140				
Phenol	1.02	0.34	mg/Kg wet	1.67		61.2	15-140				†
Pyrene	1.09	0.17	mg/Kg wet	1.67		65.7	40-140				
1,2,4-Trichlorobenzene	1.09	0.34	mg/Kg wet	1.67		65.6	40-140				
2,4,5-Trichlorophenol	1.18	0.34	mg/Kg wet	1.67		71.0	30-130				
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.0	30-130				
Surrogate: 2-Fluorophenol	*4.19*		mg/Kg wet	6.73		62.3	30-130				
Surrogate: Phenol-d6	*4.42*		mg/Kg wet	6.67		66.3	30-130				
Surrogate: Nitrobenzene-d5	*2.29*		mg/Kg wet	3.33		68.6	30-130				
Surrogate: 2-Fluorobiphenyl	*2.43*		mg/Kg wet	3.33		72.9	30-130				
Surrogate: 2,4,6-Tribromophenol	*5.60*		mg/Kg wet	6.67		83.9	30-130				
Surrogate: p-Terphenyl-d14	*2.53*		mg/Kg wet	3.33		76.0	30-130				

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes	
Batch B175467 - SW-846 3546												
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17								
Acenaphthene	0.958	0.17	mg/Kg wet	1.67		57.5		40-140	1.07	30		
Acenaphthylene	0.950	0.17	mg/Kg wet	1.67		57.0		40-140	0.528	30		
Acetophenone	1.05	0.34	mg/Kg wet	1.67		62.9		40-140	0.414	30		
Aniline	0.655	0.34	mg/Kg wet	1.67		**39.3**	*	40-140	3.95	30	L-04	
Anthracene	1.05	0.17	mg/Kg wet	1.67		63.0		40-140	3.03	30		
Benzo(a)anthracene	1.11	0.17	mg/Kg wet	1.67		66.6		40-140	2.46	30		
Benzo(a)pyrene	1.12	0.17	mg/Kg wet	1.67		67.3		40-140	1.29	30		
Benzo(b)fluoranthene	1.08	0.17	mg/Kg wet	1.67		65.0		40-140	2.24	30		
Benzo(g,h,i)perylene	1.05	0.17	mg/Kg wet	1.67		63.2		40-140	2.27	30		
Benzo(k)fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.6		40-140	3.30	30		
Bis(2-chloroethoxy)methane	0.980	0.34	mg/Kg wet	1.67		58.8		40-140	2.65	30		
Bis(2-chloroethyl)ether	0.901	0.34	mg/Kg wet	1.67		54.1		40-140	2.23	30		
Bis(2-chloroisopropyl)ether	1.04	0.34	mg/Kg wet	1.67		62.2		40-140	1.16	30		
Bis(2-Ethylhexyl)phthalate	1.03	0.34	mg/Kg wet	1.67		62.0		40-140	0.355	30		
4-Bromophenylphenylether	1.20	0.34	mg/Kg wet	1.67		72.1		40-140	1.14	30		
Butylbenzylphthalate	1.07	0.34	mg/Kg wet	1.67		64.0		40-140	1.03	30		
4-Chloroaniline	0.689	0.66	mg/Kg wet	1.67		41.3		15-140	1.36	30		†
2-Chloronaphthalene	0.951	0.34	mg/Kg wet	1.67		57.1		40-140	0.315	30		
2-Chlorophenol	0.981	0.34	mg/Kg wet	1.67		58.9		30-130	0.373	30		
Chrysene	0.972	0.17	mg/Kg wet	1.67		58.3		40-140	0.516	30		
Dibenz(a,h)anthracene	1.09	0.17	mg/Kg wet	1.67		65.5		40-140	0.582	30		
Dibenzofuran	1.12	0.34	mg/Kg wet	1.67		66.9		40-140	0.269	30		
Di-n-butylphthalate	1.02	0.34	mg/Kg wet	1.67		60.9		40-140	2.86	30		
1,2-Dichlorobenzene	0.972	0.34	mg/Kg wet	1.67		58.3		40-140	2.92	30		
1,3-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	2.26	30		
1,4-Dichlorobenzene	0.939	0.34	mg/Kg wet	1.67		56.4		40-140	0.213	30		
3,3-Dichlorobenzidine	0.880	0.17	mg/Kg wet	1.67		52.8		40-140	4.21	30		
2,4-Dichlorophenol	1.13	0.34	mg/Kg wet	1.67		67.9		30-130	1.26	30		
Diethylphthalate	1.10	0.34	mg/Kg wet	1.67		66.1		40-140	0.303	30		
2,4-Dimethylphenol	1.02	0.34	mg/Kg wet	1.67		61.0		30-130	0.654	30		
Dimethylphthalate	1.14	0.34	mg/Kg wet	1.67		68.6		40-140	1.23	30		
2,4-Dinitrophenol	0.602	0.66	mg/Kg wet	1.67		36.1		15-140	1.59	30	V-05	†
2,4-Dinitrotoluene	1.13	0.34	mg/Kg wet	1.67		67.9		40-140	1.43	30		
2,6-Dinitrotoluene	1.19	0.34	mg/Kg wet	1.67		71.3		40-140	0.816	30		
Di-n-octylphthalate	1.04	0.34	mg/Kg wet	1.67		62.6		40-140	3.87	30		
1,2-Diphenylhydrazine (as Azobenzene)	1.02	0.34	mg/Kg wet	1.67		61.4		40-140	1.11	30		
Fluoranthene	1.08	0.17	mg/Kg wet	1.67		64.5		40-140	4.63	30		
Fluorene	1.05	0.17	mg/Kg wet	1.67		62.8		40-140	0.542	30		
Hexachlorobenzene	1.22	0.34	mg/Kg wet	1.67		73.0		40-140	1.49	30		
Hexachlorobutadiene	1.34	0.34	mg/Kg wet	1.67		80.3		40-140	0.695	30	V-20	
Hexachloroethane	1.00	0.34	mg/Kg wet	1.67		60.3		40-140	2.15	30		
Indeno(1,2,3-cd)pyrene	1.10	0.17	mg/Kg wet	1.67		66.2		40-140	1.09	30		
Isophorone	1.03	0.34	mg/Kg wet	1.67		62.0		40-140	0.420	30		
2-Methylnaphthalene	1.11	0.17	mg/Kg wet	1.67		66.5		40-140	2.38	30		
2-Methylphenol	0.950	0.34	mg/Kg wet	1.67		57.0		30-130	2.46	30		
3/4-Methylphenol	1.03	0.34	mg/Kg wet	1.67		61.5		30-130	0.456	30		
Naphthalene	1.01	0.17	mg/Kg wet	1.67		60.6		40-140	0.0990	30		
Nitrobenzene	1.05	0.34	mg/Kg wet	1.67		63.0		40-140	0.286	30		
2-Nitrophenol	1.02	0.34	mg/Kg wet	1.67		60.9		30-130	1.49	30		
4-Nitrophenol	1.26	0.66	mg/Kg wet	1.67		75.5		15-140	3.94	30		†
Pentachlorophenol	0.614	0.34	mg/Kg wet	1.67		36.8		30-130	4.04	30	V-05	
Phenanthrene	1.04	0.17	mg/Kg wet	1.67		62.5		40-140	1.51	30		

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175467 - SW-846 3546										
LCS Dup (B175467-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Phenol	0.991	0.34	mg/Kg wet	1.67		59.5	15-140	2.82	30	†
Pyrene	1.14	0.17	mg/Kg wet	1.67		68.5	40-140	4.26	30	
1,2,4-Trichlorobenzene	1.11	0.34	mg/Kg wet	1.67		66.8	40-140	1.84	30	
2,4,5-Trichlorophenol	1.27	0.34	mg/Kg wet	1.67		76.2	30-130	7.12	30	
2,4,6-Trichlorophenol	1.10	0.34	mg/Kg wet	1.67		66.2	30-130	0.242	30	
Surrogate: 2-Fluorophenol	*4.13*		mg/Kg wet	6.73		61.3	30-130			
Surrogate: Phenol-d6	*4.35*		mg/Kg wet	6.67		65.2	30-130			
Surrogate: Nitrobenzene-d5	*2.27*		mg/Kg wet	3.33		68.0	30-130			
Surrogate: 2-Fluorobiphenyl	*2.54*		mg/Kg wet	3.33		76.2	30-130			
Surrogate: 2,4,6-Tribromophenol	*5.48*		mg/Kg wet	6.67		82.2	30-130			
Surrogate: p-Terphenyl-d14	*2.59*		mg/Kg wet	3.33		77.8	30-130			

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QUALITY CONTROL

Polychlorinated Biphenyls By GC/ECD - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175466 - SW-846 3546										
Blank (B175466-BLK1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	ND	0.020	mg/Kg wet							
Aroclor-1016 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1221	ND	0.020	mg/Kg wet							
Aroclor-1221 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1232	ND	0.020	mg/Kg wet							
Aroclor-1232 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1242	ND	0.020	mg/Kg wet							
Aroclor-1242 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1248	ND	0.020	mg/Kg wet							
Aroclor-1248 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1254	ND	0.020	mg/Kg wet							
Aroclor-1254 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1260	ND	0.020	mg/Kg wet							
Aroclor-1260 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1262	ND	0.020	mg/Kg wet							
Aroclor-1262 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1268	ND	0.020	mg/Kg wet							
Aroclor-1268 [2C]	ND	0.020	mg/Kg wet							
Surrogate: Decachlorobiphenyl	*0.196*		mg/Kg wet	0.200		98.1	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.4	30-150			
Surrogate: Tetrachloro-m-xylene	*0.193*		mg/Kg wet	0.200		96.4	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.180*		mg/Kg wet	0.200		90.1	30-150			
LCS (B175466-BS1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		100	40-140			
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		103	40-140			
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		89.8	40-140			
Aroclor-1260 [2C]	0.19	0.020	mg/Kg wet	0.200		96.7	40-140			
Surrogate: Decachlorobiphenyl	*0.197*		mg/Kg wet	0.200		98.3	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.189*		mg/Kg wet	0.200		94.7	30-150			
Surrogate: Tetrachloro-m-xylene	*0.200*		mg/Kg wet	0.200		99.9	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.187*		mg/Kg wet	0.200		93.4	30-150			
LCS Dup (B175466-BSD1)				Prepared: 04/27/17 Analyzed: 04/30/17						
Aroclor-1016	0.20	0.020	mg/Kg wet	0.200		102	40-140	1.17	30	
Aroclor-1016 [2C]	0.21	0.020	mg/Kg wet	0.200		104	40-140	1.11	30	
Aroclor-1260	0.18	0.020	mg/Kg wet	0.200		91.2	40-140	1.57	30	
Aroclor-1260 [2C]	0.20	0.020	mg/Kg wet	0.200		98.5	40-140	1.92	30	
Surrogate: Decachlorobiphenyl	*0.199*		mg/Kg wet	0.200		99.5	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.192*		mg/Kg wet	0.200		96.0	30-150			
Surrogate: Tetrachloro-m-xylene	*0.201*		mg/Kg wet	0.200		100	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.189*		mg/Kg wet	0.200		94.3	30-150			

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QUALITY CONTROL

Petroleum Hydrocarbons Analyses - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175469 - SW-846 3546										
Blank (B175469-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	ND	8.3	mg/Kg wet							
Surrogate: o-Terphenyl	*3.07*		mg/Kg wet	3.33		92.0	40-140			
LCS (B175469-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	28.5	8.3	mg/Kg wet	33.3		85.6	40-140			
Surrogate: o-Terphenyl	*3.04*		mg/Kg wet	3.33		91.3	40-140			
LCS Dup (B175469-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17						
TPH (C9-C36)	29.6	8.3	mg/Kg wet	33.3		88.8	40-140	3.66	30	
Surrogate: o-Terphenyl	*3.15*		mg/Kg wet	3.33		94.6	40-140			

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175482 - SW-846 7471										
Blank (B175482-BLK1)				Prepared & Analyzed: 04/27/17						
Mercury	ND	0.025	mg/Kg wet							
LCS (B175482-BS1)				Prepared & Analyzed: 04/27/17						
Mercury	9.48	1.9	mg/Kg wet	9.36		101	73.7-126.3			
LCS Dup (B175482-BSD1)				Prepared & Analyzed: 04/27/17						
Mercury	9.99	1.9	mg/Kg wet	9.36		107	73.7-126.3	5.20	30	
Batch B175526 - SW-846 3050B										
Blank (B175526-BLK1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Antimony	ND	2.5	mg/Kg wet							
Arsenic	ND	2.5	mg/Kg wet							
Barium	ND	2.5	mg/Kg wet							
Beryllium	ND	0.25	mg/Kg wet							
Cadmium	ND	0.25	mg/Kg wet							
Chromium	ND	0.50	mg/Kg wet							
Lead	ND	0.75	mg/Kg wet							
Nickel	ND	0.50	mg/Kg wet							
Selenium	ND	5.0	mg/Kg wet							
Silver	ND	0.50	mg/Kg wet							
Thallium	ND	2.5	mg/Kg wet							
Vanadium	ND	1.0	mg/Kg wet							
Zinc	ND	1.0	mg/Kg wet							
LCS (B175526-BS1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Antimony	125	5.0	mg/Kg wet	88.2		142	0-210.3			
Arsenic	54.1	5.0	mg/Kg wet	57.0		95.0	77.8-122.1			
Barium	94.3	5.0	mg/Kg wet	110		85.8	82-117.4			
Beryllium	72.6	0.50	mg/Kg wet	67.5		108	82.3-117.7			
Cadmium	75.3	0.50	mg/Kg wet	77.8		96.8	81.9-118.2			
Chromium	59.2	1.0	mg/Kg wet	65.0		91.1	78.7-120.6			
Lead	76.0	1.5	mg/Kg wet	85.6		88.8	82.4-117.8			
Nickel	57.8	1.0	mg/Kg wet	61.3		94.2	82.2-117.8			
Selenium	75.1	10	mg/Kg wet	78.9		95.2	77.1-122.3			
Silver	51.2	1.0	mg/Kg wet	54.2		94.4	74.3-125.4			
Thallium	172	5.0	mg/Kg wet	178		96.9	78.2-121.6			
Vanadium	48.6	2.0	mg/Kg wet	56.3		86.3	64.8-135.2			
Zinc	182	2.0	mg/Kg wet	198		91.9	79.7-120.8			
LCS Dup (B175526-BSD1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Antimony	143	4.9	mg/Kg wet	88.2		162	0-210.3	13.3	30	
Arsenic	53.4	4.9	mg/Kg wet	57.0		93.7	77.8-122.1	1.37	30	
Barium	101	4.9	mg/Kg wet	110		91.4	82-117.4	6.40	30	
Beryllium	76.5	0.49	mg/Kg wet	67.5		113	82.3-117.7	5.21	30	
Cadmium	73.3	0.49	mg/Kg wet	77.8		94.2	81.9-118.2	2.76	30	
Chromium	59.9	0.98	mg/Kg wet	65.0		92.1	78.7-120.6	1.15	30	
Lead	74.9	1.5	mg/Kg wet	85.6		87.5	82.4-117.8	1.47	30	
Nickel	57.1	0.98	mg/Kg wet	61.3		93.2	82.2-117.8	1.15	30	
Selenium	74.5	9.8	mg/Kg wet	78.9		94.4	77.1-122.3	0.818	30	
Silver	51.2	0.98	mg/Kg wet	54.2		94.4	74.3-125.4	0.0109	30	
Thallium	171	4.9	mg/Kg wet	178		96.1	78.2-121.6	0.835	30	
Vanadium	51.1	2.0	mg/Kg wet	56.3		90.7	64.8-135.2	5.03	30	
Zinc	177	2.0	mg/Kg wet	198		89.6	79.7-120.8	2.49	30	

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175526 - SW-846 3050B										
MRL Check (B175526-MRL1)				Prepared: 04/27/17 Analyzed: 05/01/17						
Lead	0.693	0.74	mg/Kg wet	0.741		93.6	80-120			
Batch B175646 - SW-846 3050B										
Blank (B175646-BLK1)				Prepared: 04/28/17 Analyzed: 05/02/17						
Antimony	ND	2.5	mg/Kg wet							
Arsenic	ND	2.5	mg/Kg wet							
Barium	ND	2.5	mg/Kg wet							
Beryllium	ND	0.25	mg/Kg wet							
Cadmium	ND	0.25	mg/Kg wet							
Chromium	ND	0.50	mg/Kg wet							
Lead	ND	0.75	mg/Kg wet							
Nickel	ND	0.50	mg/Kg wet							
Selenium	ND	5.0	mg/Kg wet							
Silver	ND	0.50	mg/Kg wet							
Thallium	ND	2.5	mg/Kg wet							
Vanadium	ND	1.0	mg/Kg wet							
Zinc	ND	1.0	mg/Kg wet							
LCS (B175646-BS1)				Prepared: 04/28/17 Analyzed: 05/02/17						
Antimony	78.6	5.1	mg/Kg wet	88.2		89.2	0-210.3			
Arsenic	54.8	5.1	mg/Kg wet	57.0		96.2	77.8-122.1			
Barium	106	5.1	mg/Kg wet	110		96.7	82-117.4			
Beryllium	67.4	0.51	mg/Kg wet	67.5		99.9	82.3-117.7			
Cadmium	72.6	0.51	mg/Kg wet	77.8		93.3	81.9-118.2			
Chromium	59.9	1.0	mg/Kg wet	65.0		92.1	78.7-120.6			
Lead	75.4	1.5	mg/Kg wet	85.6		88.1	82.4-117.8			
Nickel	57.0	1.0	mg/Kg wet	61.3		93.0	82.2-117.8			
Selenium	77.1	10	mg/Kg wet	78.9		97.7	77.1-122.3			
Silver	50.8	1.0	mg/Kg wet	54.2		93.8	74.3-125.4			
Thallium	176	5.1	mg/Kg wet	178		98.7	78.2-121.6			
Vanadium	53.4	2.0	mg/Kg wet	56.3		94.8	64.8-135.2			
Zinc	186	2.0	mg/Kg wet	198		94.0	79.7-120.8			
LCS Dup (B175646-BSD1)				Prepared: 04/28/17 Analyzed: 05/02/17						
Antimony	71.4	4.8	mg/Kg wet	88.2		81.0	0-210.3	9.60	30	
Arsenic	52.1	4.8	mg/Kg wet	57.0		91.5	77.8-122.1	5.03	30	
Barium	95.2	4.8	mg/Kg wet	110		86.5	82-117.4	11.1	30	
Beryllium	63.4	0.48	mg/Kg wet	67.5		93.9	82.3-117.7	6.19	30	
Cadmium	68.7	0.48	mg/Kg wet	77.8		88.2	81.9-118.2	5.60	30	
Chromium	56.1	0.97	mg/Kg wet	65.0		86.2	78.7-120.6	6.62	30	
Lead	74.2	1.5	mg/Kg wet	85.6		86.7	82.4-117.8	1.66	30	
Nickel	53.4	0.97	mg/Kg wet	61.3		87.1	82.2-117.8	6.60	30	
Selenium	73.8	9.7	mg/Kg wet	78.9		93.6	77.1-122.3	4.33	30	
Silver	47.5	0.97	mg/Kg wet	54.2		87.6	74.3-125.4	6.78	30	
Thallium	166	4.8	mg/Kg wet	178		93.3	78.2-121.6	5.59	30	
Vanadium	49.7	1.9	mg/Kg wet	56.3		88.3	64.8-135.2	7.05	30	
Zinc	175	1.9	mg/Kg wet	198		88.2	79.7-120.8	6.35	30	

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175646 - SW-846 3050B										
MRL Check (B175646-MRL1)				Prepared: 04/28/17 Analyzed: 05/02/17						
Lead	0.890	0.75	mg/Kg wet	0.753		118	80-120			
Batch B175747 - SW-846 7471										
Blank (B175747-BLK1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Mercury	ND	0.025	mg/Kg wet							
LCS (B175747-BS1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Mercury	9.64	1.9	mg/Kg wet	9.36		103	73.7-126.3			
LCS Dup (B175747-BSD1)				Prepared: 05/01/17 Analyzed: 05/02/17						
Mercury	7.89	1.9	mg/Kg wet	9.36		84.3	73.7-126.3	19.9	30	

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175351 - SM2580 A										
Duplicate (B175351-DUP2)	**Source: 17D1129-05**			Prepared & Analyzed: 04/26/17						
Oxidation/Reduction Potential	145		mV		149			2.72	24.6	
Batch B175358 - SW-846 9045C										
LCS (B175358-BS1)				Prepared & Analyzed: 04/26/17						
pH	6.05		pH Units	6.00		101	98.5-110			
LCS (B175358-BS2)				Prepared & Analyzed: 04/26/17						
pH	5.95		pH Units	6.00		99.2	98.5-110			
Duplicate (B175358-DUP2)	**Source: 17D1129-05**			Prepared & Analyzed: 04/26/17						
pH	7.6		pH Units		7.9			3.86	5	
Batch B175376 - SW-846 9045C										
LCS (B175376-BS1)				Prepared & Analyzed: 04/26/17						
pH	6.05		pH Units	6.00		101	98.5-110			
Duplicate (B175376-DUP1)	**Source: 17D1129-07**			Prepared & Analyzed: 04/26/17						
pH	7.5		pH Units		7.2			3.55	5	
Batch B175501 - SW-846 7196A										
Blank (B175501-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Hexavalent Chromium	ND	0.16	mg/Kg wet							
LCS (B175501-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Hexavalent Chromium	56	1.8	mg/Kg wet	64.0		87.5	80-120			
LCS Dup (B175501-BSD1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Hexavalent Chromium	58	1.8	mg/Kg wet	63.9		91.6	80-120	4.27	20	
Batch B175566 - SW-846 9014										
Blank (B175566-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Cyanide	ND	0.40	mg/Kg							
LCS (B175566-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Cyanide	9.0	0.40	mg/Kg	10.0		90.4	85.9-110			

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B175577 - SW-846 9030A										
Blank (B175577-BLK1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Sulfide	ND	2.0	mg/Kg							
LCS (B175577-BS1)				Prepared: 04/27/17 Analyzed: 04/28/17						
Reactive Sulfide	13	2.0	mg/Kg	14.8		86.5	64.5-120			
Batch B175829 - SM21-22 2510B Modified										
Blank (B175829-BLK1)				Prepared & Analyzed: 05/02/17						
Specific conductance	ND	2.0	µmhos/cm							
LCS (B175829-BS2)				Prepared & Analyzed: 05/02/17						
Specific conductance	230	2.0	µmhos/cm	234		97.0	89.2-110			
Duplicate (B175829-DUP1)	**Source: 17D1129-07**			Prepared & Analyzed: 05/02/17						
Specific conductance	14	2.0	µmhos/cm		16			10.3	15.2	

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS

Lab Sample ID: B175466-BS1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.19	5.4

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS Dup

Lab Sample ID: B175466-BSD1 Date(s) Analyzed 04/30/2017 04/30/2017

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	0.000	0.000	0.20	
	2	0.000	0.000	0.000	0.21	4.9
Aroclor-1260	1	0.000	0.000	0.000	0.18	
	2	0.000	0.000	0.000	0.20	10.5

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
ND	Not Detected
RL	Reporting Limit
DL	Method Detection Limit
MCL	Maximum Contaminant Level
	Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.
	No results have been blank subtracted unless specified in the case narrative section.
DL-03	Elevated reporting limit due to matrix.
L-04	Laboratory fortified blank/laboratory control sample recovery and duplicate recovery are outside of control limits. Reported value for this compound is likely to be biased on the low side.
L-07	Either laboratory fortified blank/laboratory control sample or duplicate recovery is outside of control limits, but the other is within limits. RPD between the two LFB/LCS results is within method specified criteria.
L-14	Compound classified by MA CAM as difficult with acceptable recoveries of 40-160%. Recovery does not meet 70-130% criteria but does meet difficult compound criteria.
O-32	A dilution was performed as part of the standard analytical procedure.
V-05	Continuing calibration did not meet method specifications and was biased on the low side for this compound. Increased uncertainty is associated with the reported value which is likely to be biased on the low side.
V-16	Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.
V-20	Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.
W-06	Elevated method reporting limit due to intense color of sample

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 1030 in Soil	
Ignitability	NY,NH,CT,NC,ME,VA
SW-846 6010C-D in Soil	
Antimony	CT,NH,NY,ME,VA,NC
Arsenic	CT,NH,NY,ME,VA,NC
Barium	CT,NH,NY,ME,VA,NC
Beryllium	CT,NH,NY,ME,VA,NC
Cadmium	CT,NH,NY,ME,VA,NC
Chromium	CT,NH,NY,ME,VA,NC
Lead	CT,NH,NY,AIHA,ME,VA,NC
Nickel	CT,NH,NY,ME,VA,NC
Selenium	CT,NH,NY,ME,VA,NC
Silver	CT,NH,NY,ME,VA,NC
Thallium	CT,NH,NY,ME,VA,NC
Vanadium	CT,NH,NY,ME,VA,NC
Zinc	CT,NH,NY,ME,VA,NC
SW-846 7196A in Soil	
Hexavalent Chromium	NY,CT,NH,NC,ME,VA
SW-846 7471B in Soil	
Mercury	CT,NH,NY,NC,ME,VA
SW-846 8082A in Soil	
Aroclor-1016	CT,NH,NY,NC,ME,VA
Aroclor-1016 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1221	CT,NH,NY,NC,ME,VA
Aroclor-1221 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1232	CT,NH,NY,NC,ME,VA
Aroclor-1232 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1242	CT,NH,NY,NC,ME,VA
Aroclor-1242 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1248	CT,NH,NY,NC,ME,VA
Aroclor-1248 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1254	CT,NH,NY,NC,ME,VA
Aroclor-1254 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1260	CT,NH,NY,NC,ME,VA
Aroclor-1260 [2C]	CT,NH,NY,NC,ME,VA
Aroclor-1262	NH,NY,NC,ME,VA
Aroclor-1262 [2C]	NH,NY,NC,ME,VA
Aroclor-1268	NH,NY,NC,ME,VA
Aroclor-1268 [2C]	NH,NY,NC,ME,VA
SW-846 8260C in Soil	
Acetone	CT,NH,NY,ME
Benzene	CT,NH,NY,ME
Bromobenzene	NH,NY,ME
Bromochloromethane	NH,NY,ME
Bromodichloromethane	CT,NH,NY,ME
Bromoform	CT,NH,NY,ME

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
Bromomethane	CT,NH,NY,ME
2-Butanone (MEK)	CT,NH,NY,ME
n-Butylbenzene	CT,NH,NY,ME
sec-Butylbenzene	CT,NH,NY,ME
tert-Butylbenzene	CT,NH,NY,ME
Carbon Disulfide	CT,NH,NY,ME
Carbon Tetrachloride	CT,NH,NY,ME
Chlorobenzene	CT,NH,NY,ME
Chlorodibromomethane	CT,NH,NY,ME
Chloroethane	CT,NH,NY,ME
Chloroform	CT,NH,NY,ME
Chloromethane	CT,NH,NY,ME
2-Chlorotoluene	CT,NH,NY,ME
4-Chlorotoluene	CT,NH,NY,ME
Dibromomethane	NH,NY,ME
1,2-Dichlorobenzene	CT,NH,NY,ME
1,3-Dichlorobenzene	CT,NH,NY,ME
1,4-Dichlorobenzene	CT,NH,NY,ME
Dichlorodifluoromethane (Freon 12)	NY,ME
1,1-Dichloroethane	CT,NH,NY,ME
1,2-Dichloroethane	CT,NH,NY,ME
1,1-Dichloroethylene	CT,NH,NY,ME
cis-1,2-Dichloroethylene	CT,NH,NY,ME
trans-1,2-Dichloroethylene	CT,NH,NY,ME
1,2-Dichloropropane	CT,NH,NY,ME
1,3-Dichloropropane	NH,NY,ME
2,2-Dichloropropane	NH,NY,ME
1,1-Dichloropropene	NH,NY,ME
cis-1,3-Dichloropropene	CT,NH,NY,ME
trans-1,3-Dichloropropene	CT,NH,NY,ME
1,4-Dioxane	NY
Ethylbenzene	CT,NH,NY,ME
Hexachlorobutadiene	NH,NY,ME
2-Hexanone (MBK)	CT,NH,NY,ME
Isopropylbenzene (Cumene)	CT,NH,NY,ME
p-Isopropyltoluene (p-Cymene)	NH,NY
Methyl tert-Butyl Ether (MTBE)	NH,NY
Methylene Chloride	CT,NH,NY,ME
4-Methyl-2-pentanone (MIBK)	CT,NH,NY
Naphthalene	NH,NY,ME
n-Propylbenzene	NH,NY
Styrene	CT,NH,NY,ME
1,1,1,2-Tetrachloroethane	CT,NH,NY,ME
1,1,2,2-Tetrachloroethane	CT,NH,NY,ME
Tetrachloroethylene	CT,NH,NY,ME
Toluene	CT,NH,NY,ME
1,2,3-Trichlorobenzene	NY

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
1,2,4-Trichlorobenzene	NH,NY,ME
1,1,1-Trichloroethane	CT,NH,NY,ME
1,1,2-Trichloroethane	CT,NH,NY,ME
Trichloroethylene	CT,NH,NY,ME
Trichlorofluoromethane (Freon 11)	CT,NH,NY,ME
1,2,3-Trichloropropane	NH,NY,ME
1,2,4-Trimethylbenzene	CT,NH,NY,ME
1,3,5-Trimethylbenzene	CT,NH,NY,ME
Vinyl Chloride	CT,NH,NY,ME
m+p Xylene	CT,NH,NY,ME
o-Xylene	CT,NH,NY,ME
SW-846 8270D in Soil	
Acenaphthene	CT,NY,NH,ME,NC,VA
Acenaphthene	CT,NY,NH
Acenaphthylene	CT,NY,NH,ME,NC,VA
Acenaphthylene	CT,NY,NH
Acetophenone	NY,NH
Aniline	NY,NH
Anthracene	CT,NY,NH
Anthracene	CT,NY,NH,ME,NC,VA
Benzo(a)anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH,ME,NC,VA
Benzo(a)pyrene	CT,NY,NH,ME,NC,VA
Benzo(a)pyrene	CT,NY,NH
Benzo(b)fluoranthene	CT,NY,NH,ME,NC,VA
Benzo(b)fluoranthene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH,ME,NC,VA
Benzo(k)fluoranthene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH,ME,NC,VA
Bis(2-chloroethoxy)methane	CT,NY,NH
Bis(2-chloroethyl)ether	CT,NY,NH
Bis(2-chloroisopropyl)ether	CT,NY,NH
Bis(2-Ethylhexyl)phthalate	CT,NY,NH
4-Bromophenylphenylether	CT,NY,NH
Butylbenzylphthalate	CT,NY,NH
4-Chloroaniline	CT,NY,NH
2-Chloronaphthalene	CT,NY,NH
2-Chlorophenol	CT,NY,NH
Chrysene	CT,NY,NH
Chrysene	CT,NY,NH,ME,NC,VA
Dibenz(a,h)anthracene	CT,NY,NH
Dibenz(a,h)anthracene	CT,NY,NH,ME,NC,VA
Dibenzofuran	CT,NY,NH
Di-n-butylphthalate	CT,NY,NH
1,2-Dichlorobenzene	NY,NH

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8270D in Soil	
1,3-Dichlorobenzene	NY,NH
1,4-Dichlorobenzene	NY,NH
3,3-Dichlorobenzidine	CT,NY,NH
2,4-Dichlorophenol	CT,NY,NH
Diethylphthalate	CT,NY,NH
2,4-Dimethylphenol	CT,NY,NH
Dimethylphthalate	CT,NY,NH
2,4-Dinitrophenol	CT,NY,NH
2,4-Dinitrotoluene	CT,NY,NH
2,6-Dinitrotoluene	CT,NY,NH
Di-n-octylphthalate	CT,NY,NH
1,2-Diphenylhydrazine (as Azobenzene)	NY,NH
Fluoranthene	CT,NY,NH
Fluoranthene	CT,NY,NH,ME,NC,VA
Fluorene	CT,NY,NH,ME,NC,VA
Fluorene	NY,NH
Hexachlorobenzene	CT,NY,NH
Hexachlorobutadiene	CT,NY,NH
Hexachloroethane	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH,ME,NC,VA
Isophorone	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH,ME,NC,VA
2-Methylphenol	CT,NY,NH
3/4-Methylphenol	CT,NY,NH
Naphthalene	CT,NY,NH,ME,NC,VA
Naphthalene	CT,NY,NH
Nitrobenzene	CT,NY,NH
2-Nitrophenol	CT,NY,NH
4-Nitrophenol	CT,NY,NH
Pentachlorophenol	CT,NY,NH
Phenanthrene	CT,NY,NH,ME,NC,VA
Phenanthrene	CT,NY,NH
Phenol	CT,NY,NH
Pyrene	CT,NY,NH
Pyrene	CT,NY,NH,ME,NC,VA
1,2,4-Trichlorobenzene	CT,NY,NH
2,4,5-Trichlorophenol	CT,NY,NH
2,4,6-Trichlorophenol	CT,NY,NH

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The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC - ISO17025:2005	100033	02/1/2018
MA	Massachusetts DEP	M-MA100	06/30/2017
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2017
NY	New York State Department of Health	10899 NELAP	04/1/2018
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2018
RI	Rhode Island Department of Health	LAO00112	12/30/2017
NC	North Carolina Div. of Water Quality	652	12/31/2017
NJ	New Jersey DEP	MA007 NELAP	06/30/2017
FL	Florida Department of Health	E871027 NELAP	06/30/2017
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2017
ME	State of Maine	2011028	06/9/2017
VA	Commonwealth of Virginia	460217	12/14/2017
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2017

con-test® ANALYTICAL LABORATORY
Phone: 413-525-2332
Fax: 413-525-6405
Email: info@contestlabs.com
www.contestlabs.com
39 Spruce Street
East longmeadow, MA 01028

CHAIN OF CUSTODY RECORD

17D1129

Rev 04.05.12

Company Name: Weston + Sampson
Address: 5 Centennial Drive
Peabody, MA
Attention: Joe Spencer
Project Location: 21 Galler St
Sampled By: Taylor Smith

Telephone: 978-532-1900
Project #: 2160299
Client PO#:

DATA DELIVERY (check all that apply)
○ FAX ☒ EMAIL ○ WEBSITE
Fax #:
Email: JSpencer@WSEinc.com
Format: ○ PDF ☒ EXCEL ○ GIS
○ OTHER
○ "Enhanced Data Package"

Project Proposal Provided? (for billing purposes)
○ yes _____ proposal date

Con-Test Lab ID (laboratory use only)	Client Sample ID / Description	Collection Beginning Date/Time	Collection Ending Date/Time	Composite	Grab	*Matrix Code	Conc Code	MCP-14	VOCs	Hexavalent Chromium	D3 Base Characterization
1	SP-1 (0-1)	Date 4/25	1300		X	S		X		X	
2	SP-1 (2-5)		1305		X			X		X	
3	SP-2 (0-1)		1350		X			X		X	
4	SP-2 (2-5)		1400		X			X		X	
5	SP-3 (0-1)		1415		X			X		X	
6	SP-3 (2-5)		1420		X			X		X	
7	D3P. Characterization		1425	X					X		X

Disposal list=RCRA-8 metals, 8082, 8270, 8260, 8100, pH, conductivity, reactivity & ignitability. Also run PAHs on samples -01 through -06 per Joe S - MEK 4/26/17

21 Galler St

ANALYSIS REQUESTED

# of Containers	6 3 4
** Preservation	H V A
***Container Code	A V A

Dissolved Metals
○ Field Filtered
○ Lab to Filter

***Cont. Code:
A=amber glass
G=glass
P=plastic
ST=sterile
V=vial
S=summa can
T=tedlar bag
O=Other

**Preservation
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium bisulfate
X = Na hydroxide
T = Na thiosulfate
O = Other _____

*Matrix Code:
GW = groundwater
WW = wastewater
DW = drinking water
A = air
S = soil/solid
SL = sludge
O = other _____

Please use the following codes to let Con-Test know if a specific sample may be high in concentration in Matrix/Conc. Code Box:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

Relinquished by: (signature)		Date/Time: 4/25
Received by: (signature)		Date/Time: 4:40
Relinquished by: (signature)		Date/Time: 17:20
Received by: (signature)		Date/Time: 1720

Turnaround ††
☐ 7-Day
☐ 10-Day
☒ Other 5 day
RUSH †
☐ †24-Hr ☐ †48-Hr
☐ †72-Hr ☐ †4-Day
† Require lab approval

Detection Limit Requirements
Massachusetts: MCP + D3p Char.
Connecticut:
Other:

Is your project MCP or RCP ?
☒ MCP Form Required
○ RCP Form Required
○ MA State DW Form Required PWSID # _____

NELAC & AIHA-LAP, LLC Accredited
WBE/DBE Certified

TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR INCORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

PLEASE BE CAREFUL NOT TO CONTAMINATE THIS DOCUMENT

Table of Contents

39 Spruce St.
East Longmeadow, MA 01028
P: 413-525-2332
F: 413-525-6405
www.contestlabs.com

con-test ANALYTICAL LABORATORY

Table of Contents

Sample Receipt Checklist

CLIENT NAME: Weston & Sampson **RECEIVED BY:** JM **DATE:** 4/25/17

1) **Was the chain(s) of custody relinquished and signed?** Yes X No ____ No COC Incl.

2) **Does the chain agree with the samples?** Yes X No ____
If not, explain:

3) **Are all the samples in good condition?** Yes X No ____
If not, explain:

4) **How were the samples received:**

On Ice X Direct from Sampling ____ Ambient ____ In Cooler(s) X

Were the samples received in Temperature Compliance of (2-6°C)? Yes X No ____ N/A ____

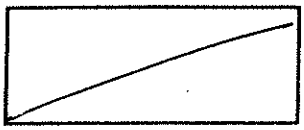
Temperature °C by Temp blank ____ # ____ Temperature °C by Temp gun 5.1 # 7

5) **Are there Dissolved samples for the lab to filter?** Yes ____ No X

Who was notified ____ Date ____ Time ____

6) **Are there any RUSH or SHORT HOLDING TIME samples?** Yes X No ____

Who was notified ____ Date ____ Time ____

7) **Location where samples are stored:** 

Permission to subcontract samples? Yes No
(Walk-in clients only) if not already approved
Client Signature: ____

8) **Do all samples have the proper Acid pH:** Yes ____ No ____ N/A X

9) **Do all samples have the proper Base pH:** Yes ____ No ____ N/A X

10) **Was the PC notified of any discrepancies with the CoC vs the samples:** Yes ____ N/A X

Containers received at Con-Test

	# of containers		# of containers
1 Liter Amber		16 oz amber	
500 mL Amber		8 oz amber/clear jar	7
250 mL Amber (8oz amber)		4 oz amber/clear jar	6
1 Liter Plastic		2 oz amber/clear jar	
500 mL Plastic		Plastic Bag / Ziploc	
250 mL plastic		SOC Kit	
40 mL Vial - type listed below	3	Perchlorate Kit	
Colisure / bacteria bottle		Flashpoint bottle	
Dissolved Oxygen bottle		Other glass jar	
Encore		Other	

40 mL vials: # HCl ____ # Methanol 1

Bisulfate 2 # DI Water ____

Thiosulfate ____ Unpreserved ____

Time and Date Frozen:

Login Sample Receipt Checklist

(Rejection Criteria Listing - Using Sample Acceptance Policy)

Any False statement will be brought to the attention of Client

Question	Answer (True/False) T/F/NA	Comment
1) The cooler's custody seal, if present, is intact.	NA	
2) The cooler or samples do not appear to have been compromised or tampered with.	T	
3) Samples were received on ice.	T	
4) Cooler Temperature is acceptable.	T	
5) Cooler Temperature is recorded.	T	
6) COC is filled out in ink and legible.	T	
7) COC is filled out with all pertinent information.	T	
8) Field Sampler's name present on COC.	T	
9) There are no discrepancies between the sample IDs on the container and the COC.	T	
10) Samples are received within Holding Time.	T	
11) Sample containers have legible labels.	T	
12) Containers are not broken or leaking.	T	
13) Air Cassettes are not broken/open.	NA	
14) Sample collection date/times are provided.	T	
15) Appropriate sample containers are used.	T	
16) Proper collection media used.	T	
17) No headspace sample bottles are completely filled.	NA	
18) There is sufficient volume for all requsted analyses, including any requested MS/MSDs.	T	
19) Trip blanks provided if applicable.	NA	
20) VOA sample vials do not have head space or bubble is <6mm (1/4") in diameter.	NA	
21) Samples do not require splitting or compositing.	T	

Who notified of False statements? **Date/Time:**

Doc #277 Rev. 4 August 2013 **Log-In Technician Initials:** SM **Date/Time:** 4/25/17 1920

MADEP MCP Analytical Method Report Certification Form

Laboratory Name: Con-Test Analytical Laboratory	Project #: 17D1129
Project Location: 21 Caller St.	RTN:

This Form provides certifications for the following data set: [list Laboratory Sample ID Number(s)]

17D1129-01 thru 17D1129-07

Matrices: Soil

CAM Protocol (check all that below)

8260 VOC CAM II A (X)	7470/7471 Hg CAM IIIB (X)	MassDEP VPH CAM IV A ( )	8081 Pesticides CAM V B ( )	7196 Hex Cr CAM VI B (X)	MassDEP APH CAM IX A ( )
8270 SVOC CAM II B (X)	7010 Metals CAM III C ( )	MassDEP EPH CAM IV A ( )	8151 Herbicides CAM V C ( )	8330 Explosives CAM VIII A ( )	TO-15 VOC CAM IX B ( )
6010 Metals CAM III A (X)	6020 Metals CAM III D ( )	8082 PCB CAM V A (X)	9014 Total Cyanide/PAC CAM VI A ( )	6860 Perchlorate CAM VIII B ( )	

Affirmative response to Questions A throughF is required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☑ Yes	☐ No[1]
B	Were the analytical method(s) and all associated QC requirements specificed in the selected CAM protocol(s) followed?	☑ Yes	☐ No[1]
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☑ Yes	☐ No[1]
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, Quality Assurance and Quality Control Guidlines for the Acquisition and Reporting of Analytical Data?	☑ Yes	☐ No[1]
E a	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	☐ Yes	☐ No[1]
E b	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes	☐ No[1]
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all No responses to Qestions A through E)?	☑ Yes	☐ No[1]

A response to questions G, H and I below is required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☑ Yes	☐ No[1]

<u>Data User Note:</u> Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were all QC perfomance standards specified in the CAM protocol(s) achieved?	☐ Yes	☑ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes	☑ No[1]

[1] *All Negative responses must be addressed in an attached Environmental Laboratory case narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:  Position: Project Manager

Printed Name: Lisa A. Worthington Date: 05/03/17

Weston & Sampson

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

June 13, 2017

Mr. Brendan Callahan
Department of Community Development and Planning
24 Lowell Street
Peabody, Massachusetts 01960

Re: Limited Subsurface Site Investigation
North River Corridor Riverwalk
24 Caller Street
Peabody, Massachusetts

Dear Mr. Callahan:

Weston & Sampson is pleased to submit this Limited Subsurface Site Investigation Letter Report for the portion of 24 Caller Street located adjacent to the North River Canal in Peabody, Massachusetts. Specifically, this assessment evaluated an approximate 10-foot wide strip of land abutting the south side of the North River in Peabody, Massachusetts (the Site). The assessment was performed as part of a multi-parcel limited assessment in support of the proposed Riverwalk project along the North River Corridor. Weston & Sampson performed the following tasks as part of the Limited Subsurface Site Investigation:

- Site reconnaissance and review of previous investigations conducted at the Site;
- Soil boring advancement; and,
- Soil sampling and analysis.

See attached Figures 1 and 2 for a Site Locus Map and a Site Plan (with soil sampling locations), respectively.

SITE BACKGROUND

In support of the City of Peabody's (the City's) desire to construct a Riverwalk along the North River Corridor, the City is evaluating potential property acquisition and/or easement takings at selected properties along the corridor. Specifically, the City is interested in purchasing the property located at 24 Caller Street (Parcel ID 086-142A). The property has a documented history of environmental releases and was regulated under the Massachusetts Contingency Plan (MCP). In 2000, 24 Caller Street [Release Tracking Number (RTN) 3-18180] was closed under the MCP with an Activity and Use Limitation (AUL) [i.e., an A-3 Response Action Outcome (RAO) and AUL].

The AUL is located on the northwestern portion of the parcel and is approximately 15,000 square feet of the 42,776-square feet total parcel area. The AUL restricts any activity including, but not limited to excavation, which is likely to disturb contaminated soil located at 1 to 8 feet below grade. Residential use and any other use at which a child's presence is likely [i.e., an educational facility/school (with the exception of adult education), a daycare/nursery, a recreational facility (such as a park or athletic fields, etc.)] is also prohibited. The portion of the 24 Caller Street parcel that the City is interested in redeveloping into the Riverwalk is within the AUL area.

No files are available on-line from Massachusetts Department of Environmental Protection (MassDEP) for RTN 3-18180. A copy of the RAO Statement for the 24 Caller Street property (RTN 3-18180), dated August 4, 2000, was provided by the City. The RAO report is incomplete and did not include relevant data tables, appendices and/or referenced historical reports. A file review was therefore completed at the MassDEP for RTN 3-18180 on December 8, 2016. Contaminants of concern include metals (lead / chromium / cadmium / arsenic), polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs), and to a lesser extent polychlorinated biphenyls (PCBs). In addition, the site file for RTN 3-18180 indicated that a historic 'landfill' was identified in the northeast portion of parcel.

Given that the property has continued to operate as a barrel reconditioner in the 17 years since regulatory closure and the data gaps from the previous RAO, a Limited Subsurface Site Investigation was conducted to evaluate the

quality of the surficial and near surficial soils. The investigation was confined to the area of the proposed Riverwalk only.

SUBSURFACE INVESTIGATION

Weston & Sampson performed a subsurface investigation at the Site on February 15, 2017 and April 27, 2017. The investigation included the advancement of five (5) soil borings and analysis of eleven (11) soil samples.

A detailed summary of the investigation is provided below. See Figure 2 for sampling locations. A summary of laboratory analytical results is provided in Table 1.

Soil Boring Advancement

On February 15, 2017, Weston & Sampson oversaw the advancement of five (5) soil borings (SB-1 through SB-5) at the Site. The borings were advanced by New England Geotech, LLC, of Jamestown, Rhode Island, to depths of 4.5 to 5 feet below ground surface (bgs) using direct-push methods. In the case of SB-1 and SB-2, a track-mounted hydraulic drill rig was used to advance each boring, while an electric hammer was used to advance borings SB-3 through SB-5. Boring locations were selected by Weston & Sampson based on documented historical Site use and a review of previous Site investigations, and were spatially distributed to obtain a representative evaluation of the conditions of the proposed Riverwalk area.

Soil Sampling and Analysis

A Weston & Sampson geologist screened each soil boring at continuous depth intervals and logged soil descriptions using a modified Burmeister Soil Classification System. Each sample was field-screened for visual and olfactory evidence of impacts, as well as volatile organic compounds (VOCs) using a photoionization detector (PID) in accordance with the MassDEP jar headspace screening method. Field screening results are included in the soil boring logs Attachment A.

Two (2) soil samples from each boring (one sample at the 0-1 foot or 0-2 foot interval, and one sample at the 2-4.5 foot or 2-5 foot interval) were submitted to Con-Test Analytical Laboratory of East Longmeadow, Massachusetts (Con-Test) for analysis of MCP 14 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, nickel, lead, mercury, selenium, silver, thallium, vanadium, and zinc) and PAHs. One sample, SB-3 (2-4.5) was analyzed for VOCs due to a slightly elevated jar headspace screening concentration and olfactory evidence of petroleum impacts. Discrepancies in sampling intervals was due to boring refusal or the necessity to collect a sufficient volume of soil to support the analyses selected.

Weston & Sampson also composited soil from all five (5) soil boring locations, and submitted the composite sample (Comp-1) for analysis of typical disposal characterization parameters. The disposal characterization was conducted in accordance with the Massachusetts Department of Environmental Protection (DEP) Policy # COMM-97-001: Reuse and Disposal of Contaminated Soil in Massachusetts and included the following analyses: total petroleum hydrocarbons (TPH); Resource Conservation and Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver); semi-volatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); pH; ignitability; specific conductivity; and reactivity. The sample was later analyzed for Toxicity Characteristic Leaching Procedure (TCLP) arsenic, chromium, and lead analysis due to the concentration of those metal analytes were above the theoretical RCRA “Rule of 20.”

On April 27, 2017, Weston & Sampson returned to the Site to collect a sample at 0-1 feet bgs from the location of sample SB-2. The sample was analyzed for hexavalent chromium, due to the high concentrations of total chromium that were detected in the original surficial soil sample collected at that location on February 15, 2017.

SUBSURFACE INVESTIGATION RESULTS

In general, the following shallow geologic conditions were encountered during the subsurface soil investigation program:

Fill Material: Light brown to dark brown fine to coarse sand matrix containing variable amounts of coal fragments, ash, brick, concrete, suspected lime, and metal. Note the borings were not advanced deeper than five (5) feet below ground surface.

Bedrock was not encountered during the investigation.

Field Screening Results

As shown in the attached boring logs, PID field screening of soil samples collected from soil borings SB-1, SB-2, SB-4, and SB-5 did not identify detectable VOCs. The PID field screening of the soil sample collected from SB-3 from 2-5 feet bgs showed VOCs at a headspace concentration of 4.8 parts per million by volume (ppmv). Soil boring logs are included in Attachment A.

Soil Analytical Results

As shown in Table 1, analysis of soil samples identified concentrations of metals and benzo(a)pyrene above applicable MCP Method 1 S-1/GW-2 and S-1/GW-3 standards. The following is a summary of the exceedances identified:

- Antimony was identified at concentrations exceeding the applicable Method 1 standards in samples SB-2 (0-1), SB-3 (0-2), and SB-5 (2-5).
- Arsenic was identified at concentrations exceeding the applicable Method 1 standards in samples SB-1 (2-5), SB-5 (0-2), and SB-5 (2-5).
- Unspeciated chromium was identified at concentrations exceeding the applicable Method 1 standards in samples SB-2 (0-1), SB-4 (0-2), SB-4 (2-4.5), SB-5 (0-2), and SB-5 (2-5). Further speciation by Weston & Sampson showed the chromium detected in SB-2 (0-1) was the less toxic trivalent species.
- Lead was identified at concentrations exceeding the applicable Method 1 standards in samples SB-1 (0-1), SB-2 (0-1), SB-2 (2-5), SB-3 (0-2), SB-3 (2-4.5), SB-4 (0-2), SB-4 (2-4.5), and SB-5 (0-2).
- Zinc was identified at concentrations exceeding the applicable Method 1 standards in samples SB-1 (2-5) and SB-5 (0-2).
- Benzo(a)pyrene was identified at concentrations exceeding the applicable Method 1 standards in samples SB-1 (0-1), SB-3 (2-4.5), SB-4 (0-2), and SB-5 (0-2).

No other analytes were detected in excess of the applicable Method 1 standards in SB-1 through SB-5.

It should be noted that, at the time of sampling, Weston & Sampson evaluated the need to perform an Imminent Hazard (IH) investigation in accordance with the MCP at 310 CMR 40.0426. Weston & Sampson determined that an IH investigation was not necessary because access to the Site is restricted to employees of Clark Barrel.

The results of the disposal characterization analyses are presented in Table 2. The results were compared to the COMM-97-001 requirements for reuse at Massachusetts lined and unlined landfills. As shown in Table 2, soil analytical results indicate that arsenic, chromium, and lead are present at concentrations exceeding the RCS-1 thresholds; therefore, the soil is considered Contaminated Media under the MCP, and will be classified as Remediation Waste if transported off-Site. The results for the TCLP analysis indicate that arsenic, chromium, and lead are not leachable and therefore would not constitute a “hazardous waste” as defined RCRA. The arsenic concentration of 190 mg/kg exceeds the COMM-97-001 Reuse level for In-State Lined and Unlined Landfills; therefore, the material cannot be disposed of at an In-State Landfill.

CONCLUSIONS & COST ESTIMATES

In summary, the data is generally consistent with the limited findings presented in the RAO report for RTN 3-18180. Based on the data collected, no new reportable conditions under the MCP were encountered. Because the Site is fenced with limited access, no IH condition was discovered. However, the concentrations indicate that:

- In general, contaminants in the 0-2 feet bgs depth interval tend to be greater than the concentrations of contaminants in soils in the 2-5 ft bgs depth interval;
- Excavation will require soil management under the MCP;
- The contaminated media (soil) will require disposal at an appropriate facility and documentation by a Licensed Site Professional (LSP); and
- The soil did not fail the leachability test and does not require disposal at a RCRA facility.

Future Site use for the Riverwalk trail will have a different exposure scenario than current site conditions, therefore a Method 3 Risk Characterization for the proposed Riverwalk (i.e. easement) area will need to evaluate risks under the new conditions and with new (i.e., post-construction) exposure point concentrations. Specifically, recreational use (such as a park or athletic fields) and/or any other use at which a child's presence is likely, are currently prohibited at the Site, in accordance with the AUL. Likewise, any activity including, but not limited to, excavation which is likely to disturb contaminated soil located at 1 to 8 feet bgs associated with underground utility and/or construction work, without prior development and implementation of a Soil Management Plan (SMP) and a Health and Safety Plan (HASP) is also prohibited. The contaminated soil located at 1 to 8 feet below surface grade must remain at depth and may not be relocated, unless such activity is first evaluated by a Licensed Site Professional (LSP) who renders an Opinion which states that such activity poses no greater risk of harm to health, safety, public welfare, or the environment and ensures that a condition of No Significant Risk is maintained.

In summary, to construct the Riverwalk, soils will likely be excavated and disposed of at a licensed facility. Following removal of impacted fill, soil sampling will be required to evaluate remaining conditions and associated risk. Clean fill will be used to construct the Riverwalk pathways. A new risk characterization will be required for the Riverwalk area. A geotextile membrane barrier may also be required to separate impacted fill as part of the risk management strategy. A separate Activity and Use Limitation (AUL) may also be required to document and manage site risks along the Riverwalk corridor area.

Assuming only the Riverwalk portion of the property were to be obtained through an easement, potential obligations to the City to construct a river walk along the corridor at the 24 Caller Street Property may include the following:

- MCP compliance costs for soil disturbance / construction activities ~ $40,000
  - Release Abatement Measure Plan (RAM) Plan, including HASP & SMP
  - RAM Status Report
  - Method 3 Risk Assessment for Riverwalk Area
  - Revised PSS and AUL for Riverwalk Area (and associated land survey)
  - RAM Completion Report
  - Soil Management & Bills of Lading (BOLs)
- Construction Specifications ~ $5,000
- Construction Administration, Coordination & Oversight ~ $5,000
- Soil removal and out-of-state disposal of approximately 600 tons (assumed to be an area measuring 525 feet long by 10 feet wide and a depth of 2 feet) of impacted soil from the Riverwalk ~ $60,000

Estimated TOTAL = $110,000* (not including permitting or associated Riverwalk construction costs).

*Note: Given the existing condition of the canal wall along the 24 Caller Street property, further structural evaluations may conclude that additional soils require removal as part of wall repair alternatives.

If the City is interested in purchasing the entire 24 Caller Street parcel, a comprehensive Phase I/II Environmental Site Assessment (ESA) is recommended prior to the City taking title to the property in order to: 1) address data gaps; 2) to support the proposed reuse and evaluate exposure risks under non-industrial/commercial use; 3) to provide liability protection to the City; and 4) to evaluate regulatory obligations and costs to proceed with

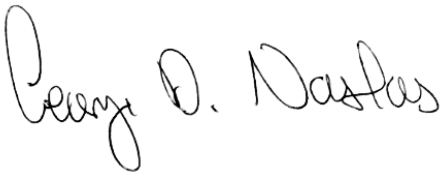
redevelopment and the river walk. As detailed above, the RAO report for RTN 3-18180 was incomplete and did not include copies of relevant data / tables, appendices and/or referenced previous reports. Based upon our review, several data gaps exist at the property based upon the lack of information provided in the RAO report as well as the lack of any recent data relevant to the existing conditions at parcel based upon the barrel reclamation operations that have continued to be conducted at property since 2000.

Estimated Phase I/II ESA cost = ~ $60K (Phase I/II ESA with Hazardous Building Materials Assessment; not including any potential regulatory submittals)

We look forward to discussing these findings with you in greater detail and working with the City to make your visions for the Riverwalk a reality. If you have any comments or questions, please contact us at 978-532-1900.

Very truly yours,

WESTON & SAMPSON ENGINEERS, INC.



Attachments: Figures
Tables
Attachment A

O:\Peabody MA\North River Corridor Due Diligence\21& 24 Caller St\Limited Subsurface Investigations\24 Caller\Summary Letter\Site Investigation Summary.docx

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

FIGURES



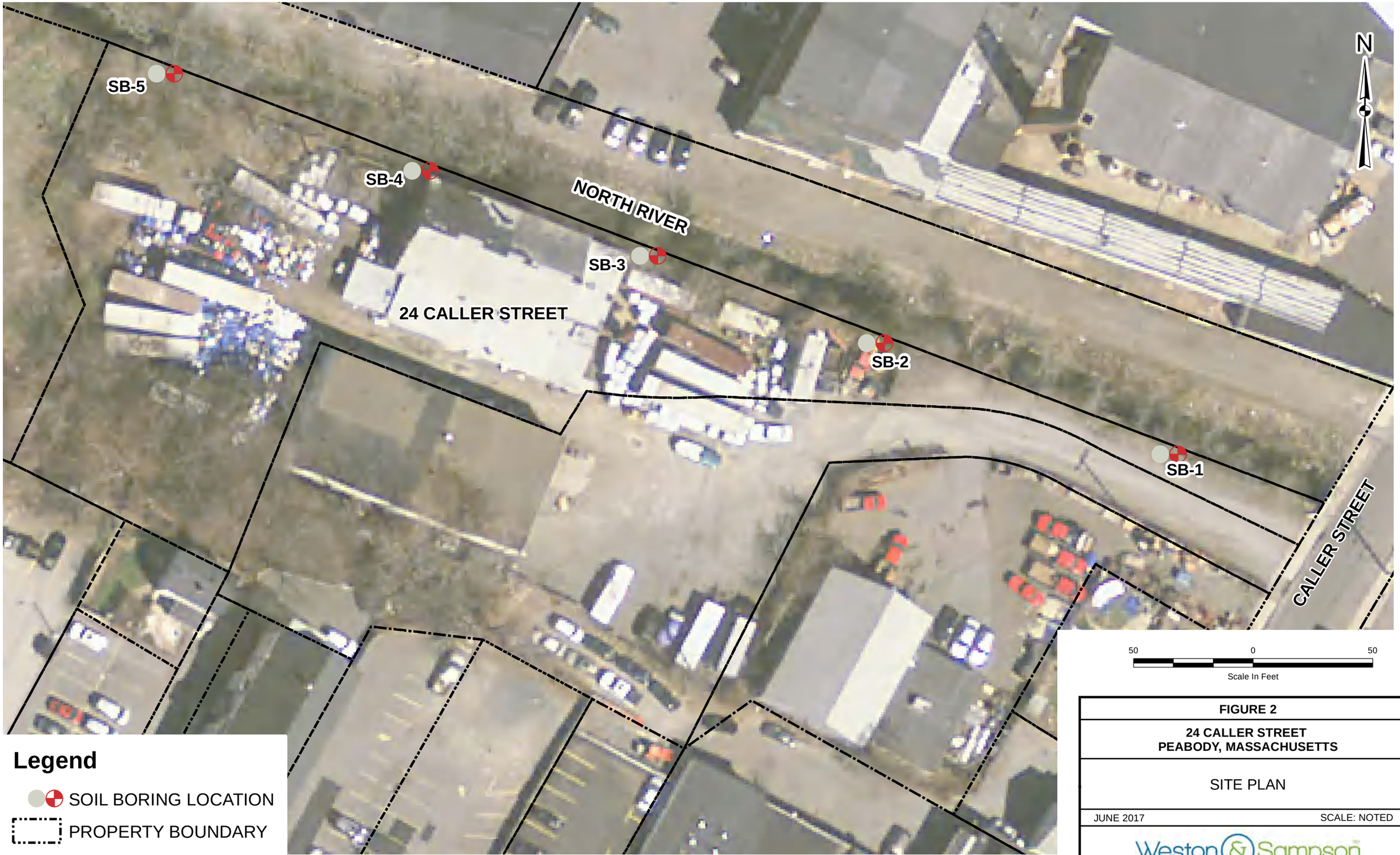
FIGURE 1
24 CALLER STREET
PEABODY, MASSACHUSETTS

LOCUS MAP

0 2,000 4,000 **Feet**

Weston & Sampson

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Legend

- SOIL BORING LOCATION
- PROPERTY BOUNDARY

FIGURE 2

24 CALLER STREET
PEABODY, MASSACHUSETTS

SITE PLAN

JUNE 2017 SCALE: NOTED

Weston & Sampson

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5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

TABLES

Table 1
Summary of Laboratory Analytical Results - Soil Borings
24 Caller Street
Peabody, Massachusetts

Parameter	Units	Reportable Concentrations	Method 1 Cleanup Standards[1]									
		RCS-1	S-1/GW-2	S-1/GW-3	SB-1 (0-1)	SB-1 (2-5)	SB-2 (0-1)	SB-2 (2-5)	SB-3 (0-2)	SB-3 (2-4.5)	SB-4 (0-2)	SB-4 (2-4.5)	SB-5 (0-2)	SB-5 (2-5)
					0-1 Feet	2-5 Feet	0-1 Feet	2-5 Feet	0-2 Feet	2-4.5 Feet	0-2 Feet	2-4.5 Feet	0-2 Feet	2-5 Feet
					2/15/2017	2/15/2017	2/15/2017 & 4/27/2017	2/15/2017	2/15/2017	2/15/2017	2/15/2017	2/15/2017	2/15/2017	2/15/2017
Metals														
ANTIMONY	mg/kg	20	20	20	<3.1	**4.5**	**22**	<2.8	**29**	**3**	**3.9**	**11**	**14**	**24**
ARSENIC	mg/kg	20	20	20	**3.2**	**23**	**6.4**	**7.8**	**10**	**8.3**	**16**	**14**	**24**	**130**
BARIUM	mg/kg	1000	1000	1000	**89**	**280**	**190**	**64**	**230**	**97**	**100**	**120**	**110**	**78**
BERYLLIUM	mg/kg	90	90	90	**0.39**	**1.0**	**1.0**	**0.39**	**0.36**	<0.30	**0.46**	**0.64**	**0.48**	**0.43**
CADMIUM	mg/kg	70	70	70	**1.6**	**3.1**	**9.2**	**0.62**	**2.0**	**3.7**	**4.8**	**2.6**	**2.1**	**3.3**
TRIVALENT CHROMIUM	mg/kg	1000	1000	1000	NT	NT	**610**	NT	NT	NT	NT	NT	NT	NT
HEXAVALENT CHROMIUM[2]	mg/kg	100	100	100	**70**	**26**	<1.1	**13**	**88**	**64**	**300**	**340**	**390**	**200**
LEAD	mg/kg	200	200	200	**320**	**110**	**1200**	**270**	**660**	**240**	**470**	**320**	**310**	**150**
MERCURY	mg/kg	20	20	20	**0.19**	**3.1**	**1.2**	**0.71**	**0.41**	**0.22**	**0.59**	**0.24**	**0.34**	**0.31**
NICKEL	mg/kg	600	600	600	**30**	**26**	**70**	**14**	**19**	**16**	**41**	**30**	**19**	**12**
SELENIUM	mg/kg	400	400	400	<6.3	**14**	<7.1	<5.5	<6.0	<6.1	<7.7	<6.8	**6.6**	**6.9**
SILVER	mg/kg	100	100	100	**0.88**	<0.61	**2.8**	<0.55	**1.3**	**1.5**	**2.7**	**1.2**	<0.63	<0.64
THALLIUM	mg/kg	8	8	8	<3.1	<3.1	<3.6	<2.8	<3.0	<3.0	<3.9	<3.4	<3.2	<3.2
VANADIUM	mg/kg	400	400	400	**51**	**27**	**95**	**17**	**42**	**38**	**74**	**36**	**40**	**24**
ZINC	mg/kg	1000	1000	1000	**230**	**1500**	**770**	**59**	**310**	**170**	**320**	**390**	**3700**	**400**
VOCs														
N-BUTYLBENZENE	mg/kg	NS	NS	NS	NT	NT	NT	NT	NT	**0.0035**	NT	NT	NT	NT
1,2-DICHLOROBENZENE	mg/kg	9	100	300	NT	NT	NT	NT	NT	**0.0084**	NT	NT	NT	NT
P-ISOPROPYLTOLUENE	mg/kg	100	~	~	NT	NT	NT	NT	NT	**0.006**	NT	NT	NT	NT
NAPHTHALENE	mg/kg	4	20	500	NT	NT	NT	NT	NT	**0.014**	NT	NT	NT	NT
TOLUENE	mg/kg	30	500	500	NT	NT	NT	NT	NT	**0.0035**	NT	NT	NT	NT
1,2,4-TRIMETHYLBENZENE	mg/kg	1000	~	~	NT	NT	NT	NT	NT	**0.0095**	NT	NT	NT	NT
1,3,5-TRIMETHYLBENZENE	mg/kg	10	~	~	NT	NT	NT	NT	NT	**0.0042**	NT	NT	NT	NT
O-XYLENE	mg/kg	100	100	500	NT	NT	NT	NT	NT	**0.0029**	NT	NT	NT	NT
PAHs														
ACENAPHTHENE	mg/kg	4	1000	1000	<0.44	<0.22	<0.49	<0.20	<0.21	**0.37**	<1.1	<0.47	**0.29**	<0.23
ACENAPHTHYLENE	mg/kg	1	600	10	**0.54**	<0.22	**0.59**	<0.20	**0.21**	**0.42**	<1.1	<0.47	**0.58**	**0.69**
ANTHRACENE	mg/kg	1000	1000	1000	<0.44	<0.22	<0.49	<0.20	**0.26**	**1.3**	<1.1	<0.47	**0.71**	<0.23
BENZO(A)ANTHRACENE	mg/kg	7	7	7	**2.4**	**0.38**	**1.6**	<0.20	**1.4**	**2.9**	**1.6**	**0.67**	**2.1**	**0.93**
BENZO(A)PYRENE	mg/kg	2	2	2	**2.2**	**0.39**	**1.7**	<0.20	**1.3**	**2.3**	**2.1**	**0.66**	**2.1**	**1.6**
BENZO(B)FLUORANTHENE	mg/kg	7	7	7	**3.6**	**0.74**	**3.3**	<0.20	**2.7**	**2.9**	**2.2**	**0.92**	**2.5**	**1.6**
BENZO(G,H,I)PERYLENE	mg/kg	1000	1000	1000	**1.5**	**0.28**	**3.2**	<0.20	**1.2**	**2.1**	**5.2**	**0.7**	**1.7**	**1.3**
BENZO(K)FLUORANTHENE	mg/kg	70	70	70	**1.3**	**0.23**	**1.0**	<0.20	**0.89**	**1.1**	<1.1	<0.47	**0.81**	**0.65**
CHRYSENE	mg/kg	70	70	70	**2.4**	**0.64**	**1.8**	<0.20	**1.8**	**2.9**	**2.1**	**0.75**	**2.4**	**1.2**
DIBENZ(A,H)ANTHRACENE	mg/kg	0.7	0.7	0.7	<0.44	<0.22	**0.52**	<0.20	**0.36**	**0.59**	<1.1	<0.47	**0.46**	**0.29**
FLUORANTHENE	mg/kg	1000	1000	1000	**4.1**	**0.71**	**2.8**	<0.20	**2.4**	**6.1**	**3.1**	**1.3**	**5.1**	**0.93**
FLUORENE	mg/kg	1000	1000	1000	<0.44	<0.22	<0.49	<0.20	<0.21	**0.72**	<1.1	<0.47	**0.59**	<0.23
INDENO(1,2,3-CD)PYRENE	mg/kg	7	7	7	**1.5**	**0.27**	**3.0**	<0.20	**1.2**	**2.1**	**2.4**	**0.6**	**1.8**	**1.2**
2-METHYLNAPHTHALENE	mg/kg	0.7	80	300	<0.44	<0.22	<0.49	**0.34**	**0.69**	**0.4**	<1.1	<0.47	**0.25**	<0.23
NAPHTHALENE	mg/kg	4	20	500	<0.44	<0.22	<0.49	<0.20	**0.32**	**0.38**	<1.1	<0.47	**0.86**	**0.23**
PHENANTHRENE	mg/kg	10	500	500	**1.5**	**0.51**	**1.1**	<0.20	**1.6**	**6.4**	**1.9**	**0.75**	**5.4**	**0.53**
PYRENE	mg/kg	1000	1000	1000	**3.8**	**0.7**	**2.9**	<0.20	**2.3**	**5.4**	**3.6**	**1.1**	**4.9**	**2.1**

QC by JRS 6/2/2017 #N/A

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard
MCP = Massachusetts Contingency Plan
mg/kg = milligram per killiogram

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).
2 = Unspeciated chromium is conservatively assumed to be the hexavalent species

Table 2
Summary of Laboratory Analytical Results - Disposal Characterization
24 Caller Street
Peabody, Massachusetts
February 15, 2017

Parameter	Units	Reportable Concentrations[1]	COMM-97-001 In-State Disposal/Reuse Levels		Sample Location, Depth, and Date
		RCS-1	Unlined	Lined	Comp-1 / SB-3 (2-4.5)
Metals					
ARSENIC	mg/kg	20	40	40	**190**
TCLP ARSENIC	mg/L	NS	5	5	**0.099**
BARIUM	mg/kg	1000	NS	NS	**110**
CADMIUM	mg/kg	70	30	80	**5.8**
CHROMIUM	mg/kg	100	1000	1000	**210**
TCLP CHROMIUM	mg/L	NS	5	5	**0.023**
LEAD	mg/kg	200	1000	2000	**280**
TCLP LEAD	mg/L	NS	5	5	**0.031**
MERCURY	mg/kg	20	10	10	**0.94**
SELENIUM	mg/kg	400	NS	NS	**7.8**
SILVER	mg/kg	100	NS	NS	<0.74
PCBs					
Total PCBs	mg/kg	1	<2	<2	ND
TPH					
TPH	mg/kg	1000	2500	5000	**470**
VOCs					
N-BUTYLBENZENE	mg/kg	NS	NS	NS	**0.0035**
1,2-DICHLOROBENZENE	mg/kg	9	NS	NS	**0.0084**
P-ISOPROPYLTOLUENE	mg/kg	100	NS	NS	**0.006**
NAPHTHALENE	mg/kg	4	NS	NS	**0.014**
TOLUENE	mg/kg	30	NS	NS	**0.0035**
1,2,4-TRIMETHYLBENZENE	mg/kg	1000	NS	NS	**0.0095**
1,3,5-TRIMETHYLBENZENE	mg/kg	10	NS	NS	**0.0042**
O-XYLENE	mg/kg	100	NS	NS	**0.0029**
Total VOCs	mg/kg	NS	4	10	**0.052**
SVOCs					
BENZO(A)ANTHRACENE	mg/kg	7	NS	NS	**0.82**
BENZO(A)PYRENE	mg/kg	2	NS	NS	**0.82**
BENZO(B)FLUORANTHENE	mg/kg	7	NS	NS	**1.1**
BENZO(G,H,I)PERYLENE	mg/kg	1000	NS	NS	**0.65**
BENZO(K)FLUORANTHENE	mg/kg	70	NS	NS	**0.39**
BIS(2-ETHYLHEXYL)PHTHALATE	mg/kg	90	NS	NS	**0.66**
CHRYSENE	mg/kg	70	NS	NS	**0.88**
FLUORANTHENE	mg/kg	1000	NS	NS	**1.6**
INDENO(1,2,3-CD)PYRENE	mg/kg	7	NS	NS	**0.65**
PHENANTHRENE	mg/kg	10	NS	NS	**0.9**
PYRENE	mg/kg	1000	NS	NS	**1.6**
Total SVOCs	mg/kg	NS	100	100	**10.07**
General Chemistry					
% Solids	%Wt	NS	NS	NS	**65**
SPECIFIC CONDUCTANCE	(µmhos/cm)	NS	4000	8000	**15**
IGNITABILITY	(present/absent)	NS	Absent	Absent	Absent
REACTIVE CYANIDE	mg/kg	NS	ND	ND	<4.0
REACTIVE SULFIDE	mg/kg	NS	ND	ND	<20
PH	pH Units	NS	>2 and <12	>2 and <12	**9.8**

QC by JRS 3/1/2017 #N/A

Abbreviations:
VOCs = Volatile Organic Compounds
SVOCs = Semivolatile Organic Compounds
PCBs=Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbons
ND = Not Detected
NT = Not Tested
NS = No Standard

Notes:
< = indicates parameter not detected above laboratory method reporting limit, shown
BOLD Parameter detected above laboratory detection limit
BOLD Parameter exceeds the applicable MCP Method 1, S-1 standard
BOLD Parameter exceeds the COMM-97-001 standard for reuse at In-State landfills
1 = Standards are from Massachusetts Contingency Plan (MCP), 310 CMR 40, April 2014 (updated January 2015).

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

ATTACHMENT A

Boring Logs

Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-1
24 Caller St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No. 2160299	
	CHKD BY JRS	

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 2/15/17	DATE END 2/15/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (ft)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			30/60	0-2.5'	0-2.5'	0	Dark brown fine to coarse SAND with little silt; trace gravel		SAND FILL
				2.5-5'	2.5-5'	0	Dark brown fine to coarse SAND with little silt; trace gravel, coal, coal ash		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:

BORING No. SB-1

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Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-2
24 Caller St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	JRS

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 2/15/17	DATE END 2/15/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (ft)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			30/60	0-2.5'	0-2.5'	0	Brown fine to coarse SAND with little organic silt		SAND FILL
				2.5-5'	2.5-5'	0	Brown to red fine to coarse SAND; trace silt, coal, coal ash		
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:

BORING No. SB-2

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Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-3
24 Caller St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	JRS

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 2/15/17	DATE END 2/15/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher

CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (ft)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			30/60	0-4.5'	0-2'	0			
					2-4.5'	4.8	Brown fine to coarse SAND; trace silt	*	SAND FILL
5									
							End of Boring @ 4.5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
* Petroleum odor observed at approximately 4 feet below ground surface

BORING No. SB-3

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Weston & Sampson SM

PROJECT	REPORT OF BORING No.	SB-4
24 Caller St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	JRS

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 2/15/17	DATE END 2/15/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (ft)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			30/60	0-4.5'	0-2'	0			
							Brown fine to coarse SAND; trace silt		SAND FILL
					2-4.5'	0			
5							End of Boring @ 4.5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:

BORING No. SB-4

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Weston & Sampson℠

PROJECT	REPORT OF BORING No.	SB-5
24 Caller St (Peabody Riverwalk)	SHEET 1 OF 1	
	Project No.	2160299
	CHKD BY	JRS

BORING Co.	NE Geotech	BORING LOCATION	See Figure 2
FOREMAN	Keith	GROUND SURFACE ELEV.	DATUM
WSE REP	Taylor Smith	DATE START 2/15/17	DATE END 2/15/17

SAMPLER: ATS track mounted rig
DT 22 Sampler 2.25 inch
CASING: DT 22 2.25 inch PVC liners w/o catcher
CASING SIZE: 2.25 inch Method Direct Push

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME

DEPTH (feet)	CASING (lb/ft)	SAMPLE No.	REC/PEN (ft)	DEPTH (ft)	PID Depth	PID (ppm)	SAMPLE DESCRIPTION Burmister Classification	NOTES	STRATUM DESCRIPTION
			30/60	0-4.5'	0-2'	0			
							Dark brown fine to coarse SAND with little silt	*	SAND FILL
					2-5'	0			
5							End of Boring @ 5'		
10									
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0-4	V. LOOSE	0-2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
> 50	V. DENSE	15-30	V. STIFF
		> 30	HARD

REMARKS:

NOTES:
* White material observed at 3 feet below ground surface (suspected lime material).

BORING No. SB-5

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Appendix D

Soil Boring and Test Pit Logs – November 2018

BORING NUMBER: **B-1**

Weston & Sampson

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractors
DRILLING METHOD: Fluid rotary with driven casing
BORING LOCATION: 24 Caller St.
FOREMAN/DRILLER: Brett Raiche
CASING/AUGER SIZE: 4.0" flush joint casing
GROUND ELEV: 12 ft. +/- (NAVD 88)
DRILL RIG TYPE: Acker Soil Scout tracked rig
SAMPLING METHOD: Standard penetration test (SPT)
DATE STARTED: 11/8/2018
OTHER EQUIPMENT: -
SAMPLER HAMMER: 140-lb. w/ rope and cathead
DATE COMPLETED: 11/8/2018

Sample Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%		
trace	0 - 10%	trace organics	< 5%

Data Plots

Laboratory Test Data:
PL = Plastic Limit, %
MC = Moisture content, %
LL = Liquid Limit, %

In-Situ Test Data
SPT N-Value

Remarks and Additional Tests

WOR = Weight of rods
WOH = Weight of hammer
P200 = Percent passing the #200 sieve (laborator value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/8/2018
Depth: 2.6 ft. +/-

Depth Scale, ft.	Sample Type	Blows on Sampler/6" *Blows on Casing/12"*	N-Value, Blows/ft.	Sample Recovery, in. Sampler Penetration, in.	Strata Description and Graphic Log	Sample Description	Data Plots (SPT N-Value)	Remarks and Additional Tests
1						(3") ORGANIC MATTER. (9") REINFORCED CONCRETE.		
1		4						
2		2	4	6/24		Very loose, dark brown to black, gravelly fine to coarse SAND, trace silt, trace debris (coal, weathered mortar), trace organics (roots); moist to wet. [FILL]	4	
2		2						
3		1						
3		WOH						
4		1	2	4/24	FILL	Very loose, brown, gravelly fine to coarse SAND, some debris (brick fragments, weathered mortar), trace silt, trace organics (roots); wet. [FILL]	2	
4		1						
5		3						
5		1						
6		1	4	3/24		Very loose, brown, gravelly fine to coarse SAND, trace debris (weathered mortar), trace silt, trace organics (roots); wet. [FILL]	4	
6		3						
7		5						
8		5	9	13/24		Top 5" - Dark brown, ORGANIC SILT, some fine to coarse sand, some debris (brick fragments, weathered mortar), trace gravel; wet. [FILL] Bottom 8" - Brown/gray, fine to medium SAND, some organics (roots, fibers), little silt; wet.	9	
8		4						
9		5				No recovery.		
10		2	4	0/24	ORGANIC SOILS		4	
10		2						
11		2						
11		3	5	8/24		Loose, gray, fine to coarse SAND, some organics (wood, roots, fibers), little silt, trace gravel; wet.	5	Gravel = 0.0 % Sand = 86.7 % Fines = 13.3 %
12		2						
12		4						
13								
14								Casing terminated at 14 ft.
15		5				Loose, yellowish brown, fine SAND, little silt; wet.		
15		4						
16		4	8	10/24			8	
16		3						
17					SAND			
18								
19								
20								
20		6						
21		5	11	14/24		Medium dense, yellowish brown to reddish yellow, fine SAND, little silt; wet.	11	
21		6						
22		6						
						End of boring at 22 ft.		

SAMPLE LEGEND

- Standard split spoon sampler driven w/ 140-lb. hammer (24" long, 2" OD, 1-3/8" ID)
- Thin-walled tube sampler pushed w/ rig hydraulics (30" long, 3" ID)
- NX rock core sampler advanced using rotary drilling methods (5' long, 3" ID)
- Modified split spoon sampler driven w/ 140-lb. hammer (24" long, 3" OD, 2-3/8" ID)

N-VALUE RELATIONSHIPS

N-VALUE BLOWS/FT.	DENSITY OF GRANULAR SOILS	N-VALUE BLOWS/FT.	CONSISTENCY OF COHESIVE SOILS
0 - 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very Dense	15 - 30	Very Stiff
		> 30	Hard

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

W&S BORING LOG - MODIFIED - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 1/4/19 11:20 - \\WSE03.LOCAL\WSE\PROJECTS\MA\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.05 - BDG - BORINGS\PEABODY RIVERWALK BORING LOGS.GPJ

BORING NUMBER: **B-2**

Weston & Sampson

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractors
DRILLING METHOD: Fluid rotary with driven casing
BORING LOCATION: 24 Caller St.
FOREMAN/DRILLER: Brett Raiche
CASING/AUGER SIZE: 4.0" flush joint casing
GROUND ELEV: 12 ft. +/- (NAVD 88)
DRILL RIG TYPE: Acker Soil Scout tracked rig
SAMPLING METHOD: Standard penetration test (SPT)
DATE STARTED: 11/8/2018
OTHER EQUIPMENT: -
SAMPLER HAMMER: 140-lb. w/ rope and cathead
DATE COMPLETED: 11/8/2018

Sample Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil			Organic Soils		
	GRAVEL, SAND, SILT, CLAY	> 50%		PEAT	> 50%
	gravelly, sandy, silty, clayey	35 - 50%		organic (soil name)	15 - 50%
	some	20 - 35%		(soil name) with some organics	5 - 15%
	little	10 - 20%			
	trace	0 - 10%		trace organics	< 5%

Data Plots

Laboratory Test Data:
PL = Plastic Limit, %
MC = Moisture content, %
LL = Liquid Limit, %

PL MC LL

In-Situ Test Data
SPT N-Value

10 20 30 40

Remarks and Additional Tests

WOR = Weight of rods
WOH = Weight of hammer
P200 = Percent passing the #200 sieve (laborator value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/8/2018
Depth: 4 ft. +/-

Depth Scale, ft.	Sample Type	Blows on Sampler/6" *Blows on Casing/12"*	N-Value, Blows/ft.	Sample Recovery, in. Sampler Penetration, in.	Strata Description and Graphic Log	Sample Description	Data Plots	Remarks and Additional Tests
1		5, 10, 5, 5	15	18/24	FILL	Top 2" - Wood panel. Middle 12" - Black, fine to coarse SAND, some silt, some organics, little gravel, trace debris (brick fragments, coal); moist. [FILL] Bottom 4" - Brown, fine to coarse SAND, trace debris (weathered mortar, coal), trace silt, trace gravel, trace organics; moist. [FILL]	15	
2								
3		5, 6, 5, 3	11	6/24		Medium dense, brown to black, fine to coarse SAND, some organics (roots, fibers), little silt, trace debris (wood/lumber), trace gravel; moist. [FILL]	11	
4								
5		24, 29, 8, 10	37	10/24		Top 4" - Dense, brown, fine to coarse SAND, some organics (roots), little silt, trace debris (brick fragments), ; wet. [FILL] Bottom 6" - Lumber/wood.	37	
6		15, 22, 26, 21	48	0/24		No recovery.	48	Possibly pushing piece of lumber.
7								
8		6, 10, 12, 13	22	14/24		Top 10" - Medium dense, brown to yellowish brown, gravelly medium to coarse SAND, trace silt; wet. Bottom 4" - Yellowish brown, fine SAND, some silt; wet.	22	Gravel = 0.0 % Sand = 74.1 % Fines = 25.9 % Casing terminated at 10 ft.
9								
10								
11								
12								
13								
14		4, 6, 5, 7	11	10/24	SAND	Medium dense, yellowish brown, fine SAND, some silt; wet.	11	
15								
16								
17								
18								
19		6, 6, 6, 6	12	10/24		Medium dense, yellowish brown, fine SAND, some silt; wet.	12	
20								
21						End of boring at 21 ft.		

SAMPLE LEGEND

- Standard split spoon sampler driven w/ 140-lb. hammer (24" long, 2" OD, 1-3/8" ID)
- Thin-walled tube sampler pushed w/ rig hydraulics (30" long, 3" ID)
- NX rock core sampler advanced using rotary drilling methods (5' long, 3" ID)
- Modified split spoon sampler driven w/ 140-lb. hammer (24" long, 3" OD, 2-3/8" ID)

N-VALUE RELATIONSHIPS

N-VALUE BLOWS/FT.	DENSITY OF GRANULAR SOILS	N-VALUE BLOWS/FT.	CONSISTENCY OF COHESIVE SOILS
0 - 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very Dense	15 - 30	Very Stiff
		> 30	Hard

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

W&S BORING LOG - MODIFIED - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 1/4/19 11:20 - \\WSE03.LOCAL\WSE\PROJECTS\MA\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.05 - BDG - BORINGS\PEABODY RIVERWALK BORING LOGS.GPJ

BORING NUMBER: **B-3**

Weston & Sampson

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractors
DRILLING METHOD: Fluid rotary with driven casing
BORING LOCATION: 24 Caller St.
FOREMAN/DRILLER: Mike Matarozzo
CASING/AUGER SIZE: 4.0" flush joint casing
GROUND ELEV: 12 ft. +/- (NAVD 88)
DRILL RIG TYPE: Mobile Drill B-47 truck rig
SAMPLING METHOD: Standard penetration test (SPT)
DATE STARTED: 11/5/2018
OTHER EQUIPMENT: -
SAMPLER HAMMER: 140-lb. automatic hammer
DATE COMPLETED: 11/5/2018

Depth Scale, ft.	Sample Type	Blows on Sampler/6" *Blows on Casing/12"*	N-Value, Blows/ft.	Sample Recovery, in. Sampler Penetration, in.	Strata Description and Graphic Log	Sample Description
1		9 10 5 11	15	15/24	FILL	Top 5" - Gray-brown GRAVEL, little fine to coarse SAND, trace silt; moist. [FILL] Bottom 11" - Medium dense, dark brown, ORGANIC SILT, trace sand, trace gravel, trace debris (asphalt millings); moist. [FILL]
2		4 11 9 9	20	0/24		No recovery.
3						
4		4 3 3 100	6	2/22		Loose, brown, gravelly fine to coarse SAND, trace silt; wet. [FILL]
5						
6					ORGANIC SOIL	
7						
8		2 3 6 10	9	9/24	SAND	Top 3" - Brown to dark brown, gravelly fine to coarse SAND, some organics, some silt; wet. Bottom 6" - Medium dense, yellowish brown, fine to coarse SAND, little gravel, little silt; wet.
9						
10		11 11 14 14	25	16/24		Medium dense, yellowish brown, fine SAND, little silt; wet.
11						
12						
13						
14		2 2 2 3	4	21/24	SILT	Medium stiff, yellow/bluish gray, clayey SILT, little fine sand; wet.
15						
16						
17						
18						
19		1 3 2 1	5	19/24		Medium stiff, yellowish brown, fine sandy SILT; wet.
20						
21						End of boring at 21 ft.

Soil Classification Name Guide based on Constituent Percentages

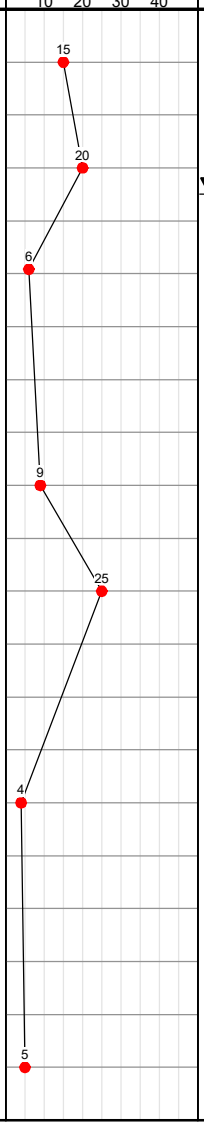
Mineral Soil			Organic Soils		
	GRAVEL, SAND, SILT, CLAY	> 50%		PEAT	> 50%
	gravelly, sandy, silty, clayey	35 - 50%		organic (soil name)	15 - 50%
	some	20 - 35%		(soil name) with some organics	5 - 15%
	little	10 - 20%			
	trace	0 - 10%		trace organics	< 5%

Data Plots

Laboratory Test Data:
PL = Plastic Limit, %
MC = Moisture content, %
LL = Liquid Limit, %

PL MC LL

In-Situ Test Data
SPT N-Value



Remarks and Additional Tests

WOR = Weight of rods
WOH = Weight of hammer
P200 = Percent passing the #200 sieve (laborator value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/5/2018
Depth: 3.5 ft. +/-

Gravel = 16.6 %
Sand = 69.3 %
Fines = 14.1 %

Casing terminated at 14 ft.

SAMPLE LEGEND

- Standard split spoon sampler driven w/ 140-lb. hammer (24" long, 2" OD, 1-3/8" ID)
- Thin-walled tube sampler pushed w/ rig hydraulics (30" long, 3" ID)
- NX rock core sampler advanced using rotary drilling methods (5' long, 3" ID)
- Modified split spoon sampler driven w/ 140-lb. hammer (24" long, 3" OD, 2-3/8" ID)

N-VALUE RELATIONSHIPS

N-VALUE BLOWS/FT.	DENSITY OF GRANULAR SOILS	N-VALUE BLOWS/FT.	CONSISTENCY OF COHESIVE SOILS
0 - 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very Dense	15 - 30	Very Stiff
		> 30	Hard

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

W&S BORING LOG - MODIFIED - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 1/4/19 11:20 - \\WSE03.LOCAL\WSE\PROJECTS\MA\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.05 - BDG - BORINGS\PEABODY RIVERWALK BORING LOGS.GPJ

BORING NUMBER: **B-4**

Weston & Sampson

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractors
DRILLING METHOD: Fluid rotary with driven casing
BORING LOCATION: 21 Caller St.
FOREMAN/DRILLER: Brett Raiche
CASING/AUGER SIZE: 4.0" flush joint casing
GROUND ELEV: 11 ft. +/- (NAVD 88)
DRILL RIG TYPE: Acker Soil Scout tracked rig
SAMPLING METHOD: Standard penetration test (SPT)
DATE STARTED: 11/8/2018
OTHER EQUIPMENT: -
SAMPLER HAMMER: 140-lb. w/ rope and cathead
DATE COMPLETED: 11/8/2018

Sample Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%		
trace	0 - 10%	trace organics	< 5%

Data Plots

Laboratory Test Data:
PL = Plastic Limit, %
MC = Moisture content, %
LL = Liquid Limit, %

PL MC LL

In-Situ Test Data
SPT N-Value
10 20 30 40

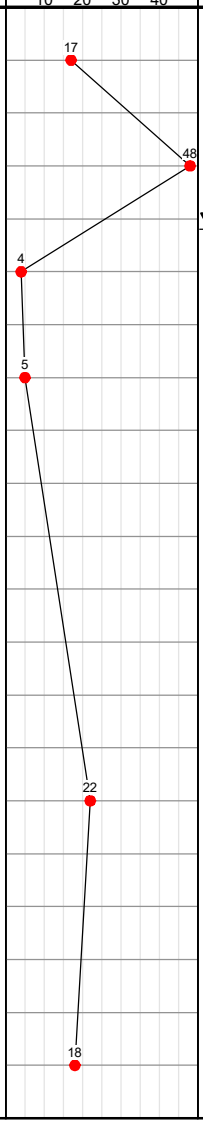
Remarks and Additional Tests

WOR = Weight of rods
WOH = Weight of hammer
P200 = Percent passing the #200 sieve (laborator value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/8/2018
Depth: 4.2 ft. +/-

Depth Scale, ft.	Sample Type	Blows on Sampler/6" *Blows on Casing/12"*	N-Value, Blows/ft.	Sample Recovery, in. Sampler Penetration, in.	Strata Description and Graphic Log	Sample Description
1		2, 8, 9, 10	17	11/24	FILL	Top 6" - Dark brown, fine to coarse SAND, some gravel, some organics (roots, fibers), little silt; moist. [FILL] Bottom 5" - Medium dense, brown, gravelly fine to coarse SAND, trace silt; moist. [FILL]
2		13, 38, 10, 6	48	7/24		Very dense, brown to black, gravelly fine to coarse SAND, little silt, little debris (glass, wood/lumber), trace organics; moist. [FILL]
4		3, 2, 2, 3	4	8/24		Loose, brown to gray, fine to medium SAND, some debris (brick fragments, weathered mortar), little silt, trace gravel, trace organis (roots, wood); wet. [FILL]
6		3, 3, 2, 3	5	8/24	ORGANIC SOIL	Loose, dark brown, fine sandy ORGANIC SILT, trace gravel; wet.
8		WOH/12", 2, 13		22/24		Top 13" - Very loose, dark gray, silty fine SAND, trace gravel; organic odor; wet. Bottom 9" - Dark gray, silty fine to coarse SAND, little gravel; organic odor; wet.
14		11, 11, 11, 11	22	6/24	SAND	Medium dense, gray, fine SAND, little silt; wet.
19		7, 9, 9, 11	18	13/24		Medium dense, brownish gray, fine SAND, little silt; wet.
21						End of boring at 21 ft.



Auger grinding from about 1.5 to 4 ft.
When advancing casing to 4 ft, bouncing observed at about 2 ft. Boring moved 1 ft N. Bouncing observed again at about 2 ft. Boring moved another 1 ft W.
Gravel = 3.3 %
Sand = 72.1 %
Fines = 24.6 %
Casing terminated at 4 ft.

Auger grinding from about 9 to 10 ft.

SAMPLE LEGEND

- Standard split spoon sampler driven w/ 140-lb. hammer (24" long, 2" OD, 1-3/8" ID)
- Thin-walled tube sampler pushed w/ rig hydraulics (30" long, 3" ID)
- NX rock core sampler advanced using rotary drilling methods (5' long, 3" ID)
- Modified split spoon sampler driven w/ 140-lb. hammer (24" long, 3" OD, 2-3/8" ID)

N-VALUE RELATIONSHIPS

N-VALUE BLOWS/FT.	DENSITY OF GRANULAR SOILS	N-VALUE BLOWS/FT.	CONSISTENCY OF COHESIVE SOILS
0 - 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very Dense	15 - 30	Very Stiff
		> 30	Hard

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

W&S BORING LOG - MODIFIED - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 1/4/19 11:20 - \\WSE03.LOCAL\WSE\PROJECTS\MA\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.05 - BDG - BORINGS\PEABODY RIVERWALK BORING LOGS.GPJ

BORING NUMBER: **B-5**

Weston & Sampson

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractors
DRILLING METHOD: Fluid rotary with driven casing
BORING LOCATION: 166R Main St.
FOREMAN/DRILLER: Brett Raiche
CASING/AUGER SIZE: 4.0" flush joint casing
GROUND ELEV: 9 ft. +/- (NAVD 88)
DRILL RIG TYPE: Acker Soil Scout tracked rig
SAMPLING METHOD: Standard penetration test (SPT)
DATE STARTED: 11/9/2018
OTHER EQUIPMENT: -
SAMPLER HAMMER: 140-lb. w/ rope and cathead
DATE COMPLETED: 11/9/2018

Sample Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%	trace organics	< 5%
trace	0 - 10%		

Data Plots

Laboratory Test Data:
PL = Plastic Limit, %
MC = Moisture content, %
LL = Liquid Limit, %

PL MC LL

In-Situ Test Data
SPT N-Value
10 20 30 40

Remarks and Additional Tests

WOR = Weight of rods
WOH = Weight of hammer
P200 = Percent passing the #200 sieve (laboratory value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/9/2018
Depth: 2.9 ft. +/-

Depth Scale, ft.	Sample Type	Blows on Sampler/6" *Blows on Casing/12"*	N-Value, Blows/ft.	Sample Recovery, in. Sampler Penetration, in.	Strata Description and Graphic Log	Sample Description
1		2 3 4 5	7	9/24	FILL	(3") ASPHALT CONCRETE. Loose, dark brown, medium to coarse SAND, little gravel, little silt, trace organics (roots, fibers), trace debris (glass, wood); moist. [FILL]
2						
3		5 3 2 3	5	6/24		Loose, gray-brown, fine to coarse SAND, some silt, little gravel, trace gravel trace organic (roots); moist to wet. [FILL]
4						
5		1 1 1 2	2	10/24		Top 4" - Dark brown, gravelly medium to coarse SAND, little silt, trace organics (roots); wet. [FILL] Bottom 6" - Dark brown to black, ORGANIC SILT, little fine to coarse sand, trace gravel; wet. [FILL]
6						
7		3 1 2 2	3	18/24	ORGANIC SOIL	Top 4" - Dark brown, gravelly medium to coarse SAND, little silt, trace organics (fibers); wet. [FILL] Bottom 14" - Soft, gray-brown SILT, some organics (fibers); wet.
8						
9						
10		14 12 7 9	19	6/24	SAND	Medium dense, gray, gravelly fine to coarse SAND, little silt; wet.
11						
12						
13						
14		9 5 8 9	13	5/24	SILT	Stiff, gray SILT, some fine sand, trace gravel; wet.
15						
16						
17						
18						
19		7 7 6 7	13	19/24		Stiff, gray SILT, some fine sand; wet.
20						
21						End of boring at 21 ft.

Auger grinding from about 8.5 to 9.5 ft.
Casing terminated at 9 ft.
Rock fragments at bottom of spoon.

Gravel = 3.1 %
Sand = 33.0 %
Fines = 63.9 %
Rock fragments at top of spoon.

SAMPLE LEGEND

- Standard split spoon sampler driven w/ 140-lb. hammer (24" long, 2" OD, 1-3/8" ID)
- Thin-walled tube sampler pushed w/ rig hydraulics (30" long, 3" ID)
- NX rock core sampler advanced using rotary drilling methods (5' long, 3" ID)
- Modified split spoon sampler driven w/ 140-lb. hammer (24" long, 3" OD, 2-3/8" ID)

N-VALUE RELATIONSHIPS

N-VALUE BLOWS/FT.	DENSITY OF GRANULAR SOILS	N-VALUE BLOWS/FT.	CONSISTENCY OF COHESIVE SOILS
0 - 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very Dense	15 - 30	Very Stiff
		> 30	Hard

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

W&S BORING LOG - MODIFIED - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 1/4/19 11:20 - \\WSE03.LOCAL\WSE\PROJECTS\MA\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.05 - BDG - BORINGS\PEABODY RIVERWALK BORING LOGS.GPJ

BORING NUMBER: **B-6**

Weston & Sampson

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractors
DRILLING METHOD: Fluid rotary with driven casing
BORING LOCATION: 166R Main St.
FOREMAN/DRILLER: Brett Raiche
CASING/AUGER SIZE: 4.0" flush joint casing
GROUND ELEV: 9 ft. +/- (NAVD 88)
DRILL RIG TYPE: Acker Soil Scout tracked rig
SAMPLING METHOD: Standard penetration test (SPT)
DATE STARTED: 11/9/2018
OTHER EQUIPMENT: -
SAMPLER HAMMER: 140-lb. w/ rope and cathead
DATE COMPLETED: 11/9/2018

Depth Scale, ft. | **Sample Type** | **Blows on Sampler/6"** *Blows on Casing/12"* | **N-Value, Blows/ft.** | **Sample Recovery, in. Sampler Penetration, in.** | **Strata Description and Graphic Log**

Sample Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil			Organic Soils		
	GRAVEL, SAND, SILT, CLAY	> 50%		PEAT	> 50%
	gravelly, sandy, silty, clayey	35 - 50%		organic (soil name)	15 - 50%
	some	20 - 35%		(soil name) with some organics	5 - 15%
	little	10 - 20%			
	trace	0 - 10%		trace organics	< 5%

Data Plots

Laboratory Test Data:
PL = Plastic Limit, %
MC = Moisture content, %
LL = Liquid Limit, %

PL MC LL

In-Situ Test Data
SPT N-Value
10 20 30 40

Remarks and Additional Tests

WOR = Weight of rods
WOH = Weight of hammer
P200 = Percent passing the #200 sieve (laborator value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/9/2018
Depth: 3 ft. +/-

Depth	Sample	Blows	N-Value	Recovery / Penetration	Strata	Description
1		2, 5, 15, 14	20	6/24	FILL	(2") ASPHALT CONCRETE. Medium dense, light brown to brown, fine to coarse SAND, some gravel, little silt, little debris (wood), trace organics (roots, fibers); moist. [FILL]
2						
3		12, 10, 8, 6	18	10/24		Top 5" - Brown, medium to coarse sandy GRAVEL, trace silt, trace debris (wood); wet. [FILL] Bottom 5" - Orange brown to brown, fine to coarse SAND, little silt, trace gravel, trace debris (wood); wet. [FILL]
4						
5		2, 3, 2, 2	5	9/24		Dark brown, fine to coarse SAND, some silt, little gravel, trace to some organics; wet.
6						
7		2, 1, 1, 1	2	14/24	ORGANIC SOILS	Top 7" - Very soft, black, PEAT, trace sand, trace gravel; wet. Bottom 7" - Dark brown, ORGANIC SILT; wet.
8						
9		2, 1, 1, 1	2	8/24		Very soft, brown, CLAY with some organics, some fine sand, trace gravel; wet.
10						
11						
12						
13						
14		10, 11, 4, 3	15	17/24	SAND	Top 4" - Medium dense, gray, fine to coarse gravelly SAND, little silt; wet. Bottom 13" - Gray, silty fine SAND; wet.
15						
16						
17						
18						
19						
20		8, 8, 6, 7	14	9/24		Top 6" - Gray, fine SAND, little silt; wet. Bottom 3" - Light brown, silty fine SAND; wet.
21						End of boring at 21 ft.

MC = 93%
OC = 10.6 %
Gravel = 1.6 %
Sand = 33.5 %
Fines = 64.9 %
Casing terminated at 9 ft.

SAMPLE LEGEND

- Standard split spoon sampler driven w/ 140-lb. hammer (24" long, 2" OD, 1-3/8" ID)
- Thin-walled tube sampler pushed w/ rig hydraulics (30" long, 3" ID)
- NX rock core sampler advanced using rotary drilling methods (5' long, 3" ID)
- Modified split spoon sampler driven w/ 140-lb. hammer (24" long, 3" OD, 2-3/8" ID)

N-VALUE RELATIONSHIPS

N-VALUE BLOWS/FT.	DENSITY OF GRANULAR SOILS	N-VALUE BLOWS/FT.	CONSISTENCY OF COHESIVE SOILS
0 - 4	Very Loose	< 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very Dense	15 - 30	Very Stiff
		> 30	Hard

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

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TEST PIT NUMBER: **TP-1**

Weston & Sampson

CLIENT: City of Peabody
PROJECT NUMBER: 2180658
PROJECT: MVP Action Grant
LOCATION: Peabody, MA
LOGGED BY: BDG
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractor
OPERATOR: Brett Raiche
EXCAVATOR: Kubota U17
BUCKET TYPE: Toothed, 1-ft wide
TEST PIT LOCATION: 24 Caller St.
GROUND ELEVATION: 11 ft. +/- (NAVD 88)
DATE STARTED: 11/7/2018
DATE COMPLETED: 11/7/2018

6 ft. +/-
Plan Sketch (NTS)
4.5 ft. +/-

Material Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil	GRAVEL, SAND, SILT, CLAY	> 50%	Organic Soils	PEAT	> 50%
	gravelly, sandy, silty, clayey	35 - 50%		organic (soil name)	15 - 50%
	some	20 - 35%		(soil name) with some organics	5 - 15%
	little	10 - 20%			
	trace	0 - 10%		trace organics	< 5%

Remarks and Tests

P200 = Percent passing the #200 sieve (laborator value)
MC = Moisture content, % (laboratory value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/7/2018
Depth: 5.8 ft. +/-

Depth Scale, ft.	Strata Description and Graphic Log	Material Description	Remarks and Tests
1	FILL	(5") TOPSOIL. 0.4'	Approx. 34-inch-thick stacked boulder wall. No mortar visible at back of wall.
1–5	FILL	Brown, fine to coarse SAND, trace to little gravel, trace to little silt, with trace to some organics (roots), with trace debris (coal, glass, plastics, concrete fragments); moist. [FILL]	
6	FILL	*Wet below 5.8 ft due to seepage.* 6.2'	Minor caving below approximately 5.3 ft.
		End of test pit at 6.2 ft.	

34-inch thick stacked boulder wall



Photo 1 - Overview of TP-1.

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Relative soil densities and consistencies, where noted, are estimates based on visual observation only.
3. Water level observations were made at time of excavation. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements were made.

W&S TEST PIT LOG - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 12/11/18 15:22 - \\WSE03.LOCAL\WSE\PROJECTS\MAP\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.06 - BDG - TEST PITS\PEABODY RIVERWALK TEST PIT LOGS.GPJ

TEST PIT NUMBER: **TP-2**

Weston & Sampson

CLIENT: City of Peabody
PROJECT NUMBER: 2180658
PROJECT: MVP Action Grant
LOCATION: Peabody, MA
LOGGED BY: BDG
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractor
OPERATOR: Brett Raiche
EXCAVATOR: Kubota U17
BUCKET TYPE: Toothed, 1-ft wide
TEST PIT LOCATION: 24 Caller St.
GROUND ELEVATION: 11 ft. +/- (NAVD 88)
DATE STARTED: 11/7/2018
DATE COMPLETED: 11/7/2018

6 ft. +/-
Plan Sketch (NTS)
2.5 ft. +/-

Material Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%		
trace	0 - 10%	trace organics	< 5%

Remarks and Tests

P200 = Percent passing the #200 sieve (laborator value)
MC = Moisture content, % (laboratory value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/7/2018
Depth: 5.3 ft. +/-

Depth Scale, ft. | *Strata Description and Graphic Log*

1
2
3
4
5

FILL

(4") TOPSOIL. 0.3'

Brown, fine to coarse SAND, some gravel to gravelly, trace to little silt, with trace to some organics (roots), with trace debris (tile, glass, metals, brick fragements, weathered mortar), with occasioal cobbles and occasional boulders; moist. [FILL]

Wet below 5.3 ft due to seepage.

End of test pit at 5.9 ft. 5.9'

17 to 21-in. thick vertical CIP concrete wall to about 4 ft.

Base of wall below 4 ft consists of stacked stones up to 34-inches diameter.

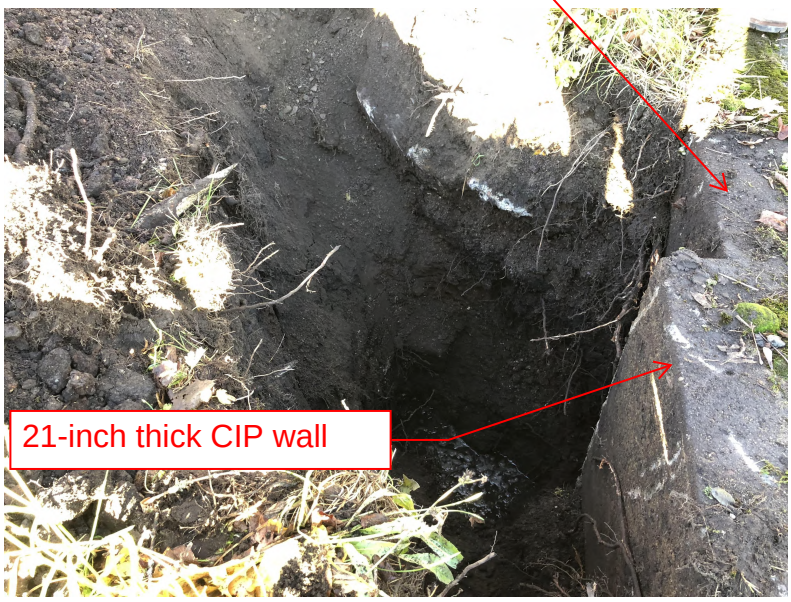


Photo 1 - Overview of TP-2.

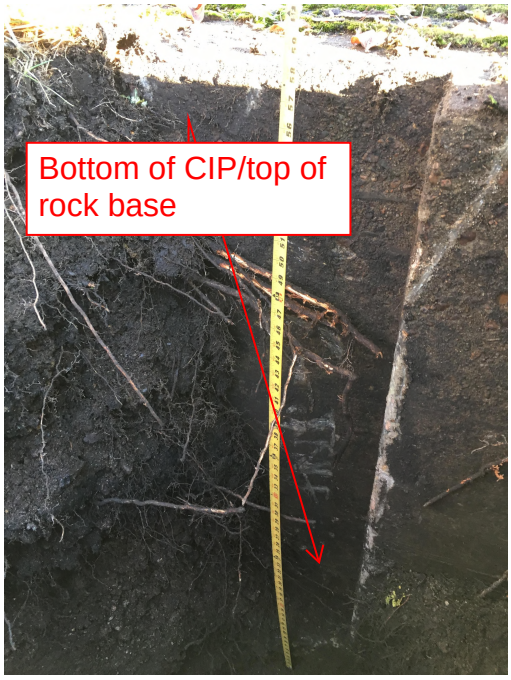


Photo 2 - Concrete wall and rock base.

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Relative soil densities and consistencies, where noted, are estimates based on visual observation only.
3. Water level observations were made at time of excavation. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements were made.

W&S TEST PIT LOG - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 12/11/18 15:23 - \\WSE03.LOCAL\WSE\PROJECTS\MAP\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.06 - BDG - TEST PITS\PEABODY RIVERWALK TEST PIT LOGS.GPJ

TEST PIT NUMBER: **TP-3**

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractor
TEST PIT LOCATION: 24 Caller St.
OPERATOR: Brett Raiche
GROUND ELEVATION: 11 ft. +/- (NAVD 88)
EXCAVATOR: Kubota U17
DATE STARTED: 11/6/2018
BUCKET TYPE: Toothed, 1-ft wide
DATE COMPLETED: 11/6/2018

6 ft. +/-
Plan Sketch (NTS)
2.5 ft. +/-

Material Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%		
trace	0 - 10%	trace organics	< 5%

Remarks and Tests

P200 = Percent passing the #200 sieve (laborator value)
MC = Moisture content, % (laboratory value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/6/2018
Depth: 5.3 ft. +/-

Depth Scale, ft.	Strata Description and Graphic Log	Material Description	Remarks and Tests
1	FILL	(5") TOPSOIL. 0.4'	Approx. 21-in.-thick vertical CIP concrete wall encountered to bottom of test pit.
2		Light brown to brown, fine to coarse SAND, trace to little gravel, trace to little silt, with trace to some organics (roots), with trace to some debris (ash, coal, plastics, metals, glass, brick fragments, concrete pieces, weathered mortar), with occasional cobbles, and few boulders (up to 28 in); moist. [FILL]	
3			
4			
5		*Wet below 5.3 ft due to seepage.* 5.7'	Minor caving below approximately 4.8 ft.
		End of test pit at 5.7 ft.	



Photo 1 - Overview of TP-3.

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Relative soil densities and consistencies, where noted, are estimates based on visual observation only.
3. Water level observations were made at time of excavation. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements were made.

W&S TEST PIT LOG - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 12/11/18 15:23 - \\WSE03.LOCAL\WSE\PROJECTS\MAP\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.06 - BDG - TEST PITS\PEABODY RIVERWALK TEST PIT LOGS.GPJ

TEST PIT NUMBER: **TP-4**

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractor
TEST PIT LOCATION: 21 Caller St.
OPERATOR: Brett Raiche
GROUND ELEVATION: 11 ft. +/- (NAVD 88)
EXCAVATOR: Kubota U17
DATE STARTED: 11/6/2018
BUCKET TYPE: Toothed, 1-ft wide
DATE COMPLETED: 11/6/2018

2 ft. +/-
Plan Sketch (NTS)
7 ft. +/-

Material Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%		
trace	0 - 10%	trace organics	< 5%

Remarks and Tests

P200 = Percent passing the #200 sieve (laborator value)
MC = Moisture content, % (laboratory value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/6/2018
Depth: 6.7 ft. +/-

Depth Scale, ft.	Strata Description and Graphic Log	Material Description	Remarks and Tests
1–6	FILL	Light brown to brown, fine to coarse SAND, trace to little gravel, trace to little silt, with trace to some organics (roots), with trace debris (plastics, brick fragments), with occasional cobbles, and few AC pavement pieces; moist. [FILL] *With some debris (brick fragments, wood/lumber, glass, tiles, coal, ash, metal wires, weathered mortar) below 1.7 ft.*	Approx. 16 to 21-in.-thick mortared stone wall observed to bottom of test pit. Backwall was roughly vertical.
		5.8'	
		Gray, fine to medium SAND, trace to little gravel, trace to little silt, with some debris (brick fragments, tile, weathered mortar, coal), with trace organics (roots, fibers); moist. [FILL] *Wet below 6.7 ft due to seepage.*	Minor caving below approximately 5.9 ft.
		6.8'	
		End of test pit at 6.8 ft.	



Photo 1 - Overview of TP-4.

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Relative soil densities and consistencies, where noted, are estimates based on visual observation only.
3. Water level observations were made at time of excavation. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements were made.

W&S TEST PIT LOG - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 12/11/18 15:23 - \\WSE03.LOCAL\WSE\PROJECTS\MAP\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.06 - BDG - TEST PITS\PEABODY RIVERWALK TEST PIT LOGS.GPJ

TEST PIT NUMBER: **TP-5**

CLIENT: City of Peabody
PROJECT NUMBER: 2180658
PROJECT: MVP Action Grant
LOCATION: Peabody, MA
LOGGED BY: BDG
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractor
OPERATOR: Brett Raiche
EXCAVATOR: Kubota U17
BUCKET TYPE: Toothed, 1-ft wide
TEST PIT LOCATION: 21 Caller St.
GROUND ELEVATION: 10 ft. +/- (NAVD 88)
DATE STARTED: 11/6/2018
DATE COMPLETED: 11/6/2018

3.5 ft. +/-
Plan Sketch (NTS)
1.5 ft. +/-

Material Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%		
trace	0 - 10%	trace organics	< 5%

Remarks and Tests

P200 = Percent passing the #200 sieve (laborator value)
MC = Moisture content, % (laboratory value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/6/2018
Depth: 4.6 ft. +/-

Depth Scale, ft.	Strata Description and Graphic Log	Material Description	Remarks and Tests
1	FILL	Brown, fine to coarse SAND, trace to some gravel, trace to little silt, with trace to some organics (roots), with trace debris (coal), with few cobbles; moist. [FILL]	20-in.-thick dry-stacked granite block wall observed to bottom of test pit. Backwall was roughly vertical.
2			
3			
4		4.0'	
4		Gray, fine to medium SAND, trace to some gravel, trace to some silt, with trace to some debris (coal, brick fragments), with trace organics (roots, fibers); moist. [FILL] *Wet below 4.6 ft due to seepage.*	
5		5.6'	
		End of test pit at 5.6 ft.	



Photo 1 - Overview of TP-5.

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.
2. Relative soil densities and consistencies, where noted, are estimates based on visual observation only.
3. Water level observations were made at time of excavation. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements were made.

W&S TEST PIT LOG - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 12/11/18 15:23 - \\WSE03.LOCAL\WSE\PROJECTS\MAP\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.06 - BDG - TEST PITS\PEABODY RIVERWALK TEST PIT LOGS.GPJ

TEST PIT NUMBER: **TP-6**

Weston & Sampson

CLIENT: City of Peabody
PROJECT: MVP Action Grant
LOGGED BY: BDG
PROJECT NUMBER: 2180658
LOCATION: Peabody, MA
CHECKED BY: SJB

CONTRACTOR: New England Boring Contractor
TEST PIT LOCATION: 21 Caller St.
OPERATOR: Brett Raiche
GROUND ELEVATION: 9 ft. +/- (NAVD 88)
EXCAVATOR: Kubota U17
DATE STARTED: 11/6/2018
BUCKET TYPE: Toothed, 1-ft wide
DATE COMPLETED: 11/6/2018

5.5 ft. +/-
Plan Sketch (NTS)
1.5 ft. +/-

Material Description

General Format: Density/consistency, color, classification name (secondary PRIMARY, additional); moisture, additional information. [UNIT NAME and/or ORIGIN]

Soil Classification Name Guide based on Constituent Percentages

Mineral Soil		Organic Soils	
GRAVEL, SAND, SILT, CLAY	> 50%	PEAT	> 50%
gravelly, sandy, silty, clayey	35 - 50%	organic (soil name)	15 - 50%
some	20 - 35%	(soil name) with some organics	5 - 15%
little	10 - 20%		
trace	0 - 10%	trace organics	< 5%

Remarks and Tests

P200 = Percent passing the #200 sieve (laborator value)
MC = Moisture content, % (laboratory value)
OC = Organic content, % (laboratory value)

Groundwater Observations

Date: 11/6/2018
Depth: 5.3 ft. +/-

Depth Scale, ft.	Strata Description and Graphic Log	Material Description	Remarks and Tests
1–5	FILL	Brown, fine to coarse SAND, little to gravelly, trace to little silt, with trace to some organics (roots), with occasional cobbles; moist. [FILL]	No wall structure visible in test pit.
		3.8' Gray to blueish gray, fine to medium SAND, trace to little gravel, trace to little silt, with trace debris (glass, brick fragments), with trace organics (roots, fibers), with few cobbles; moist. [FILL]	
		Wet below 5.3 ft due to seepage.	
		5.6' End of test pit at 5.6 ft.	



Photo 1 - Overview of TP-6.

GENERAL NOTES

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.

2. Relative soil densities and consistencies, where noted, are estimates based on visual observation only.

3. Water level observations were made at time of excavation. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements were made.

W&S TEST PIT LOG - DATA TEMPLATE - WSE STANDARD LOGS.GDT - 12/11/18 15:24 - \\WSE03.LOCAL\WSE\PROJECTS\MAP\PEABODY MA\MVP ACTION GRANT 2018\TASK 2 - ENGINEERING SERVICES & ALTERNATIVES ANALYSIS\GEOTECHNICAL\FIELD\2018.11.06 - BDG - TEST PITS\PEABODY RIVERWALK TEST PIT LOGS.GPJ

APPENDIX E

Geotechnical Analytical Laboratory Report

Client:	Weston & Sampson Engineers				
Project:	Peabody Riverwalk				
Location:	Peabody, MA			Project No:	GTX-309194
Boring ID:	B-7	Sample Type:	jar	Tested By:	GA
Sample ID:	S5	Test Date:	12/06/18	Checked By:	emm
Depth :	8-10 ft	Test Id:	483764		
Test Comment:	---				
Visual Description:	Moist, dark gray sandy clay with organics				
Sample Comment:	---				

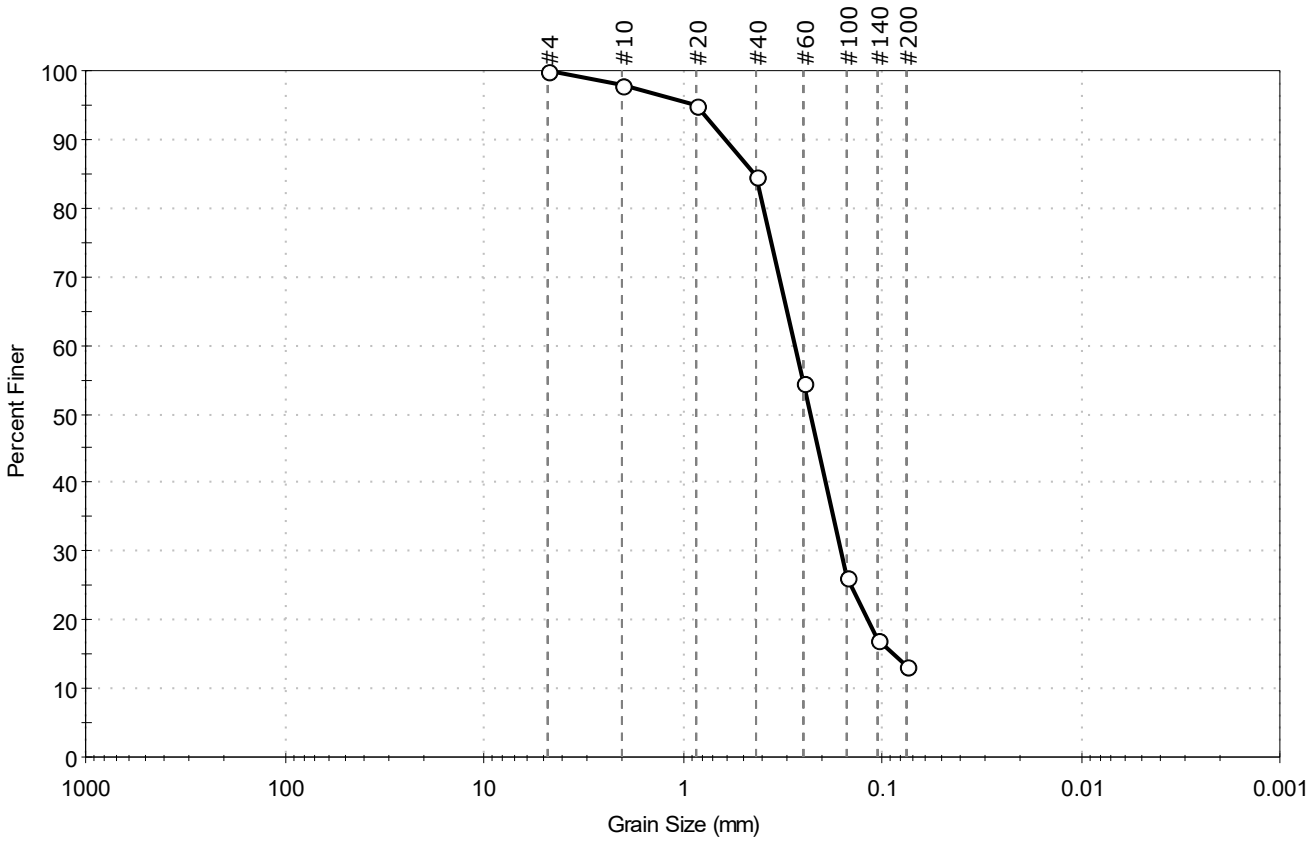
Moisture, Ash, and Organic Matter - ASTM D2974

Boring ID	Sample ID	Depth	Description	Moisture Content,%	Ash Content,%	Organic Matter,%
B-7	S5	8-10 ft	Moist, dark gray sandy clay with organics	93	89.4	10.6

Notes: Moisture content determined by Method A and reported as a percentage of oven-dried mass; dried to a constant mass at temperature of 105º C
Ash content and organic matter determined by Method C; dried to constant mass at temperature 440º C

Client:	Weston & Sampson Engineers				
Project:	Peabody Riverwalk				
Location:	Peabody, MA			Project No:	GTX-309194
Boring ID:	B-1	Sample Type:	jar	Tested By:	GA
Sample ID:	S6	Test Date:	12/06/18	Checked By:	emm
Depth :	11-13 ft	Test Id:	483340		
Test Comment:	---				
Visual Description:	Moist, very dark gray silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	86.7	13.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	98		
#20	0.85	95		
#40	0.42	85		
#60	0.25	55		
#100	0.15	26		
#140	0.11	17		
#200	0.075	13		

Coefficients

D_{85} = 0.4375 mm D_{30} = 0.1606 mm

D_{60} = 0.2749 mm D_{15} = 0.0873 mm

D_{50} = 0.2300 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

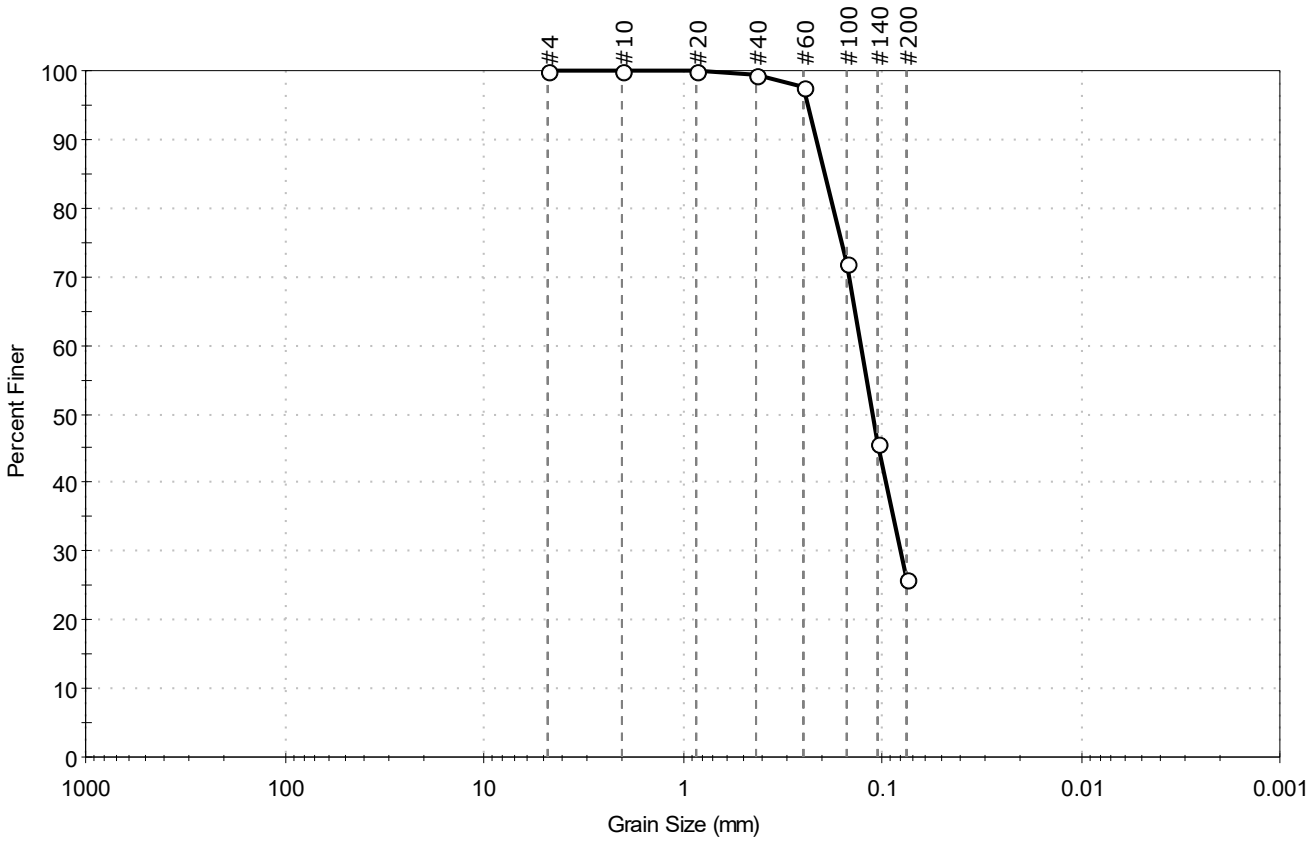
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Weston & Sampson Engineers				
Project:	Peabody Riverwalk				
Location:	Peabody, MA			Project No:	GTX-309194
Boring ID:	B-2	Sample Type:	jar	Tested By:	GA
Sample ID:	S5 (bottom)	Test Date:	12/06/18	Checked By:	emm
Depth :	9-10 ft	Test Id:	483341		
Test Comment:	---				
Visual Description:	Moist, light grayish brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	0.0	74.1	25.9

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	98		
#100	0.15	72		
#140	0.11	46		
#200	0.075	26		

Coefficients

D_{85} = 0.1946 mm D_{30} = 0.0806 mm

D_{60} = 0.1282 mm D_{15} = N/A

D_{50} = 0.1123 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

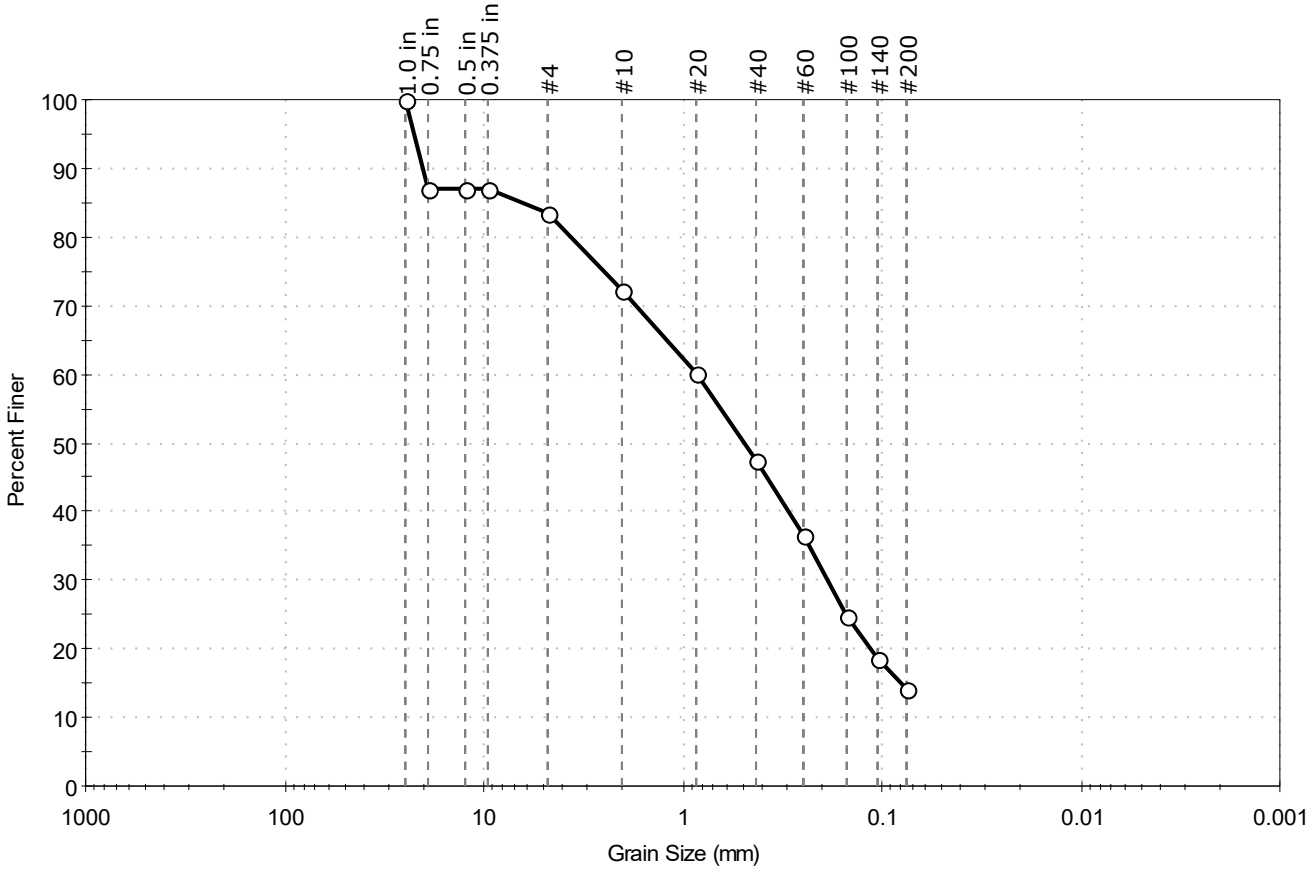
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Weston & Sampson Engineers				
Project:	Peabody Riverwalk				
Location:	Peabody, MA			Project No:	GTX-309194
Boring ID:	B-3	Sample Type:	jar	Tested By:	GA
Sample ID:	S4 (bottom)	Test Date:	12/06/18	Checked By:	emm
Depth :	9-10 ft	Test Id:	483342		
Test Comment:	---				
Visual Description:	Moist, dark yellowish brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	16.6	69.3	14.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.0 in	25.00	100		
0.75 in	19.00	87		
0.5 in	12.50	87		
0.375 in	9.50	87		
#4	4.75	83		
#10	2.00	72		
#20	0.85	60		
#40	0.42	48		
#60	0.25	37		
#100	0.15	25		
#140	0.11	19		
#200	0.075	14		

Coefficients

D_{85} = 6.4529 mm
D_{30} = 0.1878 mm
D_{60} = 0.8359 mm
D_{15} = 0.0803 mm
D_{50} = 0.4863 mm
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

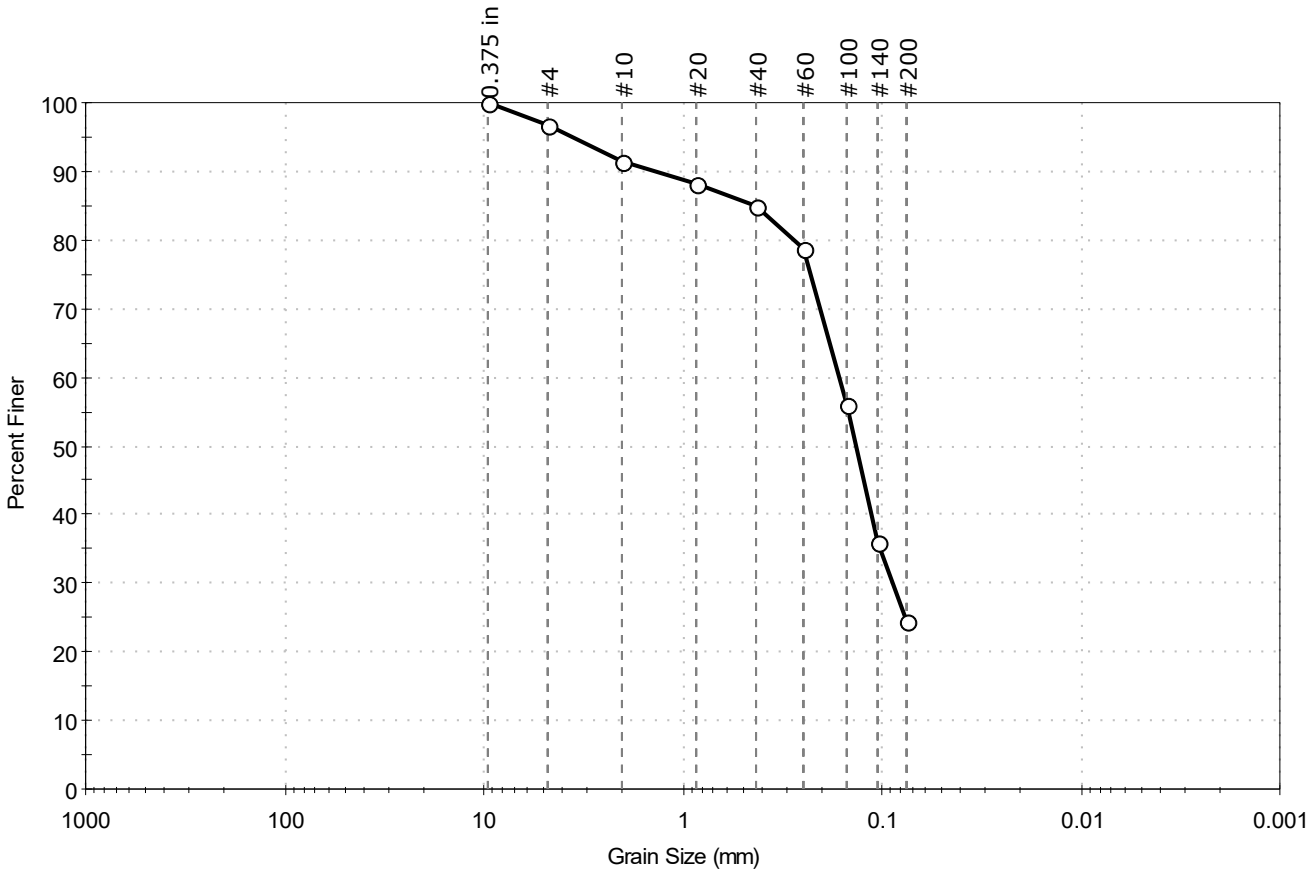
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Weston & Sampson Engineers				
Project:	Peabody Riverwalk				
Location:	Peabody, MA			Project No:	GTX-309194
Boring ID:	B-4	Sample Type:	jar	Tested By:	GA
Sample ID:	S3	Test Date:	12/06/18	Checked By:	emm
Depth :	4-6 ft	Test Id:	483343		
Test Comment:	---				
Visual Description:	Moist, dark gray silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	3.3	72.1	24.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	97		
#10	2.00	92		
#20	0.85	88		
#40	0.42	85		
#60	0.25	79		
#100	0.15	56		
#140	0.11	36		
#200	0.075	25		

Coefficients

D_{85} = 0.4313 mm D_{30} = 0.0885 mm

D_{60} = 0.1639 mm D_{15} = N/A

D_{50} = 0.1352 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

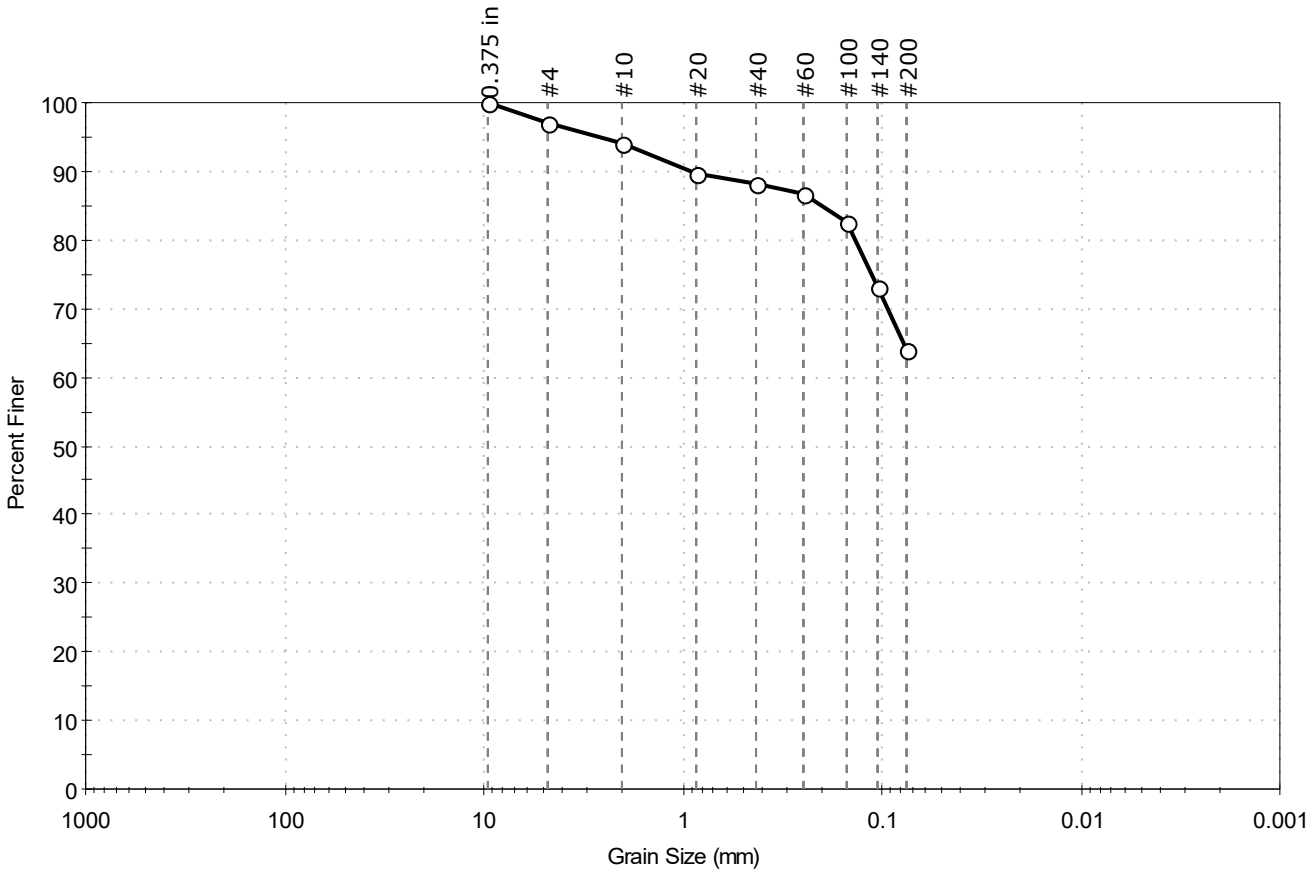
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Weston & Sampson Engineers				
Project:	Peabody Riverwalk				
Location:	Peabody, MA			Project No:	GTX-309194
Boring ID:	B-6	Sample Type:	jar	Tested By:	GA
Sample ID:	S6	Test Date:	12/06/18	Checked By:	emm
Depth :	14-16 ft	Test Id:	483344		
Test Comment:	---				
Visual Description:	Moist, gray sandy silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	3.1	33.0	63.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	97		
#10	2.00	94		
#20	0.85	90		
#40	0.42	88		
#60	0.25	87		
#100	0.15	83		
#140	0.11	73		
#200	0.075	64		

Coefficients

D_{85} = 0.2000 mm	D_{30} = N/A
D_{60} = N/A	D_{15} = N/A
D_{50} = N/A	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

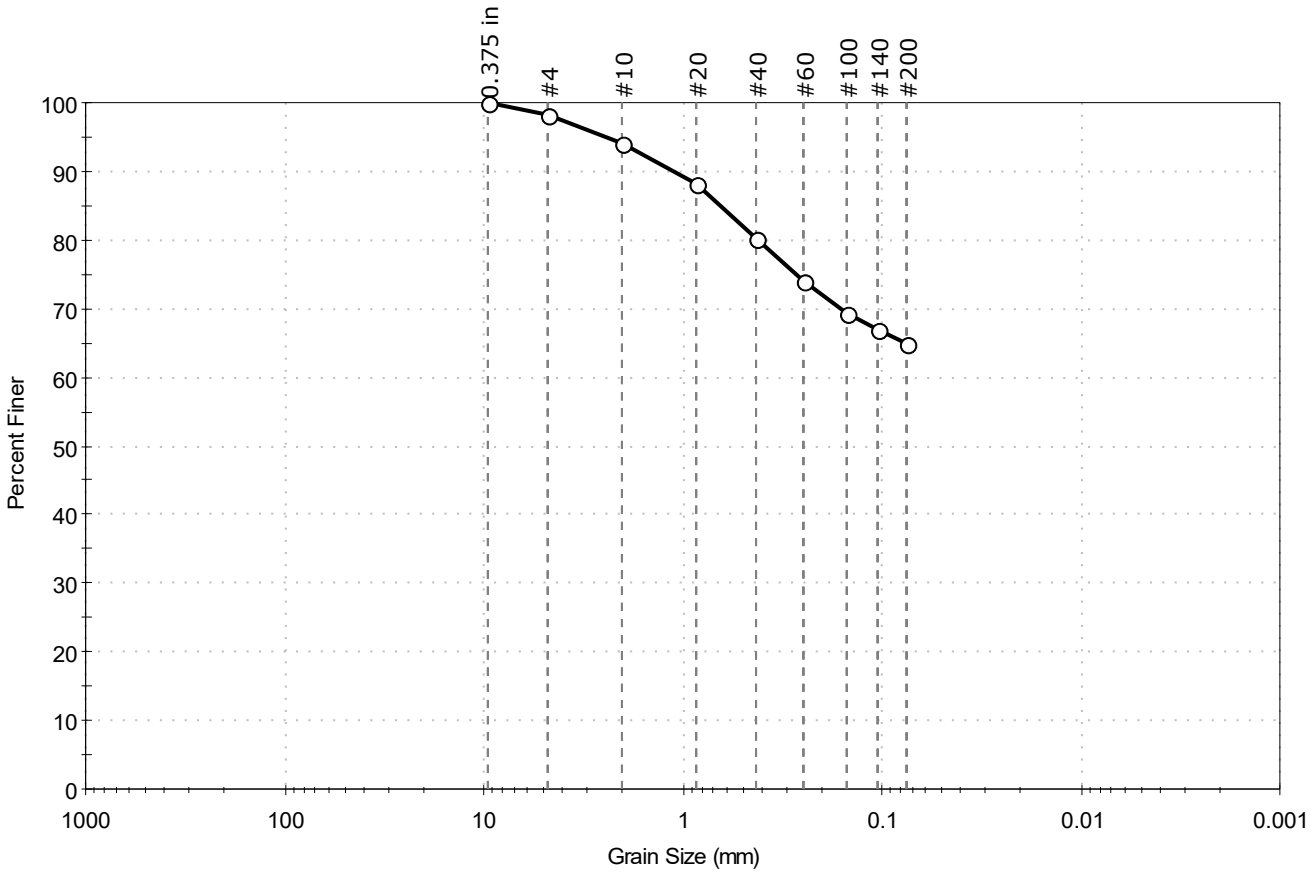
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Weston & Sampson Engineers				
Project:	Peabody Riverwalk				
Location:	Peabody, MA			Project No:	GTX-309194
Boring ID:	B-7	Sample Type:	jar	Tested By:	GA
Sample ID:	S5	Test Date:	12/06/18	Checked By:	emm
Depth :	8-10 ft	Test Id:	483345		
Test Comment:	---				
Visual Description:	Moist, dark gray sandy clay with organics				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	1.6	33.5	64.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	98		
#10	2.00	94		
#20	0.85	88		
#40	0.42	80		
#60	0.25	74		
#100	0.15	69		
#140	0.11	67		
#200	0.075	65		

Coefficients

D_{85} = 0.6414 mm	D_{30} = N/A
D_{60} = N/A	D_{15} = N/A
D_{50} = N/A	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

APPENDIX F

Disposal Characterization Analytical Laboratory Report

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

November 13, 2018

Sarah DeStefano
Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960

Project Location: North River Canal- Peabody, MA
Client Job Number:
Project Number: 2180658
Laboratory Work Order Number: 18K0257

Enclosed are results of analyses for samples received by the laboratory on November 6, 2018. If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Meghan E. Kelley
Project Manager

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Weston & Sampson Engineers MA
5 Centennial Drive
Peabody, MA 01960
ATTN: Sarah DeStefano

REPORT DATE: 11/13/2018

PURCHASE ORDER NUMBER:

PROJECT NUMBER: 2180658

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 18K0257

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: North River Canal- Peabody, MA

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
TP-5 (5-6')	18K0257-01	Soil		SM 2540G	
				SM21-22 2510B Modified	
				SM2580 A	
				SW-846 1010A	
				SW-846 1030	
				SW-846 6010D	
				SW-846 7196A	
				SW-846 7471B	
				SW-846 8082A	
				SW-846 8100 Modified	
				SW-846 8260C	
				SW-846 8270D	
				SW-846 9014	
				SW-846 9030A	
				SW-846 9045C	

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

CASE NARRATIVE SUMMARY

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

For method 6010, only a select list of metals was requested and reported.

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

SW-846 7196A

Qualifications:

MS-16

For solid method SW846-7196A, the matrix spike is outside of control limits. pH and ORP results were indicative of reducing conditions. Reanalysis is not required. Analysis is in control based on LCS recoveries.

Analyte & Samples(s) Qualified:

Hexavalent Chromium

18K0257-01[TP-5 (5-6')], B216585-MS1, B216585-MS2, B216585-MS3, B216585-MSD1

W-06

Elevated method reporting limit due to intense color of sample

Analyte & Samples(s) Qualified:

Hexavalent Chromium

18K0257-01[TP-5 (5-6')]

SW-846 8082A

Qualifications:

O-32

A dilution was performed as part of the standard analytical procedure.

Analyte & Samples(s) Qualified:

18K0257-01[TP-5 (5-6')]

SW-846 8260C

Qualifications:

V-16

Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.

Analyte & Samples(s) Qualified:

1,4-Dioxane

18K0257-01[TP-5 (5-6')], B216709-BLK1, B216709-BS1, B216709-BSD1

V-34

Initial calibration verification (ICV) did not meet method specifications and was biased on the low side for this compound. Reported result is estimated.

Analyte & Samples(s) Qualified:

Bromomethane

18K0257-01[TP-5 (5-6')], B216709-BLK1, B216709-BS1, B216709-BSD1, S029248-CCV1

SW-846 8270D

Qualifications:

V-05

Continuing calibration did not meet method specifications and was biased on the low side for this compound.

Analyte & Samples(s) Qualified:

Aniline

18K0257-01[TP-5 (5-6')], B216591-BLK1, B216591-BS1, B216591-BSD1

Pyridine

B216591-BLK1, B216591-BS1, B216591-BSD1

V-06

Continuing calibration did not meet method specifications and was biased on the high side for this compound.

Analyte & Samples(s) Qualified:

4-Nitrophenol

B216591-BS1, B216591-BSD1

V-19

Initial calibration did not meet method specifications. Compound was calibrated using linear regression with correlation coefficient <0.99. Reported result is estimated.

Analyte & Samples(s) Qualified:

2,4-Dinitrophenol

18K0257-01[TP-5 (5-6')], B216591-BLK1, B216591-BS1, B216591-BSD1

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

V-20

Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.

Analyte & Samples(s) Qualified:

4-Nitrophenol
B216591-BLK1

V-34

Initial calibration verification (ICV) did not meet method specifications and was biased on the low side for this compound. Reported result is estimated.

Analyte & Samples(s) Qualified:

4-Bromophenylphenylether
B216591-BSD1

4-Chloroaniline
18K0257-01[TP-5 (5-6')], B216591-BLK1, B216591-BS1, B216591-BSD1

Aniline
18K0257-01[TP-5 (5-6')], B216591-BLK1, B216591-BS1, B216591-BSD1

SW-846 8100 Modified

TPH (C9-C36) is quantitated against a calibration made with a diesel standard.

SW-846 8260C

Laboratory control sample recoveries for required MCP Data Enhancement 8260 compounds were all within limits specified by the method except for “difficult analytes” where recovery control limits of 40-160% are used and/or unless otherwise listed in this narrative. Difficult analytes: MIBK, MEK, acetone, 1,4-dioxane, chloromethane, dichlorodifluoromethane, 2-hexanone, and bromomethane.

SW-846 8270D

Laboratory control sample recoveries for required MCP Data Enhancement 8270 compounds were all within control limits specified by the method, 40-140% for base/neutrals and 30-130% for acids except for “difficult analytes” listed below and/or otherwise listed in this narrative. Difficult analytes limits are 15 and 140%: 2,4-dinitrophenol, 4-chloroaniline, 4-nitrophenol, and phenol.

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Lisa A. Worthington
Project Manager

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acetone	ND	0.15	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
tert-Amyl Methyl Ether (TAME)	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Benzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Bromobenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Bromochloromethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Bromodichloromethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Bromoform	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Bromomethane	ND	0.015	mg/Kg dry	1	V-34	SW-846 8260C	11/8/18	11/8/18 12:52	MFF
2-Butanone (MEK)	ND	0.059	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
n-Butylbenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
sec-Butylbenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
tert-Butylbenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
tert-Butyl Ethyl Ether (TBEE)	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Carbon Disulfide	ND	0.0089	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Carbon Tetrachloride	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Chlorobenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Chlorodibromomethane	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Chloroethane	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Chloroform	ND	0.0059	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Chloromethane	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
2-Chlorotoluene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
4-Chlorotoluene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2-Dibromoethane (EDB)	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Dibromomethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2-Dichlorobenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,3-Dichlorobenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,4-Dichlorobenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Dichlorodifluoromethane (Freon 12)	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,1-Dichloroethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2-Dichloroethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,1-Dichloroethylene	ND	0.0059	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
cis-1,2-Dichloroethylene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
trans-1,2-Dichloroethylene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2-Dichloropropane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,3-Dichloropropane	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
2,2-Dichloropropane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,1-Dichloropropene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
cis-1,3-Dichloropropene	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
trans-1,3-Dichloropropene	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Diethyl Ether	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Diisopropyl Ether (DIPE)	ND	0.0015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,4-Dioxane	ND	0.15	mg/Kg dry	1	V-16	SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Ethylbenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Volatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Hexachlorobutadiene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
2-Hexanone (MBK)	ND	0.030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Isopropylbenzene (Cumene)	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
p-Isopropyltoluene (p-Cymene)	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Methyl tert-Butyl Ether (MTBE)	ND	0.0059	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Methylene Chloride	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
4-Methyl-2-pentanone (MIBK)	ND	0.030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Naphthalene	ND	0.0059	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
n-Propylbenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Styrene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,1,1,2-Tetrachloroethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,1,2,2-Tetrachloroethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Tetrachloroethylene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Tetrahydrofuran	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Toluene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2,3-Trichlorobenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2,4-Trichlorobenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,1,1-Trichloroethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,1,2-Trichloroethane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Trichloroethylene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Trichlorofluoromethane (Freon 11)	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2,3-Trichloropropane	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,2,4-Trimethylbenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
1,3,5-Trimethylbenzene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
Vinyl Chloride	ND	0.015	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
m+p Xylene	ND	0.0059	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF
o-Xylene	ND	0.0030	mg/Kg dry	1		SW-846 8260C	11/8/18	11/8/18 12:52	MFF

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
1,2-Dichloroethane-d4	96.5	70-130		11/8/18 12:52
Toluene-d8	99.6	70-130		11/8/18 12:52
4-Bromofluorobenzene	96.1	70-130		11/8/18 12:52

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Acenaphthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Acenaphthylene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Acetophenone	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Aniline	ND	0.44	mg/Kg dry	1	V-05, V-34	SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Anthracene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Benzo(a)anthracene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Benzo(a)pyrene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Benzo(b)fluoranthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Benzo(g,h,i)perylene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Benzo(k)fluoranthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Bis(2-chloroethoxy)methane	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Bis(2-chloroethyl)ether	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Bis(2-chloroisopropyl)ether	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Bis(2-Ethylhexyl)phthalate	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
4-Bromophenylphenylether	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Butylbenzylphthalate	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
4-Chloroaniline	ND	0.86	mg/Kg dry	1	V-34	SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2-Chloronaphthalene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2-Chlorophenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Chrysene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Dibenz(a,h)anthracene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Dibenzofuran	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Di-n-butylphthalate	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
1,2-Dichlorobenzene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
1,3-Dichlorobenzene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
1,4-Dichlorobenzene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
3,3-Dichlorobenzidine	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2,4-Dichlorophenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Diethylphthalate	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2,4-Dimethylphenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Dimethylphthalate	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2,4-Dinitrophenol	ND	0.86	mg/Kg dry	1	V-19	SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2,4-Dinitrotoluene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2,6-Dinitrotoluene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Di-n-octylphthalate	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
1,2-Diphenylhydrazine/Azobenzene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Fluoranthene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Fluorene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Hexachlorobenzene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Hexachlorobutadiene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Hexachloroethane	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Indeno(1,2,3-cd)pyrene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Isophorone	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2-Methylnaphthalene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Semivolatile Organic Compounds by GC/MS

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
2-Methylphenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
3/4-Methylphenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Naphthalene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Nitrobenzene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2-Nitrophenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
4-Nitrophenol	ND	0.86	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Pentachlorophenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Phenanthrene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Phenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
Pyrene	ND	0.22	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
1,2,4-Trichlorobenzene	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2,4,5-Trichlorophenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL
2,4,6-Trichlorophenol	ND	0.44	mg/Kg dry	1		SW-846 8270D	11/7/18	11/9/18 17:46	BGL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
2-Fluorophenol	72.3	30-130		11/9/18 17:46
Phenol-d6	82.6	30-130		11/9/18 17:46
Nitrobenzene-d5	71.3	30-130		11/9/18 17:46
2-Fluorobiphenyl	51.0	30-130		11/9/18 17:46
2,4,6-Tribromophenol	99.2	30-130		11/9/18 17:46
p-Terphenyl-d14	57.1	30-130		11/9/18 17:46

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Sample Flags: O-32

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1221 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1232 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1242 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1248 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1254 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1260 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1262 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG
Aroclor-1268 [1]	ND	0.10	mg/Kg dry	4		SW-846 8082A	11/7/18	11/8/18 23:49	TG

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	93.4	30-150		11/8/18 23:49
Decachlorobiphenyl [2]	96.1	30-150		11/8/18 23:49
Tetrachloro-m-xylene [1]	94.3	30-150		11/8/18 23:49
Tetrachloro-m-xylene [2]	101	30-150		11/8/18 23:49

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Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Petroleum Hydrocarbons Analyses

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
TPH (C9-C36)	18	11	mg/Kg dry	1		SW-846 8100 Modified	11/7/18	11/8/18 12:56	KLB

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
2-Fluorobiphenyl	54.5	40-140		11/8/18 12:56

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Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Metals Analyses (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Arsenic	11	2.1	mg/Kg dry	1		SW-846 6010D	11/9/18	11/12/18 15:56	QNW
Barium	31	2.1	mg/Kg dry	1		SW-846 6010D	11/9/18	11/12/18 15:56	QNW
Cadmium	0.51	0.21	mg/Kg dry	1		SW-846 6010D	11/9/18	11/12/18 15:56	QNW
Chromium	34	0.43	mg/Kg dry	1		SW-846 6010D	11/9/18	11/12/18 15:56	QNW
Lead	42	0.64	mg/Kg dry	1		SW-846 6010D	11/9/18	11/12/18 15:56	QNW
Mercury	0.099	0.032	mg/Kg dry	1		SW-846 7471B	11/13/18	11/13/18 12:26	EJB
Selenium	ND	4.3	mg/Kg dry	1		SW-846 6010D	11/9/18	11/12/18 15:56	QNW
Silver	ND	0.43	mg/Kg dry	1		SW-846 6010D	11/9/18	11/12/18 15:56	QNW

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Project Location: North River Canal- Peabody, MA Sample Description: Work Order: 18K0257

Date Received: 11/6/2018

Field Sample #: TP-5 (5-6') Sampled: 11/6/2018 08:30

Sample ID: 18K0257-01

Sample Matrix: Soil

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total)

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Flashpoint	> 212 °F		°F	1		SW-846 1010A	11/8/18	11/8/18 19:00	DJM
Hexavalent Chromium	ND	1.0	mg/Kg dry	5	MS-16, W-06	SW-846 7196A	11/7/18	11/8/18 7:40	LL
Ignitability	Absent		present/absent	1		SW-846 1030	11/7/18	11/7/18 14:47	LED
Oxidation/Reduction Potential	130		mV	1		SM2580 A	11/6/18	11/6/18 22:41	LED
pH @20°C	6.5		pH Units	1		SW-846 9045C	11/6/18	11/6/18 22:41	LED
Reactive Cyanide	ND	0.0039	mg/Kg	1		SW-846 9014	11/8/18	11/8/18 13:45	DJM
Reactive Sulfide	ND	20	mg/Kg	1		SW-846 9030A	11/8/18	11/8/18 13:30	DJM
Specific conductance	9.8	2.0	µmhos/cm	1		SM21-22 2510B Modified	11/7/18	11/7/18 16:30	EC
% Solids	75.9		% Wt	1		SM 2540G	11/12/18	11/13/18 9:40	ITB

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Sample Extraction Data

Prep Method: % Solids-SM 2540G

Lab Number [Field ID]	Batch	Date
18K0257-01 [TP-5 (5-6')]	B216981	11/12/18

SM21-22 2510B Modified

Lab Number [Field ID]	Batch	Initial [g]	Date
18K0257-01 [TP-5 (5-6')]	B216620	1.00	11/07/18

SM2580 A

Lab Number [Field ID]	Batch	Initial [g]	Date
18K0257-01 [TP-5 (5-6')]	B216566	20.0	11/06/18

SW-846 1010A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216786	50.0	50.0	11/08/18

SW-846 1030

Lab Number [Field ID]	Batch	Initial [g]	Date
18K0257-01 [TP-5 (5-6')]	B216677	50.0	11/07/18

Prep Method: SW-846 3050B-SW-846 6010D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216858	1.53	50.0	11/09/18

SW-846 7196A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216585	2.56	100	11/07/18

Prep Method: SW-846 7471-SW-846 7471B

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B217015	0.613	50.0	11/13/18

Prep Method: SW-846 3540C-SW-846 8082A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216572	10.2	10.0	11/07/18

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Sample Extraction Data

Prep Method: SW-846 3546-SW-846 8100 Modified

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216634	30.0	1.00	11/07/18

Prep Method: SW-846 5035-SW-846 8260C

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216709	4.44	10.0	11/08/18

Prep Method: SW-846 3546-SW-846 8270D

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216591	30.5	1.00	11/07/18

SW-846 9014

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216706	25400	250	11/08/18

SW-846 9030A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
18K0257-01 [TP-5 (5-6')]	B216755	25.3	250	11/08/18

SW-846 9045C

Lab Number [Field ID]	Batch	Initial [g]	Date
18K0257-01 [TP-5 (5-6')]	B216565	20.0	11/06/18

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B216709 - SW-846 5035										
Blank (B216709-BLK1)				Prepared & Analyzed: 11/08/18						
Acetone	ND	0.10	mg/Kg wet							
tert-Amyl Methyl Ether (TAME)	ND	0.0010	mg/Kg wet							
Benzene	ND	0.0020	mg/Kg wet							
Bromobenzene	ND	0.0020	mg/Kg wet							
Bromochloromethane	ND	0.0020	mg/Kg wet							
Bromodichloromethane	ND	0.0020	mg/Kg wet							
Bromoform	ND	0.0020	mg/Kg wet							
Bromomethane	ND	0.010	mg/Kg wet							V-34
2-Butanone (MEK)	ND	0.040	mg/Kg wet							
n-Butylbenzene	ND	0.0020	mg/Kg wet							
sec-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butylbenzene	ND	0.0020	mg/Kg wet							
tert-Butyl Ethyl Ether (TBEE)	ND	0.0010	mg/Kg wet							
Carbon Disulfide	ND	0.0060	mg/Kg wet							
Carbon Tetrachloride	ND	0.0020	mg/Kg wet							
Chlorobenzene	ND	0.0020	mg/Kg wet							
Chlorodibromomethane	ND	0.0010	mg/Kg wet							
Chloroethane	ND	0.010	mg/Kg wet							
Chloroform	ND	0.0040	mg/Kg wet							
Chloromethane	ND	0.010	mg/Kg wet							
2-Chlorotoluene	ND	0.0020	mg/Kg wet							
4-Chlorotoluene	ND	0.0020	mg/Kg wet							
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.0020	mg/Kg wet							
1,2-Dibromoethane (EDB)	ND	0.0010	mg/Kg wet							
Dibromomethane	ND	0.0020	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.0020	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.0020	mg/Kg wet							
Dichlorodifluoromethane (Freon 12)	ND	0.010	mg/Kg wet							
1,1-Dichloroethane	ND	0.0020	mg/Kg wet							
1,2-Dichloroethane	ND	0.0020	mg/Kg wet							
1,1-Dichloroethylene	ND	0.0040	mg/Kg wet							
cis-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
trans-1,2-Dichloroethylene	ND	0.0020	mg/Kg wet							
1,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,3-Dichloropropane	ND	0.0010	mg/Kg wet							
2,2-Dichloropropane	ND	0.0020	mg/Kg wet							
1,1-Dichloropropene	ND	0.0020	mg/Kg wet							
cis-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
trans-1,3-Dichloropropene	ND	0.0010	mg/Kg wet							
Diethyl Ether	ND	0.010	mg/Kg wet							
Diisopropyl Ether (DIPE)	ND	0.0010	mg/Kg wet							
1,4-Dioxane	ND	0.10	mg/Kg wet							V-16
Ethylbenzene	ND	0.0020	mg/Kg wet							
Hexachlorobutadiene	ND	0.0020	mg/Kg wet							
2-Hexanone (MBK)	ND	0.020	mg/Kg wet							
Isopropylbenzene (Cumene)	ND	0.0020	mg/Kg wet							
p-Isopropyltoluene (p-Cymene)	ND	0.0020	mg/Kg wet							
Methyl tert-Butyl Ether (MTBE)	ND	0.0040	mg/Kg wet							
Methylene Chloride	ND	0.010	mg/Kg wet							
4-Methyl-2-pentanone (MIBK)	ND	0.020	mg/Kg wet							
Naphthalene	ND	0.0040	mg/Kg wet							

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B216709 - SW-846 5035											
Blank (B216709-BLK1)				Prepared & Analyzed: 11/08/18							
n-Propylbenzene	ND	0.0020	mg/Kg wet								
Styrene	ND	0.0020	mg/Kg wet								
1,1,1,2-Tetrachloroethane	ND	0.0020	mg/Kg wet								
1,1,2,2-Tetrachloroethane	ND	0.0010	mg/Kg wet								
Tetrachloroethylene	ND	0.0020	mg/Kg wet								
Tetrahydrofuran	ND	0.010	mg/Kg wet								
Toluene	ND	0.0020	mg/Kg wet								
1,2,3-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,2,4-Trichlorobenzene	ND	0.0020	mg/Kg wet								
1,1,1-Trichloroethane	ND	0.0020	mg/Kg wet								
1,1,2-Trichloroethane	ND	0.0020	mg/Kg wet								
Trichloroethylene	ND	0.0020	mg/Kg wet								
Trichlorofluoromethane (Freon 11)	ND	0.010	mg/Kg wet								
1,2,3-Trichloropropane	ND	0.0020	mg/Kg wet								
1,2,4-Trimethylbenzene	ND	0.0020	mg/Kg wet								
1,3,5-Trimethylbenzene	ND	0.0020	mg/Kg wet								
Vinyl Chloride	ND	0.010	mg/Kg wet								
m+p Xylene	ND	0.0040	mg/Kg wet								
o-Xylene	ND	0.0020	mg/Kg wet								
Surrogate: 1,2-Dichloroethane-d4	*0.0483*		mg/Kg wet	0.0500		96.6	70-130				
Surrogate: Toluene-d8	*0.0492*		mg/Kg wet	0.0500		98.4	70-130				
Surrogate: 4-Bromofluorobenzene	*0.0491*		mg/Kg wet	0.0500		98.2	70-130				
LCS (B216709-BS1)				Prepared & Analyzed: 11/08/18							
Acetone	0.310	0.10	mg/Kg wet	0.200		155	40-160			L-14	†
tert-Amyl Methyl Ether (TAME)	0.0198	0.0010	mg/Kg wet	0.0200		99.0	70-130				
Benzene	0.0197	0.0020	mg/Kg wet	0.0200		98.6	70-130				
Bromobenzene	0.0195	0.0020	mg/Kg wet	0.0200		97.3	70-130				
Bromochloromethane	0.0209	0.0020	mg/Kg wet	0.0200		104	70-130				
Bromodichloromethane	0.0193	0.0020	mg/Kg wet	0.0200		96.6	70-130				
Bromoform	0.0195	0.0020	mg/Kg wet	0.0200		97.5	70-130				
Bromomethane	0.0112	0.010	mg/Kg wet	0.0200		56.0	40-160			L-14, V-34	†
2-Butanone (MEK)	0.261	0.040	mg/Kg wet	0.200		130	40-160				†
n-Butylbenzene	0.0202	0.0020	mg/Kg wet	0.0200		101	70-130				
sec-Butylbenzene	0.0204	0.0020	mg/Kg wet	0.0200		102	70-130				
tert-Butylbenzene	0.0200	0.0020	mg/Kg wet	0.0200		100	70-130				
tert-Butyl Ethyl Ether (TBEE)	0.0198	0.0010	mg/Kg wet	0.0200		99.0	70-130				
Carbon Disulfide	0.0208	0.0060	mg/Kg wet	0.0200		104	70-130				
Carbon Tetrachloride	0.0206	0.0020	mg/Kg wet	0.0200		103	70-130				
Chlorobenzene	0.0194	0.0020	mg/Kg wet	0.0200		96.9	70-130				
Chlorodibromomethane	0.0209	0.0010	mg/Kg wet	0.0200		104	70-130				
Chloroethane	0.0195	0.010	mg/Kg wet	0.0200		97.6	70-130				
Chloroform	0.0196	0.0040	mg/Kg wet	0.0200		98.2	70-130				
Chloromethane	0.0205	0.010	mg/Kg wet	0.0200		102	40-160				†
2-Chlorotoluene	0.0200	0.0020	mg/Kg wet	0.0200		100	70-130				
4-Chlorotoluene	0.0209	0.0020	mg/Kg wet	0.0200		104	70-130				
1,2-Dibromo-3-chloropropane (DBCP)	0.0195	0.0020	mg/Kg wet	0.0200		97.4	70-130				
1,2-Dibromoethane (EDB)	0.0209	0.0010	mg/Kg wet	0.0200		104	70-130				
Dibromomethane	0.0205	0.0020	mg/Kg wet	0.0200		103	70-130				
1,2-Dichlorobenzene	0.0201	0.0020	mg/Kg wet	0.0200		100	70-130				
1,3-Dichlorobenzene	0.0203	0.0020	mg/Kg wet	0.0200		101	70-130				
1,4-Dichlorobenzene	0.0197	0.0020	mg/Kg wet	0.0200		98.4	70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B216709 - SW-846 5035											
LCS (B216709-BS1)				Prepared & Analyzed: 11/08/18							
Dichlorodifluoromethane (Freon 12)	0.0192	0.010	mg/Kg wet	0.0200		95.8	40-160				†
1,1-Dichloroethane	0.0203	0.0020	mg/Kg wet	0.0200		101	70-130				
1,2-Dichloroethane	0.0203	0.0020	mg/Kg wet	0.0200		101	70-130				
1,1-Dichloroethylene	0.0200	0.0040	mg/Kg wet	0.0200		100	70-130				
cis-1,2-Dichloroethylene	0.0201	0.0020	mg/Kg wet	0.0200		100	70-130				
trans-1,2-Dichloroethylene	0.0200	0.0020	mg/Kg wet	0.0200		99.8	70-130				
1,2-Dichloropropane	0.0193	0.0020	mg/Kg wet	0.0200		96.5	70-130				
1,3-Dichloropropane	0.0191	0.0010	mg/Kg wet	0.0200		95.3	70-130				
2,2-Dichloropropane	0.0209	0.0020	mg/Kg wet	0.0200		105	70-130				
1,1-Dichloropropene	0.0203	0.0020	mg/Kg wet	0.0200		101	70-130				
cis-1,3-Dichloropropene	0.0203	0.0010	mg/Kg wet	0.0200		101	70-130				
trans-1,3-Dichloropropene	0.0212	0.0010	mg/Kg wet	0.0200		106	70-130				
Diethyl Ether	0.0193	0.010	mg/Kg wet	0.0200		96.7	70-130				
Diisopropyl Ether (DIPE)	0.0200	0.0010	mg/Kg wet	0.0200		100	70-130				
1,4-Dioxane	0.200	0.10	mg/Kg wet	0.200		100	40-160			V-16	†
Ethylbenzene	0.0194	0.0020	mg/Kg wet	0.0200		97.0	70-130				
Hexachlorobutadiene	0.0202	0.0020	mg/Kg wet	0.0200		101	70-130				
2-Hexanone (MBK)	0.231	0.020	mg/Kg wet	0.200		116	40-160				†
Isopropylbenzene (Cumene)	0.0204	0.0020	mg/Kg wet	0.0200		102	70-130				
p-Isopropyltoluene (p-Cymene)	0.0197	0.0020	mg/Kg wet	0.0200		98.5	70-130				
Methyl tert-Butyl Ether (MTBE)	0.0223	0.0040	mg/Kg wet	0.0200		111	70-130				
Methylene Chloride	0.0173	0.010	mg/Kg wet	0.0200		86.4	70-130				
4-Methyl-2-pentanone (MIBK)	0.208	0.020	mg/Kg wet	0.200		104	40-160				†
Naphthalene	0.0179	0.0040	mg/Kg wet	0.0200		89.6	70-130				
n-Propylbenzene	0.0201	0.0020	mg/Kg wet	0.0200		100	70-130				
Styrene	0.0192	0.0020	mg/Kg wet	0.0200		96.1	70-130				
1,1,1,2-Tetrachloroethane	0.0209	0.0020	mg/Kg wet	0.0200		104	70-130				
1,1,2,2-Tetrachloroethane	0.0191	0.0010	mg/Kg wet	0.0200		95.7	70-130				
Tetrachloroethylene	0.0198	0.0020	mg/Kg wet	0.0200		98.9	70-130				
Tetrahydrofuran	0.0193	0.010	mg/Kg wet	0.0200		96.5	70-130				
Toluene	0.0191	0.0020	mg/Kg wet	0.0200		95.4	70-130				
1,2,3-Trichlorobenzene	0.0195	0.0020	mg/Kg wet	0.0200		97.6	70-130				
1,2,4-Trichlorobenzene	0.0192	0.0020	mg/Kg wet	0.0200		96.2	70-130				
1,1,1-Trichloroethane	0.0201	0.0020	mg/Kg wet	0.0200		100	70-130				
1,1,2-Trichloroethane	0.0204	0.0020	mg/Kg wet	0.0200		102	70-130				
Trichloroethylene	0.0199	0.0020	mg/Kg wet	0.0200		99.3	70-130				
Trichlorofluoromethane (Freon 11)	0.0184	0.010	mg/Kg wet	0.0200		92.0	70-130				
1,2,3-Trichloropropane	0.0175	0.0020	mg/Kg wet	0.0200		87.6	70-130				
1,2,4-Trimethylbenzene	0.0192	0.0020	mg/Kg wet	0.0200		95.9	70-130				
1,3,5-Trimethylbenzene	0.0200	0.0020	mg/Kg wet	0.0200		99.8	70-130				
Vinyl Chloride	0.0188	0.010	mg/Kg wet	0.0200		94.0	70-130				
m+p Xylene	0.0399	0.0040	mg/Kg wet	0.0400		99.8	70-130				
o-Xylene	0.0196	0.0020	mg/Kg wet	0.0200		98.1	70-130				
Surrogate: 1,2-Dichloroethane-d4	*0.0520*		mg/Kg wet	0.0500		104	70-130				
Surrogate: Toluene-d8	*0.0501*		mg/Kg wet	0.0500		100	70-130				
Surrogate: 4-Bromofluorobenzene	*0.0503*		mg/Kg wet	0.0500		101	70-130				

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B216709 - SW-846 5035											
LCS Dup (B216709-BSD1)				Prepared & Analyzed: 11/08/18							
Acetone	0.269	0.10	mg/Kg wet	0.200		134	40-160	14.1	20	L-14	†
tert-Amyl Methyl Ether (TAME)	0.0211	0.0010	mg/Kg wet	0.0200		106	70-130	6.36	20		
Benzene	0.0208	0.0020	mg/Kg wet	0.0200		104	70-130	5.42	20		
Bromobenzene	0.0217	0.0020	mg/Kg wet	0.0200		109	70-130	11.1	20		
Bromochloromethane	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	2.37	20		
Bromodichloromethane	0.0206	0.0020	mg/Kg wet	0.0200		103	70-130	6.45	20		
Bromoform	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	7.44	20		
Bromomethane	0.0128	0.010	mg/Kg wet	0.0200		63.8	40-160	13.1	20	L-14, V-34	†
2-Butanone (MEK)	0.253	0.040	mg/Kg wet	0.200		127	40-160	2.78	20		†
n-Butylbenzene	0.0231	0.0020	mg/Kg wet	0.0200		115	70-130	13.1	20		
sec-Butylbenzene	0.0237	0.0020	mg/Kg wet	0.0200		118	70-130	14.9	20		
tert-Butylbenzene	0.0232	0.0020	mg/Kg wet	0.0200		116	70-130	14.5	20		
tert-Butyl Ethyl Ether (TBEE)	0.0210	0.0010	mg/Kg wet	0.0200		105	70-130	5.69	20		
Carbon Disulfide	0.0208	0.0060	mg/Kg wet	0.0200		104	70-130	0.0770	20		
Carbon Tetrachloride	0.0219	0.0020	mg/Kg wet	0.0200		109	70-130	6.00	20		
Chlorobenzene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130	11.6	20		
Chlorodibromomethane	0.0229	0.0010	mg/Kg wet	0.0200		114	70-130	9.15	20		
Chloroethane	0.0211	0.010	mg/Kg wet	0.0200		106	70-130	7.97	20		
Chloroform	0.0209	0.0040	mg/Kg wet	0.0200		105	70-130	6.23	20		
Chloromethane	0.0198	0.010	mg/Kg wet	0.0200		99.1	40-160	3.30	20		†
2-Chlorotoluene	0.0225	0.0020	mg/Kg wet	0.0200		112	70-130	11.4	20		
4-Chlorotoluene	0.0230	0.0020	mg/Kg wet	0.0200		115	70-130	9.68	20		
1,2-Dibromo-3-chloropropane (DBCP)	0.0216	0.0020	mg/Kg wet	0.0200		108	70-130	10.2	20		
1,2-Dibromoethane (EDB)	0.0230	0.0010	mg/Kg wet	0.0200		115	70-130	9.89	20		
Dibromomethane	0.0211	0.0020	mg/Kg wet	0.0200		106	70-130	2.89	20		
1,2-Dichlorobenzene	0.0232	0.0020	mg/Kg wet	0.0200		116	70-130	14.6	20		
1,3-Dichlorobenzene	0.0233	0.0020	mg/Kg wet	0.0200		116	70-130	13.8	20		
1,4-Dichlorobenzene	0.0221	0.0020	mg/Kg wet	0.0200		110	70-130	11.4	20		
Dichlorodifluoromethane (Freon 12)	0.0201	0.010	mg/Kg wet	0.0200		101	40-160	4.96	20		†
1,1-Dichloroethane	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130	7.26	20		
1,2-Dichloroethane	0.0215	0.0020	mg/Kg wet	0.0200		107	70-130	5.70	20		
1,1-Dichloroethylene	0.0211	0.0040	mg/Kg wet	0.0200		105	70-130	5.09	20		
cis-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	4.70	20		
trans-1,2-Dichloroethylene	0.0210	0.0020	mg/Kg wet	0.0200		105	70-130	4.91	20		
1,2-Dichloropropane	0.0209	0.0020	mg/Kg wet	0.0200		105	70-130	8.14	20		
1,3-Dichloropropane	0.0201	0.0010	mg/Kg wet	0.0200		100	70-130	5.26	20		
2,2-Dichloropropane	0.0227	0.0020	mg/Kg wet	0.0200		114	70-130	8.32	20		
1,1-Dichloropropene	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	4.53	20		
cis-1,3-Dichloropropene	0.0218	0.0010	mg/Kg wet	0.0200		109	70-130	7.04	20		
trans-1,3-Dichloropropene	0.0232	0.0010	mg/Kg wet	0.0200		116	70-130	8.91	20		
Diethyl Ether	0.0198	0.010	mg/Kg wet	0.0200		99.2	70-130	2.59	20		
Diisopropyl Ether (DIPE)	0.0212	0.0010	mg/Kg wet	0.0200		106	70-130	5.82	20		
1,4-Dioxane	0.187	0.10	mg/Kg wet	0.200		93.4	40-160	6.84	20	V-16	†
Ethylbenzene	0.0214	0.0020	mg/Kg wet	0.0200		107	70-130	9.76	20		
Hexachlorobutadiene	0.0241	0.0020	mg/Kg wet	0.0200		121	70-130	17.5	20		
2-Hexanone (MBK)	0.241	0.020	mg/Kg wet	0.200		121	40-160	4.08	20		†
Isopropylbenzene (Cumene)	0.0227	0.0020	mg/Kg wet	0.0200		113	70-130	10.7	20		
p-Isopropyltoluene (p-Cymene)	0.0222	0.0020	mg/Kg wet	0.0200		111	70-130	12.0	20		
Methyl tert-Butyl Ether (MTBE)	0.0232	0.0040	mg/Kg wet	0.0200		116	70-130	4.23	20		
Methylene Chloride	0.0187	0.010	mg/Kg wet	0.0200		93.6	70-130	8.00	20		
4-Methyl-2-pentanone (MIBK)	0.224	0.020	mg/Kg wet	0.200		112	40-160	7.33	20		†
Naphthalene	0.0212	0.0040	mg/Kg wet	0.0200		106	70-130	17.0	20		

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QUALITY CONTROL

Volatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B216709 - SW-846 5035										
LCS Dup (B216709-BSD1)				Prepared & Analyzed: 11/08/18						
n-Propylbenzene	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	10.9	20	
Styrene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130	12.7	20	
1,1,1,2-Tetrachloroethane	0.0226	0.0020	mg/Kg wet	0.0200		113	70-130	7.88	20	
1,1,2,2-Tetrachloroethane	0.0224	0.0010	mg/Kg wet	0.0200		112	70-130	15.5	20	
Tetrachloroethylene	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	6.86	20	
Tetrahydrofuran	0.0190	0.010	mg/Kg wet	0.0200		95.0	70-130	1.57	20	
Toluene	0.0205	0.0020	mg/Kg wet	0.0200		102	70-130	7.08	20	
1,2,3-Trichlorobenzene	0.0225	0.0020	mg/Kg wet	0.0200		113	70-130	14.3	20	
1,2,4-Trichlorobenzene	0.0232	0.0020	mg/Kg wet	0.0200		116	70-130	18.9	20	
1,1,1-Trichloroethane	0.0216	0.0020	mg/Kg wet	0.0200		108	70-130	7.28	20	
1,1,2-Trichloroethane	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130	6.31	20	
Trichloroethylene	0.0212	0.0020	mg/Kg wet	0.0200		106	70-130	6.35	20	
Trichlorofluoromethane (Freon 11)	0.0186	0.010	mg/Kg wet	0.0200		92.9	70-130	0.995	20	
1,2,3-Trichloropropane	0.0202	0.0020	mg/Kg wet	0.0200		101	70-130	14.2	20	
1,2,4-Trimethylbenzene	0.0222	0.0020	mg/Kg wet	0.0200		111	70-130	14.4	20	
1,3,5-Trimethylbenzene	0.0224	0.0020	mg/Kg wet	0.0200		112	70-130	11.7	20	
Vinyl Chloride	0.0197	0.010	mg/Kg wet	0.0200		98.5	70-130	4.76	20	
m+p Xylene	0.0439	0.0040	mg/Kg wet	0.0400		110	70-130	9.46	20	
o-Xylene	0.0218	0.0020	mg/Kg wet	0.0200		109	70-130	10.4	20	
Surrogate: 1,2-Dichloroethane-d4	*0.0495*		mg/Kg wet	0.0500		98.9	70-130			
Surrogate: Toluene-d8	*0.0498*		mg/Kg wet	0.0500		99.5	70-130			
Surrogate: 4-Bromofluorobenzene	*0.0504*		mg/Kg wet	0.0500		101	70-130			

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B216591 - SW-846 3546										
Blank (B216591-BLK1)				Prepared: 11/07/18 Analyzed: 11/08/18						
Acenaphthene	ND	0.17	mg/Kg wet							
Acenaphthylene	ND	0.17	mg/Kg wet							
Acetophenone	ND	0.34	mg/Kg wet							
Aniline	ND	0.34	mg/Kg wet							V-05, V-34
Anthracene	ND	0.17	mg/Kg wet							
Benzo(a)anthracene	ND	0.17	mg/Kg wet							
Benzo(a)pyrene	ND	0.17	mg/Kg wet							
Benzo(b)fluoranthene	ND	0.17	mg/Kg wet							
Benzo(g,h,i)perylene	ND	0.17	mg/Kg wet							
Benzo(k)fluoranthene	ND	0.17	mg/Kg wet							
Bis(2-chloroethoxy)methane	ND	0.34	mg/Kg wet							
Bis(2-chloroethyl)ether	ND	0.34	mg/Kg wet							
Bis(2-chloroisopropyl)ether	ND	0.34	mg/Kg wet							
Bis(2-Ethylhexyl)phthalate	ND	0.34	mg/Kg wet							
4-Bromophenylphenylether	ND	0.34	mg/Kg wet							
Butylbenzylphthalate	ND	0.34	mg/Kg wet							
4-Chloroaniline	ND	0.66	mg/Kg wet							V-34
2-Chloronaphthalene	ND	0.34	mg/Kg wet							
2-Chlorophenol	ND	0.34	mg/Kg wet							
Chrysene	ND	0.17	mg/Kg wet							
Dibenz(a,h)anthracene	ND	0.17	mg/Kg wet							
Dibenzofuran	ND	0.34	mg/Kg wet							
Di-n-butylphthalate	ND	0.34	mg/Kg wet							
1,2-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,3-Dichlorobenzene	ND	0.34	mg/Kg wet							
1,4-Dichlorobenzene	ND	0.34	mg/Kg wet							
3,3-Dichlorobenzidine	ND	0.17	mg/Kg wet							
2,4-Dichlorophenol	ND	0.34	mg/Kg wet							
Diethylphthalate	ND	0.34	mg/Kg wet							
2,4-Dimethylphenol	ND	0.34	mg/Kg wet							
Dimethylphthalate	ND	0.34	mg/Kg wet							
2,4-Dinitrophenol	ND	0.66	mg/Kg wet							V-19
2,4-Dinitrotoluene	ND	0.34	mg/Kg wet							
2,6-Dinitrotoluene	ND	0.34	mg/Kg wet							
Di-n-octylphthalate	ND	0.34	mg/Kg wet							
1,2-Diphenylhydrazine/Azobenzene	ND	0.34	mg/Kg wet							
Fluoranthene	ND	0.17	mg/Kg wet							
Fluorene	ND	0.17	mg/Kg wet							
Hexachlorobenzene	ND	0.34	mg/Kg wet							
Hexachlorobutadiene	ND	0.34	mg/Kg wet							
Hexachloroethane	ND	0.34	mg/Kg wet							
Indeno(1,2,3-cd)pyrene	ND	0.17	mg/Kg wet							
Isophorone	ND	0.34	mg/Kg wet							
2-Methylnaphthalene	ND	0.17	mg/Kg wet							
2-Methylphenol	ND	0.34	mg/Kg wet							
3/4-Methylphenol	ND	0.34	mg/Kg wet							
Naphthalene	ND	0.17	mg/Kg wet							
Nitrobenzene	ND	0.34	mg/Kg wet							
2-Nitrophenol	ND	0.34	mg/Kg wet							
4-Nitrophenol	ND	0.66	mg/Kg wet							V-20
Pentachlorophenol	ND	0.34	mg/Kg wet							
Phenanthrene	ND	0.17	mg/Kg wet							

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B216591 - SW-846 3546											
Blank (B216591-BLK1)				Prepared: 11/07/18 Analyzed: 11/08/18							
Phenol	ND	0.34	mg/Kg wet								
Pyrene	ND	0.17	mg/Kg wet								
Pyridine	ND	0.34	mg/Kg wet							V-05	
1,2,4-Trichlorobenzene	ND	0.34	mg/Kg wet								
2,4,5-Trichlorophenol	ND	0.34	mg/Kg wet								
2,4,6-Trichlorophenol	ND	0.34	mg/Kg wet								
Surrogate: 2-Fluorophenol	*5.23*		mg/Kg wet	6.67		78.4	30-130				
Surrogate: Phenol-d6	*5.95*		mg/Kg wet	6.67		89.2	30-130				
Surrogate: Nitrobenzene-d5	*2.83*		mg/Kg wet	3.33		84.9	30-130				
Surrogate: 2-Fluorobiphenyl	*2.51*		mg/Kg wet	3.33		75.4	30-130				
Surrogate: 2,4,6-Tribromophenol	*7.41*		mg/Kg wet	6.67		111	30-130				
Surrogate: p-Terphenyl-d14	*3.00*		mg/Kg wet	3.33		90.0	30-130				
LCS (B216591-BS1)				Prepared: 11/07/18 Analyzed: 11/08/18							
Acenaphthene	1.30	0.17	mg/Kg wet	1.67		77.9	40-140				
Acenaphthylene	1.40	0.17	mg/Kg wet	1.67		83.8	40-140				
Acetophenone	1.31	0.34	mg/Kg wet	1.67		78.9	40-140				
Aniline	1.14	0.34	mg/Kg wet	1.67		68.4	40-140			V-05, V-34	
Anthracene	1.31	0.17	mg/Kg wet	1.67		78.7	40-140				
Benzo(a)anthracene	1.32	0.17	mg/Kg wet	1.67		79.0	40-140				
Benzo(a)pyrene	1.35	0.17	mg/Kg wet	1.67		81.2	40-140				
Benzo(b)fluoranthene	1.27	0.17	mg/Kg wet	1.67		76.1	40-140				
Benzo(g,h,i)perylene	1.38	0.17	mg/Kg wet	1.67		82.7	40-140				
Benzo(k)fluoranthene	1.28	0.17	mg/Kg wet	1.67		76.7	40-140				
Bis(2-chloroethoxy)methane	1.42	0.34	mg/Kg wet	1.67		85.4	40-140				
Bis(2-chloroethyl)ether	1.34	0.34	mg/Kg wet	1.67		80.4	40-140				
Bis(2-chloroisopropyl)ether	1.56	0.34	mg/Kg wet	1.67		93.8	40-140				
Bis(2-Ethylhexyl)phthalate	1.42	0.34	mg/Kg wet	1.67		85.0	40-140				
4-Bromophenylphenylether	1.32	0.34	mg/Kg wet	1.67		79.2	40-140				
Butylbenzylphthalate	1.38	0.34	mg/Kg wet	1.67		83.0	40-140				
4-Chloroaniline	1.17	0.66	mg/Kg wet	1.67		70.1	15-140			V-34	†
2-Chloronaphthalene	1.31	0.34	mg/Kg wet	1.67		78.6	40-140				
2-Chlorophenol	1.21	0.34	mg/Kg wet	1.67		72.6	30-130				
Chrysene	1.21	0.17	mg/Kg wet	1.67		72.6	40-140				
Dibenz(a,h)anthracene	1.38	0.17	mg/Kg wet	1.67		83.0	40-140				
Dibenzofuran	1.44	0.34	mg/Kg wet	1.67		86.3	40-140				
Di-n-butylphthalate	1.33	0.34	mg/Kg wet	1.67		79.9	40-140				
1,2-Dichlorobenzene	1.01	0.34	mg/Kg wet	1.67		60.6	40-140				
1,3-Dichlorobenzene	0.940	0.34	mg/Kg wet	1.67		56.4	40-140				
1,4-Dichlorobenzene	0.956	0.34	mg/Kg wet	1.67		57.4	40-140				
3,3-Dichlorobenzidine	1.57	0.17	mg/Kg wet	1.67		94.0	40-140				
2,4-Dichlorophenol	1.32	0.34	mg/Kg wet	1.67		79.5	30-130				
Diethylphthalate	1.45	0.34	mg/Kg wet	1.67		87.2	40-140				
2,4-Dimethylphenol	1.21	0.34	mg/Kg wet	1.67		72.5	30-130				
Dimethylphthalate	1.50	0.34	mg/Kg wet	1.67		89.8	40-140				
2,4-Dinitrophenol	1.28	0.66	mg/Kg wet	1.67		76.9	15-140			V-19	†
2,4-Dinitrotoluene	1.55	0.34	mg/Kg wet	1.67		92.8	40-140				
2,6-Dinitrotoluene	1.61	0.34	mg/Kg wet	1.67		96.9	40-140				
Di-n-octylphthalate	1.33	0.34	mg/Kg wet	1.67		79.5	40-140				
1,2-Diphenylhydrazine/Azobenzene	1.40	0.34	mg/Kg wet	1.67		84.2	40-140				
Fluoranthene	1.34	0.17	mg/Kg wet	1.67		80.3	40-140				
Fluorene	1.42	0.17	mg/Kg wet	1.67		85.1	40-140				

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QUALITY CONTROL

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Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B216591 - SW-846 3546											
LCS (B216591-BS1)				Prepared: 11/07/18 Analyzed: 11/08/18							
Hexachlorobenzene	1.32	0.34	mg/Kg wet	1.67		79.2	40-140				
Hexachlorobutadiene	1.18	0.34	mg/Kg wet	1.67		70.6	40-140				
Hexachloroethane	1.04	0.34	mg/Kg wet	1.67		62.4	40-140				
Indeno(1,2,3-cd)pyrene	1.44	0.17	mg/Kg wet	1.67		86.3	40-140				
Isophorone	1.38	0.34	mg/Kg wet	1.67		82.7	40-140				
2-Methylnaphthalene	1.32	0.17	mg/Kg wet	1.67		79.3	40-140				
2-Methylphenol	1.26	0.34	mg/Kg wet	1.67		75.5	30-130				
3/4-Methylphenol	1.39	0.34	mg/Kg wet	1.67		83.4	30-130				
Naphthalene	1.20	0.17	mg/Kg wet	1.67		72.3	40-140				
Nitrobenzene	1.31	0.34	mg/Kg wet	1.67		78.6	40-140				
2-Nitrophenol	1.37	0.34	mg/Kg wet	1.67		82.1	30-130				
4-Nitrophenol	1.81	0.66	mg/Kg wet	1.67		108	15-140			V-06	†
Pentachlorophenol	0.965	0.34	mg/Kg wet	1.67		57.9	30-130				
Phenanthrene	1.30	0.17	mg/Kg wet	1.67		78.3	40-140				
Phenol	1.31	0.34	mg/Kg wet	1.67		78.4	15-140				†
Pyrene	1.27	0.17	mg/Kg wet	1.67		76.0	40-140				
Pyridine	0.586	0.34	mg/Kg wet	1.67		35.2	30-140			V-05	†
1,2,4-Trichlorobenzene	1.14	0.34	mg/Kg wet	1.67		68.7	40-140				
2,4,5-Trichlorophenol	1.46	0.34	mg/Kg wet	1.67		87.5	30-130				
2,4,6-Trichlorophenol	1.44	0.34	mg/Kg wet	1.67		86.2	30-130				
Surrogate: 2-Fluorophenol	*4.83*		mg/Kg wet	6.67		72.4	30-130				
Surrogate: Phenol-d6	*5.74*		mg/Kg wet	6.67		86.0	30-130				
Surrogate: Nitrobenzene-d5	*2.78*		mg/Kg wet	3.33		83.5	30-130				
Surrogate: 2-Fluorobiphenyl	*2.52*		mg/Kg wet	3.33		75.7	30-130				
Surrogate: 2,4,6-Tribromophenol	*7.12*		mg/Kg wet	6.67		107	30-130				
Surrogate: p-Terphenyl-d14	*2.69*		mg/Kg wet	3.33		80.8	30-130				
LCS Dup (B216591-BSD1)				Prepared: 11/07/18 Analyzed: 11/08/18							
Acenaphthene	1.30	0.17	mg/Kg wet	1.67		78.0	40-140	0.0770	30		
Acenaphthylene	1.39	0.17	mg/Kg wet	1.67		83.5	40-140	0.383	30		
Acetophenone	1.31	0.34	mg/Kg wet	1.67		78.9	40-140	0.00	30		
Aniline	1.06	0.34	mg/Kg wet	1.67		63.3	40-140	7.74	30	V-05, V-34	
Anthracene	1.29	0.17	mg/Kg wet	1.67		77.6	40-140	1.41	30		
Benzo(a)anthracene	1.31	0.17	mg/Kg wet	1.67		78.4	40-140	0.839	30		
Benzo(a)pyrene	1.34	0.17	mg/Kg wet	1.67		80.1	40-140	1.29	30		
Benzo(b)fluoranthene	1.23	0.17	mg/Kg wet	1.67		74.1	40-140	2.66	30		
Benzo(g,h,i)perylene	1.38	0.17	mg/Kg wet	1.67		82.9	40-140	0.217	30		
Benzo(k)fluoranthene	1.26	0.17	mg/Kg wet	1.67		75.7	40-140	1.39	30		
Bis(2-chloroethoxy)methane	1.45	0.34	mg/Kg wet	1.67		87.2	40-140	2.11	30		
Bis(2-chloroethyl)ether	1.40	0.34	mg/Kg wet	1.67		83.7	40-140	4.02	30		
Bis(2-chloroisopropyl)ether	1.64	0.34	mg/Kg wet	1.67		98.7	40-140	5.07	30		
Bis(2-Ethylhexyl)phthalate	1.35	0.34	mg/Kg wet	1.67		80.9	40-140	4.94	30		
4-Bromophenylphenylether	1.36	0.34	mg/Kg wet	1.67		81.4	40-140	2.77	30	V-34	
Butylbenzylphthalate	1.38	0.34	mg/Kg wet	1.67		82.8	40-140	0.265	30		
4-Chloroaniline	0.872	0.66	mg/Kg wet	1.67		52.3	15-140	29.0	30	V-34	†
2-Chloronaphthalene	1.32	0.34	mg/Kg wet	1.67		79.0	40-140	0.609	30		
2-Chlorophenol	1.22	0.34	mg/Kg wet	1.67		73.3	30-130	0.932	30		
Chrysene	1.22	0.17	mg/Kg wet	1.67		73.2	40-140	0.933	30		
Dibenz(a,h)anthracene	1.37	0.17	mg/Kg wet	1.67		82.1	40-140	1.07	30		
Dibenzofuran	1.44	0.34	mg/Kg wet	1.67		86.6	40-140	0.347	30		
Di-n-butylphthalate	1.37	0.34	mg/Kg wet	1.67		82.0	40-140	2.54	30		
1,2-Dichlorobenzene	1.09	0.34	mg/Kg wet	1.67		65.2	40-140	7.41	30		

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QUALITY CONTROL

Semivolatile Organic Compounds by GC/MS - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes	
Batch B216591 - SW-846 3546											
LCS Dup (B216591-BSD1)				Prepared: 11/07/18 Analyzed: 11/08/18							
1,3-Dichlorobenzene	1.04	0.34	mg/Kg wet	1.67		62.2	40-140	9.72	30		
1,4-Dichlorobenzene	1.05	0.34	mg/Kg wet	1.67		63.0	40-140	9.37	30		
3,3-Dichlorobenzidine	1.28	0.17	mg/Kg wet	1.67		76.5	40-140	20.5	30		
2,4-Dichlorophenol	1.33	0.34	mg/Kg wet	1.67		79.7	30-130	0.301	30		
Diethylphthalate	1.48	0.34	mg/Kg wet	1.67		88.5	40-140	1.43	30		
2,4-Dimethylphenol	1.22	0.34	mg/Kg wet	1.67		73.1	30-130	0.824	30		
Dimethylphthalate	1.49	0.34	mg/Kg wet	1.67		89.4	40-140	0.513	30		
2,4-Dinitrophenol	1.21	0.66	mg/Kg wet	1.67		72.6	15-140	5.70	30	V-19	†
2,4-Dinitrotoluene	1.54	0.34	mg/Kg wet	1.67		92.2	40-140	0.670	30		
2,6-Dinitrotoluene	1.64	0.34	mg/Kg wet	1.67		98.6	40-140	1.76	30		
Di-n-octylphthalate	1.32	0.34	mg/Kg wet	1.67		79.3	40-140	0.302	30		
1,2-Diphenylhydrazine/Azobenzene	1.34	0.34	mg/Kg wet	1.67		80.4	40-140	4.62	30		
Fluoranthene	1.30	0.17	mg/Kg wet	1.67		78.2	40-140	2.57	30		
Fluorene	1.41	0.17	mg/Kg wet	1.67		84.8	40-140	0.330	30		
Hexachlorobenzene	1.33	0.34	mg/Kg wet	1.67		79.7	40-140	0.604	30		
Hexachlorobutadiene	1.25	0.34	mg/Kg wet	1.67		75.1	40-140	6.29	30		
Hexachloroethane	1.13	0.34	mg/Kg wet	1.67		67.9	40-140	8.41	30		
Indeno(1,2,3-cd)pyrene	1.41	0.17	mg/Kg wet	1.67		84.5	40-140	2.20	30		
Isophorone	1.40	0.34	mg/Kg wet	1.67		83.7	40-140	1.23	30		
2-Methylnaphthalene	1.33	0.17	mg/Kg wet	1.67		80.0	40-140	0.854	30		
2-Methylphenol	1.25	0.34	mg/Kg wet	1.67		75.0	30-130	0.691	30		
3/4-Methylphenol	1.37	0.34	mg/Kg wet	1.67		82.4	30-130	1.23	30		
Naphthalene	1.22	0.17	mg/Kg wet	1.67		73.1	40-140	1.10	30		
Nitrobenzene	1.34	0.34	mg/Kg wet	1.67		80.7	40-140	2.64	30		
2-Nitrophenol	1.37	0.34	mg/Kg wet	1.67		82.2	30-130	0.0974	30		
4-Nitrophenol	1.70	0.66	mg/Kg wet	1.67		102	15-140	6.00	30	V-06	†
Pentachlorophenol	0.927	0.34	mg/Kg wet	1.67		55.6	30-130	4.05	30		
Phenanthrene	1.29	0.17	mg/Kg wet	1.67		77.6	40-140	0.924	30		
Phenol	1.29	0.34	mg/Kg wet	1.67		77.2	15-140	1.54	30		†
Pyrene	1.30	0.17	mg/Kg wet	1.67		77.8	40-140	2.34	30		
Pyridine	0.681	0.34	mg/Kg wet	1.67		40.8	30-140	14.9	30	V-05	†
1,2,4-Trichlorobenzene	1.19	0.34	mg/Kg wet	1.67		71.6	40-140	4.25	30		
2,4,5-Trichlorophenol	1.45	0.34	mg/Kg wet	1.67		87.2	30-130	0.275	30		
2,4,6-Trichlorophenol	1.42	0.34	mg/Kg wet	1.67		85.3	30-130	1.03	30		
Surrogate: 2-Fluorophenol	*5.14*		mg/Kg wet	6.67		77.2	30-130				
Surrogate: Phenol-d6	*5.60*		mg/Kg wet	6.67		84.0	30-130				
Surrogate: Nitrobenzene-d5	*2.86*		mg/Kg wet	3.33		85.9	30-130				
Surrogate: 2-Fluorobiphenyl	*2.51*		mg/Kg wet	3.33		75.2	30-130				
Surrogate: 2,4,6-Tribromophenol	*7.02*		mg/Kg wet	6.67		105	30-130				
Surrogate: p-Terphenyl-d14	*2.77*		mg/Kg wet	3.33		83.2	30-130				

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QUALITY CONTROL

Polychlorinated Biphenyls with 3540 Soxhlet Extraction - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B216572 - SW-846 3540C										
Blank (B216572-BLK1)				Prepared: 11/07/18 Analyzed: 11/08/18						
Aroclor-1016	ND	0.020	mg/Kg wet							
Aroclor-1016 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1221	ND	0.020	mg/Kg wet							
Aroclor-1221 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1232	ND	0.020	mg/Kg wet							
Aroclor-1232 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1242	ND	0.020	mg/Kg wet							
Aroclor-1242 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1248	ND	0.020	mg/Kg wet							
Aroclor-1248 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1254	ND	0.020	mg/Kg wet							
Aroclor-1254 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1260	ND	0.020	mg/Kg wet							
Aroclor-1260 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1262	ND	0.020	mg/Kg wet							
Aroclor-1262 [2C]	ND	0.020	mg/Kg wet							
Aroclor-1268	ND	0.020	mg/Kg wet							
Aroclor-1268 [2C]	ND	0.020	mg/Kg wet							
Surrogate: Decachlorobiphenyl	*0.165*		mg/Kg wet	0.200		82.7	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.163*		mg/Kg wet	0.200		81.5	30-150			
Surrogate: Tetrachloro-m-xylene	*0.158*		mg/Kg wet	0.200		78.9	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.163*		mg/Kg wet	0.200		81.7	30-150			
LCS (B216572-BS1)				Prepared: 11/07/18 Analyzed: 11/08/18						
Aroclor-1016	0.19	0.020	mg/Kg wet	0.200		93.3	40-140			
Aroclor-1016 [2C]	0.19	0.020	mg/Kg wet	0.200		92.8	40-140			
Aroclor-1260	0.17	0.020	mg/Kg wet	0.200		86.7	40-140			
Aroclor-1260 [2C]	0.17	0.020	mg/Kg wet	0.200		86.8	40-140			
Surrogate: Decachlorobiphenyl	*0.174*		mg/Kg wet	0.200		87.0	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.170*		mg/Kg wet	0.200		85.2	30-150			
Surrogate: Tetrachloro-m-xylene	*0.170*		mg/Kg wet	0.200		84.8	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.174*		mg/Kg wet	0.200		86.8	30-150			
LCS Dup (B216572-BSD1)				Prepared: 11/07/18 Analyzed: 11/08/18						
Aroclor-1016	0.19	0.020	mg/Kg wet	0.200		92.7	40-140	0.576	30	
Aroclor-1016 [2C]	0.18	0.020	mg/Kg wet	0.200		92.4	40-140	0.428	30	
Aroclor-1260	0.17	0.020	mg/Kg wet	0.200		86.2	40-140	0.626	30	
Aroclor-1260 [2C]	0.17	0.020	mg/Kg wet	0.200		86.3	40-140	0.632	30	
Surrogate: Decachlorobiphenyl	*0.175*		mg/Kg wet	0.200		87.3	30-150			
Surrogate: Decachlorobiphenyl [2C]	*0.171*		mg/Kg wet	0.200		85.6	30-150			
Surrogate: Tetrachloro-m-xylene	*0.169*		mg/Kg wet	0.200		84.5	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*0.174*		mg/Kg wet	0.200		87.0	30-150			

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QUALITY CONTROL

Petroleum Hydrocarbons Analyses - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B216634 - SW-846 3546										
Blank (B216634-BLK1)				Prepared: 11/07/18 Analyzed: 11/08/18						
TPH (C9-C36)	ND	8.3	mg/Kg wet							
Surrogate: 2-Fluorobiphenyl	*2.21*		mg/Kg wet	3.33		66.2	40-140			
LCS (B216634-BS1)				Prepared: 11/07/18 Analyzed: 11/08/18						
TPH (C9-C36)	28.3	8.3	mg/Kg wet	33.3		85.0	40-140			
Surrogate: 2-Fluorobiphenyl	*2.48*		mg/Kg wet	3.33		74.3	40-140			
LCS Dup (B216634-BSD1)				Prepared: 11/07/18 Analyzed: 11/08/18						
TPH (C9-C36)	27.5	8.3	mg/Kg wet	33.3		82.6	40-140	2.92	30	
Surrogate: 2-Fluorobiphenyl	*2.33*		mg/Kg wet	3.33		70.0	40-140			

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QUALITY CONTROL

Metals Analyses (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B216858 - SW-846 3050B										
Blank (B216858-BLK1)				Prepared: 11/09/18 Analyzed: 11/12/18						
Arsenic	ND	1.7	mg/Kg wet							
Barium	ND	1.7	mg/Kg wet							
Cadmium	ND	0.17	mg/Kg wet							
Chromium	ND	0.33	mg/Kg wet							
Lead	ND	0.50	mg/Kg wet							
Selenium	ND	3.3	mg/Kg wet							
Silver	ND	0.33	mg/Kg wet							
LCS (B216858-BS1)				Prepared: 11/09/18 Analyzed: 11/12/18						
Arsenic	149	5.0	mg/Kg wet	161		92.4	83.2-116.8			
Barium	258	5.0	mg/Kg wet	260		99.4	82.7-117.3			
Cadmium	194	0.50	mg/Kg wet	211		91.9	83.4-116.6			
Chromium	126	0.99	mg/Kg wet	136		92.6	82.4-117.6			
Lead	103	1.5	mg/Kg wet	111		92.5	83-117.1			
Selenium	172	9.9	mg/Kg wet	191		90.2	79.6-120.9			
Silver	43.5	0.99	mg/Kg wet	43.3		101	79.9-119.9			
LCS Dup (B216858-BSD1)				Prepared: 11/09/18 Analyzed: 11/12/18						
Arsenic	149	5.0	mg/Kg wet	161		92.3	83.2-116.8	0.130	30	
Barium	252	5.0	mg/Kg wet	260		97.0	82.7-117.3	2.49	30	
Cadmium	197	0.50	mg/Kg wet	211		93.4	83.4-116.6	1.59	30	
Chromium	128	0.99	mg/Kg wet	136		94.0	82.4-117.6	1.49	30	
Lead	103	1.5	mg/Kg wet	111		92.5	83-117.1	0.0396	30	
Selenium	173	9.9	mg/Kg wet	191		90.5	79.6-120.9	0.383	30	
Silver	44.2	0.99	mg/Kg wet	43.3		102	79.9-119.9	1.44	30	
MRL Check (B216858-MRL1)				Prepared: 11/09/18 Analyzed: 11/12/18						
Lead	0.550	0.49	mg/Kg wet	0.492		112	80-120			
Batch B217015 - SW-846 7471										
Blank (B217015-BLK1)				Prepared & Analyzed: 11/13/18						
Mercury	ND	0.025	mg/Kg wet							
LCS (B217015-BS1)				Prepared & Analyzed: 11/13/18						
Mercury	14.0	1.9	mg/Kg wet	11.5		122	71.6-127.8			
LCS Dup (B217015-BSD1)				Prepared & Analyzed: 11/13/18						
Mercury	11.2	2.0	mg/Kg wet	11.5		97.5	71.6-127.8	22.4	30	

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC		%REC Limits	RPD	RPD Limit	Notes
Batch B216565 - SW-846 9045C											
LCS (B216565-BS1)				Prepared & Analyzed: 11/06/18							
pH	6.02		pH Units	6.00		100		90-110			
LCS (B216565-BS2)				Prepared & Analyzed: 11/06/18							
pH	6.04		pH Units	6.00		101		90-110			
Batch B216566 - SM2580 A											
Duplicate (B216566-DUP1)	**Source: 18K0257-01**			Prepared & Analyzed: 11/06/18							
Oxidation/Reduction Potential	135		mV		134				0.743	20	
Batch B216585 - SW-846 7196A											
Blank (B216585-BLK1)				Prepared: 11/07/18 Analyzed: 11/08/18							
Hexavalent Chromium	ND	0.16	mg/Kg wet								
LCS (B216585-BS1)				Prepared: 11/07/18 Analyzed: 11/08/18							
Hexavalent Chromium	59	1.9	mg/Kg wet	71.6		82.6		80-120			
LCS Dup (B216585-BSD1)				Prepared: 11/07/18 Analyzed: 11/08/18							
Hexavalent Chromium	59	1.8	mg/Kg wet	70.6		84.2		80-120	0.558	20	
Matrix Spike (B216585-MS1) Soluble MS	**Source: 18K0257-01**			Prepared: 11/07/18 Analyzed: 11/08/18							
Hexavalent Chromium	ND	1.0	mg/Kg dry	51.7	ND		*	75-125			MS-16
Matrix Spike (B216585-MS2) PDMS	**Source: 18K0257-01**			Prepared: 11/07/18 Analyzed: 11/08/18							
Hexavalent Chromium	24	1.0	mg/Kg dry	51.9	ND	**45.6**	*	75-125			MS-16
Matrix Spike (B216585-MS3) Insoluble MS	**Source: 18K0257-01**			Prepared: 11/07/18 Analyzed: 11/08/18							
Hexavalent Chromium	380	21	mg/Kg dry	8320	ND	**4.51**	*	75-125			MS-16
Matrix Spike Dup (B216585-MSD1) Soluble MS Dup	**Source: 18K0257-01**			Prepared: 11/07/18 Analyzed: 11/08/18							
Hexavalent Chromium	ND	1.0	mg/Kg dry	50.7	ND		*	75-125		35	MS-16
Batch B216620 - SM21-22 2510B Modified											
Blank (B216620-BLK1)				Prepared & Analyzed: 11/07/18							
Specific conductance	ND	2.0	µmhos/cm								
LCS (B216620-BS1)				Prepared & Analyzed: 11/07/18							
Specific conductance	200		µmhos/cm	192		104		90-110			

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QUALITY CONTROL

Conventional Chemistry Parameters by EPA/APHA/SW-846 Methods (Total) - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B216706 - SW-846 9014										
Blank (B216706-BLK1)				Prepared & Analyzed: 11/08/18						
Reactive Cyanide	ND	0.40	mg/Kg							
LCS (B216706-BS1)				Prepared & Analyzed: 11/08/18						
Reactive Cyanide	9.3	0.40	mg/Kg	10.0		92.9	83.6-111			
Batch B216755 - SW-846 9030A										
Blank (B216755-BLK1)				Prepared & Analyzed: 11/08/18						
Reactive Sulfide	ND	2.0	mg/Kg							
LCS (B216755-BS1)				Prepared & Analyzed: 11/08/18						
Reactive Sulfide	12	2.0	mg/Kg	14.8		83.8	54.9-121			
Batch B216786 - SW-846 1010A										
Blank (B216786-BLK1)				Prepared & Analyzed: 11/08/18						
Flashpoint	> 212 °F		°F							
LCS (B216786-BS1)				Prepared & Analyzed: 11/08/18						
Flashpoint	81		°F	81.0		100	98.8-101			
LCS Dup (B216786-BSD1)				Prepared & Analyzed: 11/08/18						
Flashpoint	81		°F	81.0		100	98.8-101	0.00	5	

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS

Lab Sample ID: B216572-BS1 Date(s) Analyzed: 11/08/2018 11/08/2018

Instrument ID (1): ECD3 Instrument ID (2): ECD3

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	-0.030	0.030	0.19	
	2	0.000	-0.030	0.030	0.19	0.0
Aroclor-1260	1	0.000	-0.030	0.030	0.17	
	2	0.000	-0.030	0.030	0.17	0.0

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS Dup

Lab Sample ID: B216572-BSD1 Date(s) Analyzed: 11/08/2018 11/08/2018

Instrument ID (1): ECD3 Instrument ID (2): ECD3

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%RPD
			FROM	TO		
Aroclor-1016	1	0.000	-0.030	0.030	0.19	
	2	0.000	-0.030	0.030	0.18	5.4
Aroclor-1260	1	0.000	-0.030	0.030	0.17	
	2	0.000	-0.030	0.030	0.17	0.0

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
ND	Not Detected
RL	Reporting Limit is at the level of quantitation (LOQ)
DL	Detection Limit is the lower limit of detection determined by the MDL study
MCL	Maximum Contaminant Level
	Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.
	No results have been blank subtracted unless specified in the case narrative section.
L-14	Compound classified by MA CAM as difficult with acceptable recoveries of 40-160%. Recovery does not meet 70-130% criteria but does meet difficult compound criteria.
MS-16	For solid method SW846-7196A, the matrix spike is outside of control limits. pH and ORP results were indicative of reducing conditions. Reanalysis is not required. Analysis is in control based on LCS recoveries.
O-32	A dilution was performed as part of the standard analytical procedure.
V-05	Continuing calibration did not meet method specifications and was biased on the low side for this compound.
V-06	Continuing calibration did not meet method specifications and was biased on the high side for this compound.
V-16	Response factor is less than method specified minimum acceptable value. Reduced precision and accuracy may be associated with reported result.
V-19	Initial calibration did not meet method specifications. Compound was calibrated using linear regression with correlation coefficient <0.99. Reported result is estimated.
V-20	Continuing calibration did not meet method specifications and was biased on the high side. Data validation is not affected since sample result was "not detected" for this compound.
V-34	Initial calibration verification (ICV) did not meet method specifications and was biased on the low side for this compound. Reported result is estimated.
W-06	Elevated method reporting limit due to intense color of sample

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 1010A in Soil	
Flashpoint	NY,NC,ME,VA
SW-846 1030 in Soil	
Ignitability	NY,NH,CT,NC,ME,VA
SW-846 6010D in Soil	
Arsenic	CT,NH,NY,ME,VA,NC
Barium	CT,NH,NY,ME,VA,NC
Cadmium	CT,NH,NY,ME,VA,NC
Chromium	CT,NH,NY,ME,VA,NC
Lead	CT,NH,NY,AIHA,ME,VA,NC
Selenium	CT,NH,NY,ME,VA,NC
Silver	CT,NH,NY,ME,VA,NC
SW-846 7196A in Soil	
Hexavalent Chromium	NY,CT,NH,NC,ME,VA
SW-846 7471B in Soil	
Mercury	CT,NH,NY,NC,ME,VA
SW-846 8082A in Soil	
Aroclor-1016	CT,NH,NY,ME,NC,VA
Aroclor-1016 [2C]	CT,NH,NY,ME,NC,VA
Aroclor-1221	CT,NH,NY,ME,NC,VA
Aroclor-1221 [2C]	CT,NH,NY,ME,NC,VA
Aroclor-1232	CT,NH,NY,ME,NC,VA
Aroclor-1232 [2C]	CT,NH,NY,ME,NC,VA
Aroclor-1242	CT,NH,NY,ME,NC,VA
Aroclor-1242 [2C]	CT,NH,NY,ME,NC,VA
Aroclor-1248	CT,NH,NY,ME,NC,VA
Aroclor-1248 [2C]	CT,NH,NY,ME,NC,VA
Aroclor-1254	CT,NH,NY,ME,NC,VA
Aroclor-1254 [2C]	CT,NH,NY,ME,NC,VA
Aroclor-1260	CT,NH,NY,ME,NC,VA
Aroclor-1260 [2C]	CT,NH,NY,ME,NC,VA
Aroclor-1262	NY,NC,VA
Aroclor-1262 [2C]	NY,NC,VA
Aroclor-1268	NY,NC,VA
Aroclor-1268 [2C]	NY,NC,VA
SW-846 8260C in Soil	
Acetone	CT,NH,NY,ME
Benzene	CT,NH,NY,ME
Bromobenzene	NH,NY,ME
Bromochloromethane	NH,NY,ME
Bromodichloromethane	CT,NH,NY,ME
Bromoform	CT,NH,NY,ME
Bromomethane	CT,NH,NY,ME
2-Butanone (MEK)	CT,NH,NY,ME
n-Butylbenzene	CT,NH,NY,ME
sec-Butylbenzene	CT,NH,NY,ME

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CERTIFICATIONS

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Analyte	Certifications
SW-846 8260C in Soil	
tert-Butylbenzene	CT,NH,NY,ME
Carbon Disulfide	CT,NH,NY,ME
Carbon Tetrachloride	CT,NH,NY,ME
Chlorobenzene	CT,NH,NY,ME
Chlorodibromomethane	CT,NH,NY,ME
Chloroethane	CT,NH,NY,ME
Chloroform	CT,NH,NY,ME
Chloromethane	CT,NH,NY,ME
2-Chlorotoluene	CT,NH,NY,ME
4-Chlorotoluene	CT,NH,NY,ME
1,2-Dibromo-3-chloropropane (DBCP)	NY
Dibromomethane	NH,NY,ME
1,2-Dichlorobenzene	CT,NH,NY,ME
1,3-Dichlorobenzene	CT,NH,NY,ME
1,4-Dichlorobenzene	CT,NH,NY,ME
Dichlorodifluoromethane (Freon 12)	NY,ME
1,1-Dichloroethane	CT,NH,NY,ME
1,2-Dichloroethane	CT,NH,NY,ME
1,1-Dichloroethylene	CT,NH,NY,ME
cis-1,2-Dichloroethylene	CT,NH,NY,ME
trans-1,2-Dichloroethylene	CT,NH,NY,ME
1,2-Dichloropropane	CT,NH,NY,ME
1,3-Dichloropropane	NH,NY,ME
2,2-Dichloropropane	NH,NY,ME
1,1-Dichloropropene	NH,NY,ME
cis-1,3-Dichloropropene	CT,NH,NY,ME
trans-1,3-Dichloropropene	CT,NH,NY,ME
1,4-Dioxane	NY
Ethylbenzene	CT,NH,NY,ME
Hexachlorobutadiene	NH,NY,ME
2-Hexanone (MBK)	CT,NH,NY,ME
Isopropylbenzene (Cumene)	CT,NH,NY,ME
p-Isopropyltoluene (p-Cymene)	NH,NY
Methyl tert-Butyl Ether (MTBE)	NH,NY
Methylene Chloride	CT,NH,NY,ME
4-Methyl-2-pentanone (MIBK)	CT,NH,NY
Naphthalene	NH,NY,ME
n-Propylbenzene	NH,NY
Styrene	CT,NH,NY,ME
1,1,1,2-Tetrachloroethane	CT,NH,NY,ME
1,1,2,2-Tetrachloroethane	CT,NH,NY,ME
Tetrachloroethylene	CT,NH,NY,ME
Toluene	CT,NH,NY,ME
1,2,3-Trichlorobenzene	NY
1,2,4-Trichlorobenzene	NH,NY,ME
1,1,1-Trichloroethane	CT,NH,NY,ME
1,1,2-Trichloroethane	CT,NH,NY,ME

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8260C in Soil	
Trichloroethylene	CT,NH,NY,ME
Trichlorofluoromethane (Freon 11)	CT,NH,NY,ME
1,2,3-Trichloropropane	NH,NY,ME
1,2,4-Trimethylbenzene	CT,NH,NY,ME
1,3,5-Trimethylbenzene	CT,NH,NY,ME
Vinyl Chloride	CT,NH,NY,ME
m+p Xylene	CT,NH,NY,ME
o-Xylene	CT,NH,NY,ME
SW-846 8270D in Soil	
Acenaphthene	CT,NY,NH
Acenaphthylene	CT,NY,NH
Acetophenone	NY,NH
Aniline	NY,NH
Anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH
Benzo(a)pyrene	CT,NY,NH
Benzo(b)fluoranthene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH
Bis(2-chloroethoxy)methane	CT,NY,NH
Bis(2-chloroethyl)ether	CT,NY,NH
Bis(2-chloroisopropyl)ether	CT,NY,NH
Bis(2-Ethylhexyl)phthalate	CT,NY,NH
4-Bromophenylphenylether	CT,NY,NH
Butylbenzylphthalate	CT,NY,NH
4-Chloroaniline	CT,NY,NH
2-Chloronaphthalene	CT,NY,NH
2-Chlorophenol	CT,NY,NH
Chrysene	CT,NY,NH
Dibenz(a,h)anthracene	CT,NY,NH
Dibenzofuran	CT,NY,NH
Di-n-butylphthalate	CT,NY,NH
1,2-Dichlorobenzene	NY,NH
1,3-Dichlorobenzene	NY,NH
1,4-Dichlorobenzene	NY,NH
3,3-Dichlorobenzidine	CT,NY,NH
2,4-Dichlorophenol	CT,NY,NH
Diethylphthalate	CT,NY,NH
2,4-Dimethylphenol	CT,NY,NH
Dimethylphthalate	CT,NY,NH
2,4-Dinitrophenol	CT,NY,NH
2,4-Dinitrotoluene	CT,NY,NH
2,6-Dinitrotoluene	CT,NY,NH
Di-n-octylphthalate	CT,NY,NH
1,2-Diphenylhydrazine/Azobenzene	NY,NH
Fluoranthene	CT,NY,NH

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CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications
SW-846 8270D in Soil	
Fluorene	NY,NH
Hexachlorobenzene	CT,NY,NH
Hexachlorobutadiene	CT,NY,NH
Hexachloroethane	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH
Isophorone	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH
2-Methylphenol	CT,NY,NH
3/4-Methylphenol	CT,NY,NH
Naphthalene	CT,NY,NH
Nitrobenzene	CT,NY,NH
2-Nitrophenol	CT,NY,NH
4-Nitrophenol	CT,NY,NH
Pentachlorophenol	CT,NY,NH
Phenanthrene	CT,NY,NH
Phenol	CT,NY,NH
Pyrene	CT,NY,NH
1,2,4-Trichlorobenzene	CT,NY,NH
2,4,5-Trichlorophenol	CT,NY,NH
2,4,6-Trichlorophenol	CT,NY,NH
SW-846 8270D in Water	
Acenaphthene	CT,NY,NH
Acenaphthylene	CT,NY,NH
Acetophenone	NY
Aniline	CT,NY
Anthracene	CT,NY,NH
Benzo(a)anthracene	CT,NY,NH
Benzo(a)pyrene	CT,NY,NH
Benzo(b)fluoranthene	CT,NY,NH
Benzo(g,h,i)perylene	CT,NY,NH
Benzo(k)fluoranthene	CT,NY,NH
Bis(2-chloroethoxy)methane	CT,NY,NH
Bis(2-chloroethyl)ether	CT,NY,NH
Bis(2-chloroisopropyl)ether	CT,NY,NH
Bis(2-Ethylhexyl)phthalate	CT,NY,NH
4-Bromophenylphenylether	CT,NY,NH
Butylbenzylphthalate	CT,NY,NH
4-Chloroaniline	CT,NY,NH
2-Chloronaphthalene	CT,NY,NH
2-Chlorophenol	CT,NY,NH
Chrysene	CT,NY,NH
Dibenz(a,h)anthracene	CT,NY,NH
Dibenzofuran	CT,NY,NH
Di-n-butylphthalate	CT,NY,NH
1,2-Dichlorobenzene	CT,NY,NH
1,3-Dichlorobenzene	CT,NY,NH

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CERTIFICATIONS

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Analyte	Certifications
SW-846 8270D in Water	
1,4-Dichlorobenzene	CT,NY,NH
3,3-Dichlorobenzidine	CT,NY,NH
2,4-Dichlorophenol	CT,NY,NH
Diethylphthalate	CT,NY,NH
2,4-Dimethylphenol	CT,NY,NH
Dimethylphthalate	CT,NY,NH
2,4-Dinitrophenol	CT,NY,NH
2,4-Dinitrotoluene	CT,NY,NH
2,6-Dinitrotoluene	CT,NY,NH
Di-n-octylphthalate	CT,NY,NH
1,2-Diphenylhydrazine/Azobenzene	NY
Fluoranthene	CT,NY,NH
Fluorene	NY,NH
Hexachlorobenzene	CT,NY,NH
Hexachlorobutadiene	CT,NY,NH
Hexachloroethane	CT,NY,NH
Indeno(1,2,3-cd)pyrene	CT,NY,NH
Isophorone	CT,NY,NH
2-Methylnaphthalene	CT,NY,NH
2-Methylphenol	CT,NY,NH
3/4-Methylphenol	CT,NY,NH
Naphthalene	CT,NY,NH
Nitrobenzene	CT,NY,NH
2-Nitrophenol	CT,NY,NH
4-Nitrophenol	CT,NY,NH
Pentachlorophenol	CT,NY,NH
Phenanthrene	CT,NY,NH
Phenol	CT,NY,NH
Pyrene	CT,NY,NH
1,2,4-Trichlorobenzene	CT,NY,NH
2,4,5-Trichlorophenol	CT,NY,NH
2,4,6-Trichlorophenol	CT,NY,NH

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The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC - ISO17025:2005	100033	03/1/2020
MA	Massachusetts DEP	M-MA100	06/30/2019
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2019
NY	New York State Department of Health	10899 NELAP	04/1/2019
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2019
RI	Rhode Island Department of Health	LAO00112	12/30/2018
NC	North Carolina Div. of Water Quality	652	12/31/2018
NJ	New Jersey DEP	MA007 NELAP	06/30/2019
FL	Florida Department of Health	E871027 NELAP	06/30/2019
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2019
ME	State of Maine	2011028	06/9/2019
VA	Commonwealth of Virginia	460217	12/14/2018
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2019
VT-DW	Vermont Department of Health Drinking Water	VT-255716	06/12/2019
NC-DW	North Carolina Department of Health	25703	07/31/2019

MEK 18K0257

con-test ANALYTICAL LABORATORY

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Fax: 413-525-6405
Email: info@contestlabs.com

http://www.contestlabs.com

Doc # 381 Rev 1_03242017

CHAIN OF CUSTODY RECORD

39 Spruce Street
East Longmeadow, MA 01028

Page 1 of 1

Company Name: WESTON & SAMPSON
Address: 5 CENTENNIAL DRIVE PEABODY
Phone:
Project Name: NORTH RIVER CANAL
Project Location: PEABODY MA
Project Number: 2180658
Project Manager: SARAH DESTEFANO
Con-Test Quote Name/Number:
Invoice Recipient: SARAH DESTEFANO
Sampled By: L. KOSKA

Requested Turnaround Time
7-Day ☐ 10-Day ☐
Due Date: 5DAY

Rush Approval Required
1-Day ☐ 3-Day ☐
2-Day ☐ 4-Day ☐

Data Delivery
Format: PDF ☒ EXCEL ☒
Other:
CLP Like Data Pkg Required: ☐
Email To: DESTEFANOS@WSEINC.COM
Fax To #:

Con-Test Work Order#	Client Sample ID / Description	Beginning Date/Time	Ending Date/Time	Composite	Grab	[1]Matrix Code	Conc Code	16 oz 1	40z 2	3 M/B									# of Containers
								I	I	↓									[2] Preservation Code
								A	A	V									[3] Container Code
								VOCs (8260)	SVOCs (8270)	TPH	PCBs	MCP 14 METALS	ICAP / FLASHPOINT	pH / CORROS	REACTIVITY	CONDUCTIVITY	ORP	HEX. CHROM	ANALYSIS REQUESTED
01	TP-5 (5-6')	11/6/18	0830	X	X	S	U	X	X	X	X	X	X	X	X	X	X	X	

Dissolved Metals Samples: ○ Field Filtered ○ Lab to Filter
Orthophosphate Samples: ○ Field Filtered ○ Lab to Filter

Client called and requested RCRA 8 instead of MCP 14. JLH 11/12

Comments:
PRICING
COMM 97 +A (HEX. CHROM SPECIATION (TCLP, AS NEEDED (20x RULE)

Please use ... cate possible sample concentration within the Conc Code column above:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

[1] Matrix Codes:
GW = Ground Water
WW = Waste Water
DW = Drinking Water
A = Air
S = Soil
SL = Sludge
SOL = Solid
O = Other (please define)

[2] Preservation Codes:
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium Bisulfate
X = Sodium Hydroxide
T = Sodium Thiosulfate
O = Other (please define)

[3] Container Codes:
A = Amber Glass
G = Glass
P = Plastic
ST = Sterile
V = Vial
S = Summa Canister
T = Tedlar Bag
O = Other (please define)

Relinquished by: (signature)	Date/Time:	
Received by: (signature)	Date/Time:	
Relinquished by: (signature)	Date/Time:	
Received by: (signature)	Date/Time:	
Relinquished by: (signature)	Date/Time:	
Received by: (signature)	Date/Time:	

Relinquished by: (signature): COC — Date/Time: 11/6/18
Received by: (signature): Date/Time: 1320 11-6-18
Relinquished by: (signature): Date/Time: 1710 11-6-18
Received by: (signature): 40c Date/Time: 11/06/2018 1710

Determine Metal Requirements
MA: RCS-1
Other:

Special Requirements
☒ MA MCP Required
☐ MCP Certification Form Required
☐ CT RCP Required
☐ RCP Certification Form Required
☐ MA State DW Required
PWSID #

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NELAC and AIHA-LAP, LLC Accredited

Project Entity
☐ Government ☐ Municipality ☐ MWRA ☐ WRTA
☐ Federal ☐ 21 J ☐ School
☒ City ☐ Brownfield ☐ MBTA

Other
☐ Chromatogram
☐ AIHA-LAP, LLC

PCB ONLY
☒ Soxhlet
☐ Non Soxhlet

Table of Contents

I Have Not Confirmed Sample Container Numbers With Lab Staff Before Relinquishing Over Samples_____

con-test® ANALYTICAL LABORATORY

Doc# 277 Rev 5 2017

Login Sample Receipt Checklist - (Rejection Criteria Listing - Using Acceptance Policy) Any False Statement will be brought to the attention of the Client - State True or False

Client Weston + Sampson

Received By TS Date 11/06/2018 Time 1710

How were the samples received? In Cooler T No Cooler _____ On Ice T No Ice _____

Direct from Sampling _____ Ambient _____ Melted Ice _____

By Gun # 557 Actual Temp - 4.0C

Were samples within Temperature? 2-6°C T By Blank # _____ Actual Temp - _____

Was Custody Seal Intact? NA Were Samples Tampered with? NA

Was COC Relinquished ? T Does Chain Agree With Samples? T

Are there broken/leaking/loose caps on any samples? F

Is COC in ink/ Legible? T Were samples received within holding time? T

Did COC include all pertinent Information? Client T Analysis T Sampler Name T

Project T ID's T Collection Dates/Times T

Are Sample labels filled out and legible? T

Are there Lab to Filters? F Who was notified? _____

Are there Rushes? F Who was notified? _____

Are there Short Holds? T Who was notified? LUKE

Is there enough Volume? T

Is there Headspace where applicable? NA MS/MSD? F

Proper Media/Containers Used? T Is splitting samples required? F

Were trip blanks received? F On COC? F

Do all samples have the proper pH? NA Acid _____ Base _____

Vials	#	Containers:	#		#		#
Unp-		1 Liter Amb.		1 Liter Plastic		16 oz Amb.	1
HCL-		500 mL Amb.		500 mL Plastic		8oz Amb/Clear	
Meoh-	1	250 mL Amb.		250 mL Plastic		4oz Amb/Clear	2
Bisulfate-	2	Col./Bacteria		Flashpoint		2oz Amb/Clear	
DI-		Other Plastic		Other Glass		Encore	
Thiosulfate-		SOC Kit		Plastic Bag		Frozen:	
Sulfuric-		Perchlorate		Ziplock			

Unused Media

Vials	#	Containers:	#		#		#
Unp-		1 Liter Amb.		1 Liter Plastic		16 oz Amb.	
HCL-		500 mL Amb.		500 mL Plastic		8oz Amb/Clear	
Meoh-		250 mL Amb.		250 mL Plastic		4oz Amb/Clear	
Bisulfate-		Col./Bacteria		Flashpoint		2oz Amb/Clear	
DI-		Other Plastic		Other Glass		Encore	
Thiosulfate-		SOC Kit		Plastic Bag		Frozen:	
Sulfuric-		Perchlorate		Ziplock			

Comments:

MADEP MCP Analytical Method Report Certification Form

Laboratory Name:	Con-Test Analytical Laboratory	Project #:	18K0257
Project Location:	North River Canal- Peabody, MA	RTN:	

This Form provides certifications for the following data set: [list Laboratory Sample ID Number(s)]

18K0257-01

Matrices: Soil

CAM Protocol (check all that below)

8260 VOC CAM II A (X)	7470/7471 Hg CAM IIIB (X)	MassDEP VPH CAM IV A ( )	8082 PCB CAM V A (X)	9014 Total Cyanide/PAC CAM VI A ( )	6860 Perchlorate CAM VIII B ( )
8270 SVOC CAM II B (X)	7010 Metals CAM III C ( )	MassDEP VPH CAM IV C ( )	8081 Pesticides CAM V B ( )	7196 Hex Cr CAM VI B (X)	MassDEP APH CAM IX A ( )
6010 Metals CAM III A (X)	6020 Metals CAM III D ( )	MassDEP EPH CAM IV A ( )	8151 Herbicides CAM V C ( )	8330 Explosives CAM VIII A ( )	TO-15 VOC CAM IX B ( )

Affirmative response to Questions A throughF is required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☑ Yes	☐ No[1]
B	Were the analytical method(s) and all associated QC requirements specificed in the selected CAM protocol(s) followed?	☑ Yes	☐ No[1]
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☑ Yes	☐ No[1]
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, Quality Assurance and Quality Control Guidlines for the Acquisition and Reporting of Analytical Data?	☑ Yes	☐ No[1]
E a	VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	☐ Yes	☐ No[1]
E b	APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes	☐ No[1]
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all No responses to Qestions A through E)?	☑ Yes	☐ No[1]

A response to questions G, H and I below is required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☑ Yes	☐ No[1]

***Data User Note:* Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.**

H	Were all QC perfomance standards specified in the CAM protocol(s) achieved?	☐ Yes	☑ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes	☑ No[1]

[1] *All Negative responses must be addressed in an attached Environmental Laboratory case narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: Lisa Worthington Position: Project Manager

Printed Name: Lisa A. Worthington Date: 11/13/18

APPENDIX G

Geotechnical Engineering Report- GBA, Inc.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

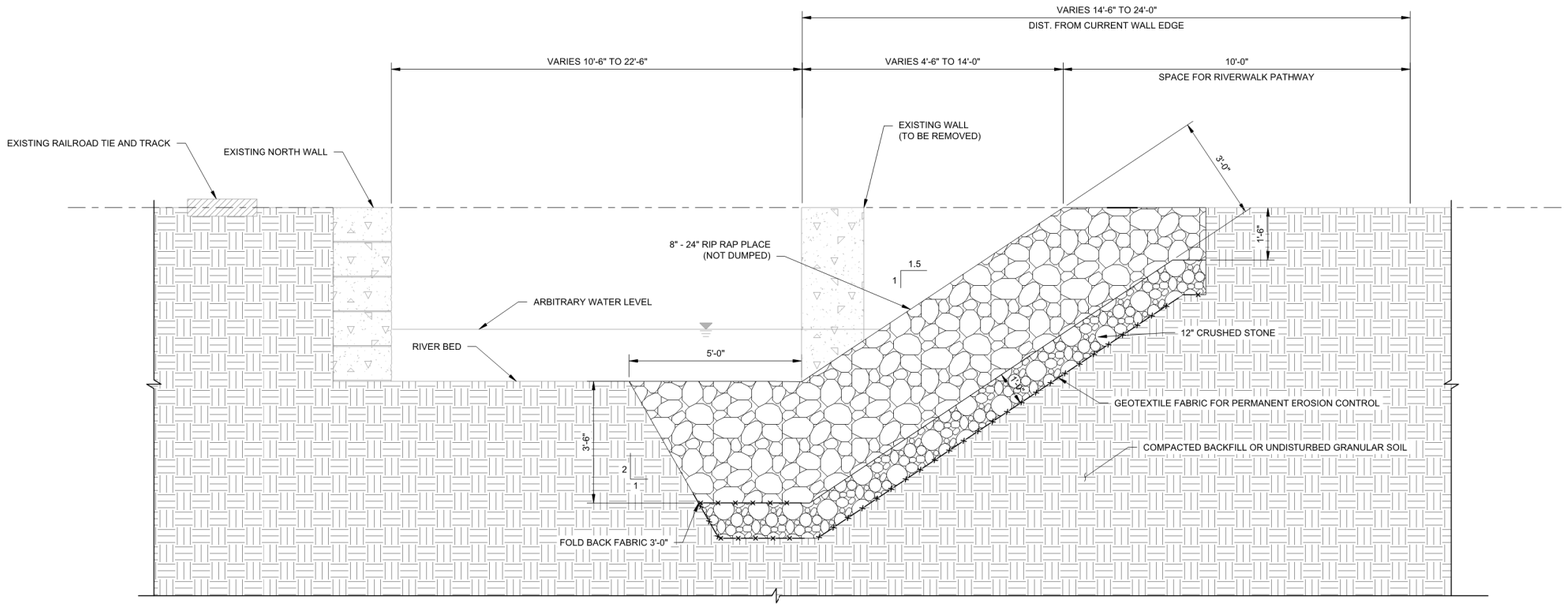
GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

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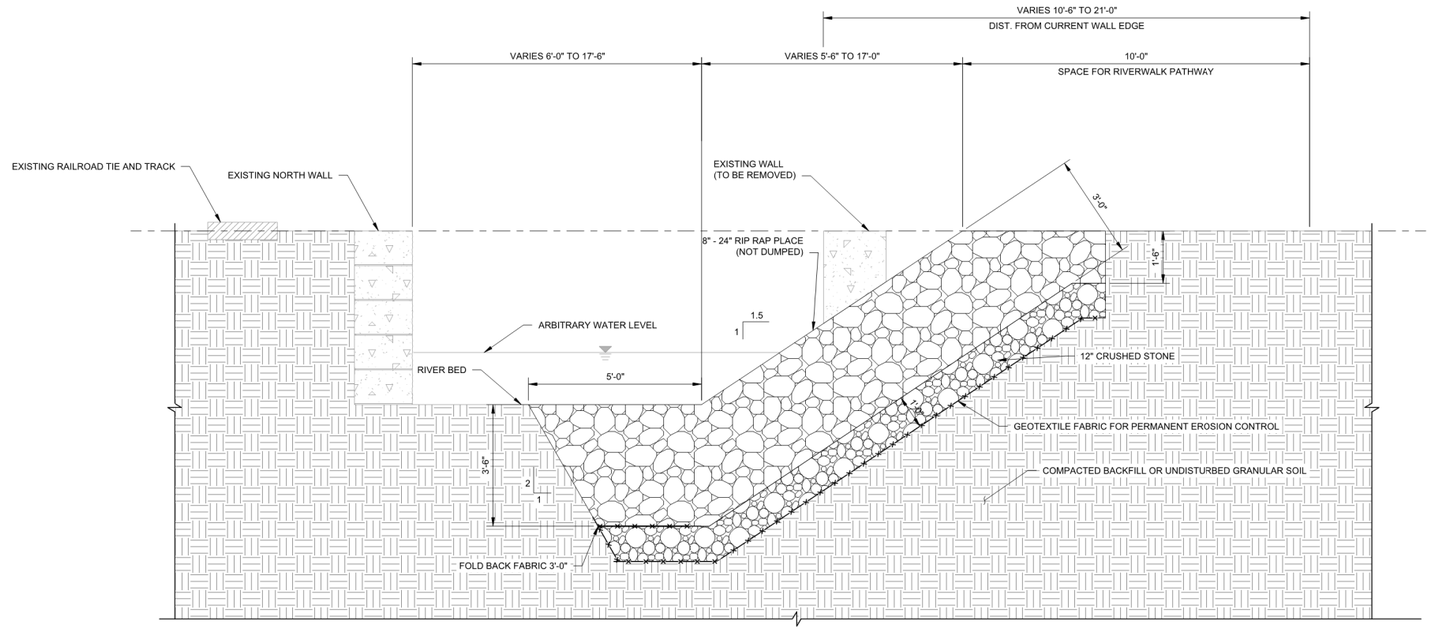
APPENDIX H

Typical Cross Sections and Alignments of Alternatives



1 RIP RAP SLOPE OPTION 1

SCALE: 1/2"=1'-0"



1 RIP RAP SLOPE OPTION 2

SCALE: 1/2"=1'-0"

FIGURE H–1
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE A –
RIP RAP SLOPE DETAILS
JANUARY, 2019 SCALE: AS NOTED

Weston & Sampson℠

N

WALLIS STREET

085-041
15 WALLIS ST
PORTER C H CONSTRUCTION INC

085-022
45 WALNUT ST
CITY OF PEABODY

085-036
49 WALNUT ST
ANZUONI J & DESALVO JR TRUSTEES

POST OFFICE

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.16'
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.80'
TOP OF NORTH WALL 11.05'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

EXIST. T.O. WALL 12.31'
PROP. T.O. BANK 12.59'
20.62
EXIST. T.O. WALL 11.83'
PROP. T.O. BANK 12.27'
18.42
10' WALKING PATH
LIMITS OF RIP RAP BASE (ALT 1)

085-039A

085-036B
3 WALNUT ST
DIGATE LUMBER CO INC

085-140
55 WALNUT ST
DIGICET-CORNING CORP

085-041A
13 WALLIS ST
DIMAMBRO ALFRED JR TRUSTEE
EXIST. T.O. WALL 11.54'
PROP. T.O. BANK 11.45'
21.13
LIMITS OF RIP RAP SLOPE (ALT 1)
EXIST. T.O. WALL 11.29'
PROP. T.O. BANK 11.00'
17.65

085-041B
WALLIS ST
ASTRO ALFRED J TRUSTEE

085-072A
17 WALLIS ST
DIMAMBRO ALFRED J TRUSTEE

085-072
82 MAIN ST
CITY OF PEABODY

085-071

085-070
98 MAIN ST (R)
IASNESKI DAVID C & TERRY A

085-073
96 MAIN ST
KNIGHTS OF COLUMBUS

UNKNOWN

085-076
100 MAIN ST (R)
ANGELAKIS CHARLES T & LUZ M

085-078
106 MAIN ST
FORTUNE PALACE INC

085-079
112 MAIN ST
FORTUNE PALACE INC

085-080
116 MAIN ST
ET ALS TRUSTEES

086-125A
23 CALLER ST
CLARK STEEL DRUM CO INC

PROP. T.O. BANK 11.00'
EXIST. T.O. WALL 11.29'
16.54
PROP. T.O. BANK 10.50'
EXIST. T.O. WALL 10.83'
16.58
PROP. T.O. BANK 9.03'
EXIST. T.O. WALL 9.15'
19.20

086-142
24 CALLER ST (R)
BOSTON CHIMNEY & TOWER CO INC

086-143
24 CALLER ST
BOSTON CHIMNEY & TOWER CO INC

086-144
22 CALLER ST
ALVES CARLOS P & TERESA D

086-145
12 CALLER ST
KOKORAS NICHOLUS & GEORGE TRS

086-1428
9 CALLER ST
VICTORY EUGENE

NORTH RIVER CANAL

CALLER ST. ELEVATION 10.14'

086-141
27 CALLER ST
PEABODY WASTE MATERIAL CORP

086-138
77 WALNUT ST
KASAPETSIOS WILLIAM & THOMAS

EXIST. T.O. WALL 12.02'
PROP. T.O. BANK 12.72'
20.90
PROP. T.O. BANK 11.62'
EXIST. T.O. WALL 11.32'
21.12

CALLER STREET

086-150B

PROP. T.O. BANK 11.45'
EXIST. T.O. WALL 11.53'
28.12
PROP. T.O. BANK 11.49'
EXIST. T.O. WALL 11.33'
28.28
PROP. T.O. BANK 8.47'
EXIST. T.O. WALL 8.59'
16.49

086-151
21 CALLER ST
ROBERT & SUSAN BAGARELLA

PROP. T.O. BANK 8.30'
EXIST. T.O. WALL 8.11'
17.13
10' WALKING PATH
EXIST. T.O. WALL 8.27'
PROP. T.O. BANK 8.96'
18.04
PROP. T.O. BANK 8.93'
EXIST. T.O. WALL 8.42'
17.41

085-150
18 HOWLEY ST
THE AZORIAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC

086-152
20 HOWLEY ST
THE AZORIAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC.

086-153A
15A MAIN ST (R)
BOB-KAT TANNING CO INC
RIVERWALK PLACE LLC
627 WASHINGTON ST
BROCKTON, MA

085-176
78 HOWLEY ST
PARSONS SPENCER

N/F MARKET STREET TRUST
29 MARKET STREET TRUST

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

HOWLEY STREET

086-1

FIGURE H-2
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE A –
RIP RAP SLOPE OPTION 1

JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson

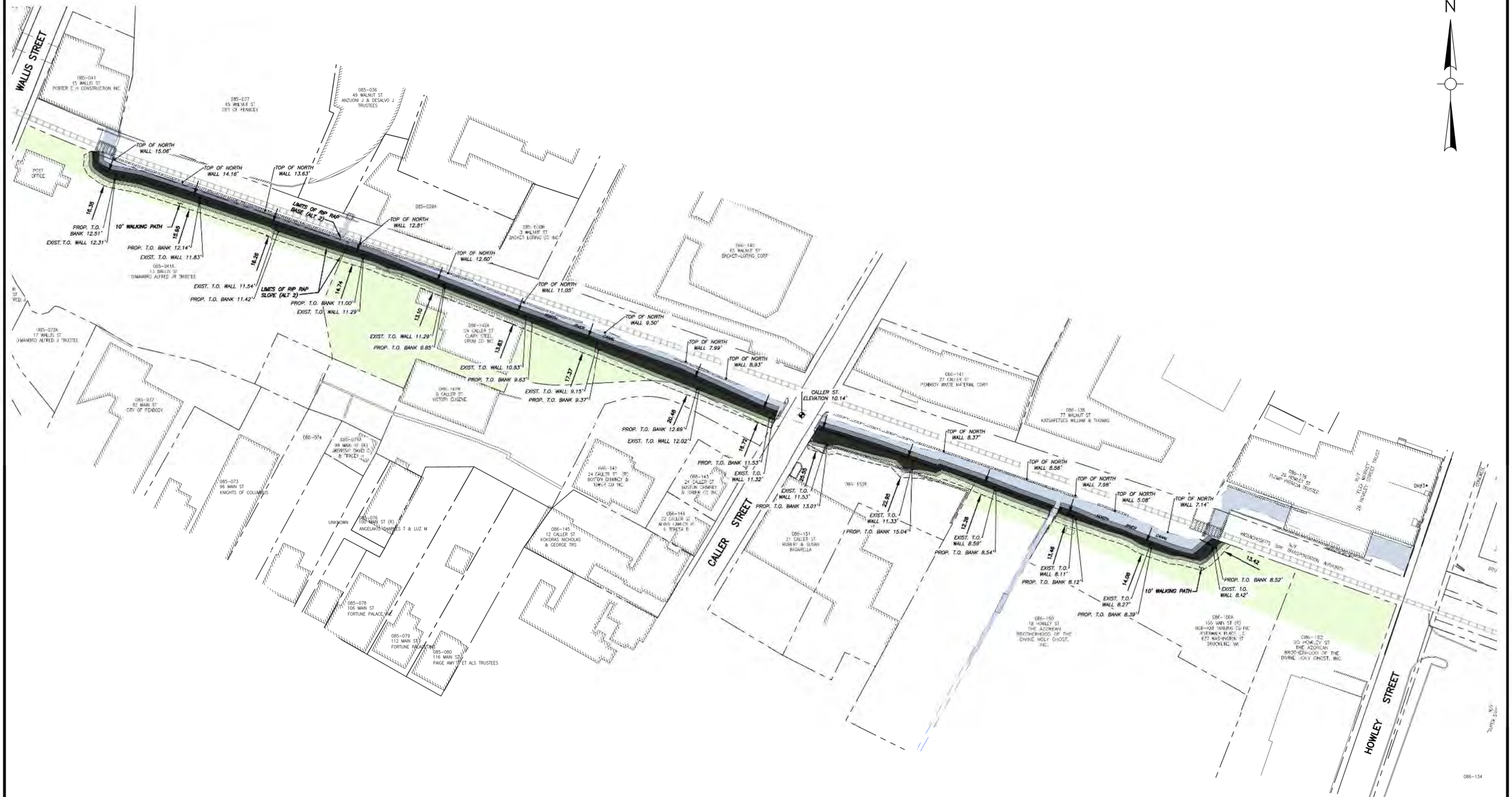
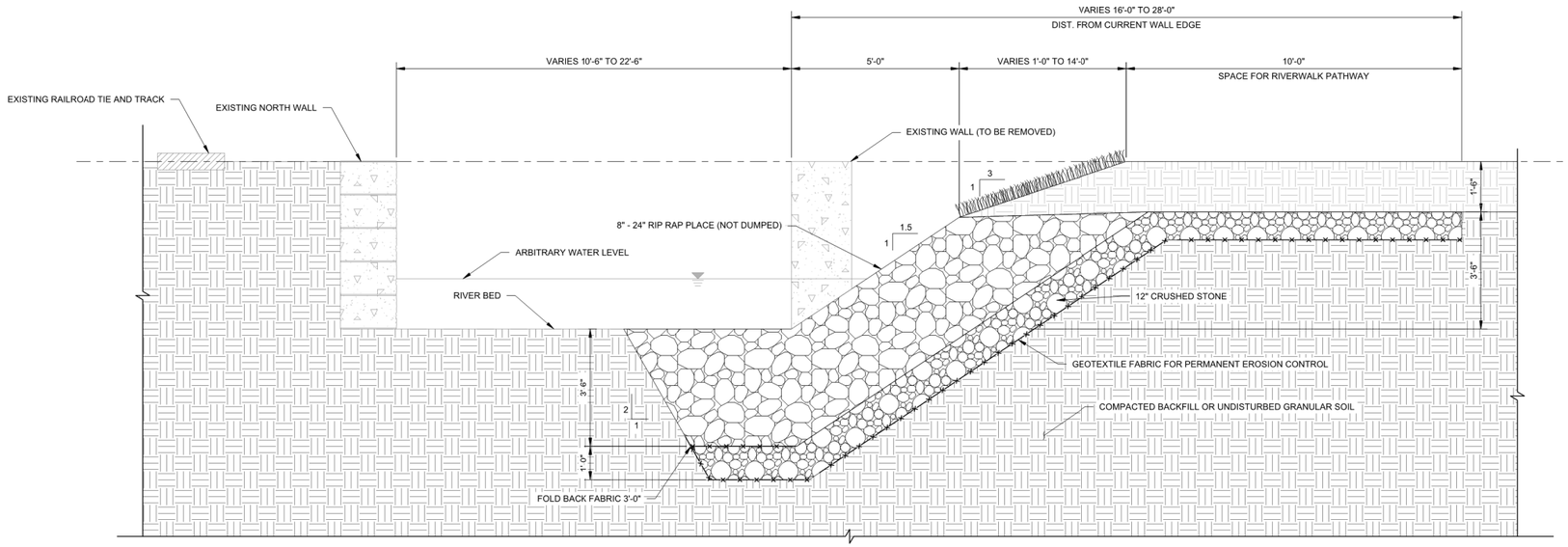


FIGURE H–3
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE A –
RIP RAP SLOPE OPTION 2

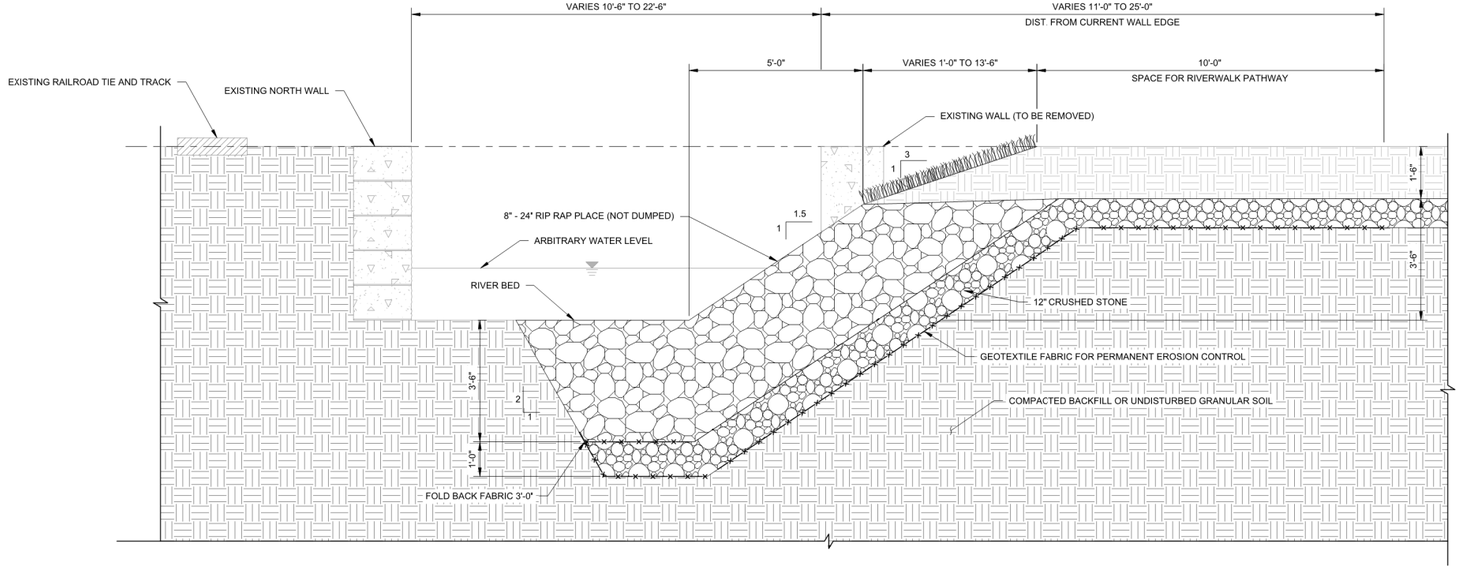
JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson℠



1 VEGETATIVE BERM ABOVE RIP RAP SLOPE OPTION 1

SCALE: 1/2"=1'-0"



2 VEGETATIVE BERM ABOVE RIP RAP SLOPE OPTION 2

SCALE: 1/2"=1'-0"

FIGURE H–4
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE DETAILS
JANUARY, 2019 SCALE: AS NOTED

Weston & Sampson℠

N

WALLIS STREET

085-041
15 WALLIS ST
PORTER E H CONSTRUCTION INC

085-037
45 WALNUT ST
CITY OF PEABODY

POST OFFICE

085-039A

085-039E
0 WALNUT ST
BARSOM LIBANE CO INC

086-140
65 WALNUT ST
BACKEN-KLABRIC CURB

085-041A
13 WALLIS ST
DIMAVERO ALFRED JR TRUSTEE

085-072A
17 WALLIS ST
DIMAVERO ALFRED J TRUSTEE

085-072
82 MAIN ST
CITY OF PEABODY

085-071

085-042
98 MAIN ST (R)
JOSHEGH DAVID C JR & TRACEY M

085-043
90 MAIN ST
KNIGHTS OF COLUMBUS

085-076
100 MAIN ST (R)
ANGELAKIS CHARLES T & LUZ M

085-078
106 MAIN ST
FORTUNE PALACE, INC

085-079
112 MAIN ST
FORTUNE PALACE INC

085-080
116 MAIN ST
PAGE AMY LEE ET ALS TRUSTEES

085-142A
0 CALLER ST
VICTORY EUGENE

085-142B
24 CALLER ST
CLARK STEEL DRUM CO INC

086-142
22 CALLER ST
ALVES CARLOS P & TERESA D

086-143
24 CALLER ST
BOSTON CHIMNEY & TOWER CO INC

086-144
22 CALLER ST
ALVES CARLOS P & TERESA D

086-145
12 CALLER ST
KOKORAS NICHOLAS & GEORGE TRS

086-150
0 CALLER ST
PEABODY WASTE MATERIAL CORP

086-138
77 WALNUT ST
KATSAPETSES WILLIAM & THOMAS

086-151
21 CALLER ST
ROBERT & SUSAN BAGARELLA

086-156
16 HOWLEY ST
THE AZOREAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC

086-126
79 HOWLEY ST
PLUMB PATRICIA TRUSTEE

086-1504
66 MAIN ST (R)
EQS-KAT OWNER CO INC
PATERNITA PLACE LLC
937 WASHINGTON ST
PEDQUINE, MA

085-162
90 HOWLEY ST
AZOREAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC.

086-134

CALLER STREET

HOWLEY STREET

NORTH RIVER CANAL

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.16'
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.60'
TOP OF NORTH WALL 11.05'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

LIMITS OF VEG. BERM EDGE (ALT 1)
LIMITS OF VEG. BERM SLOPE (ALT 1)

21.30
EXIST. T.O. WALL 12.31'
PROP. T.O.: RIPRAP 10.39'
BERM 12.76'
10' WALKING PATH
22.73
EXIST. T.O. WALL 11.83'
PROP. T.O.: RIPRAP 9.96'
BERM 12.56'
20.29
EXIST. T.O. WALL 11.54'
PROP. T.O.: RIPRAP 9.78'
BERM 11.51'
19.49
EXIST. T.O. WALL 11.29'
PROP. T.O.: RIPRAP 9.65'
BERM 11.00'
20.29
PROP. T.O.: RIPRAP 9.78'
BERM 11.00'
EXIST. T.O. WALL 11.29'
19.85
EXIST. T.O. WALL 10.83'
PROP. T.O.: RIPRAP 9.16'
BERM 10.50'
21.90
EXIST. T.O. WALL 9.15'
PROP. T.O.: RIPRAP 8.95'
BERM 9.74'
29.66
EXIST. T.O. WALL 12.02'
PROP. T.O.: RIPRAP 8.54'
BERM 12.66'
22.67
PROP. T.O.: RIPRAP 9.11'
BERM 11.76'
EXIST. T.O. WALL 11.32'
34.00
EXIST. T.O. WALL 11.53'
PROP. T.O.: RIPRAP 7.8'
BERM 13.20'
30.67
EXIST. T.O. WALL 11.33'
PROP. T.O.: RIPRAP 8.36'
BERM 12.01'
16.29
EXIST. T.O. WALL 8.59'
PROP. T.O.: RIPRAP 8.04'
BERM 8.46'
15.85
EXIST. T.O. WALL 8.11'
PROP. T.O.: RIPRAP 8.30'
BERM 8.37'
EXIST. T.O. WALL 8.27'
PROP. T.O.: RIPRAP 7.59'
BERM 9.69'
21.53
10' WALKING PATH
19.19
EXIST. T.O. WALL 8.42'
PROP. T.O.: RIPRAP 5.51'
BERM 9.11'

CALLER ST. ELEVATION 10.14'

FIGURE H-5
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE OPTION 1
JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson℠

N

WALLIS STREET

085-041
15 WALLIS ST
PORTER E H CONSTRUCTION INC

085-037
45 WALNUT ST
CITY OF PEABODY

085
49 WALNUT ST
ANZUONI J & DESALVO J TRUSTEES

POST OFFICE

085-039A

085-039B
0 WALNUT ST
MASONIC LODGING CO INC

086-140
68 WALNUT ST
LOCKE-LOBING CORP

085-041A
13 WALLIS ST
DINARDO ALFRED JR TRUSTEE

085-072A
17 WALLIS ST
DINARDO ALFRED J TRUSTEE

085-072
32 MAIN ST
CITY OF PEABODY

085-142A
24 CALLER ST
CLARK STEEL
DRIVE TO WC

085-142B
0 CALLER ST
VICTORY EUGENE

085-074
86 MAIN ST (R)
MSKHESH DAVID G
& TRACEY L

085-142
24 CALLER ST (R)
BOSTON CHIMNEY &
TOWER CO INC

085-143
24 CALLER ST
BOSTON CHIMNEY
& TOWER CO INC

085-073
96 MAIN ST
KNIGHTS OF COLUMBUS

UNKNOWN

085-076
100 MAIN ST (R)
ANGELAKIS CHARLES T & LUZ M

086-145
12 CALLER ST
KOKORAS NICHOLAS
& GEORGE TRS

086-144
22 CALLER ST
ALVES CARLOS P
& TERESA D

085-078
106 MAIN ST
FORTUNE PALACE INC

085-079
112 MAIN ST
FORTUNE PALACE INC

085-080
116 MAIN ST
PAIGE AMY LEE ET ALS TRUSTEES

CALLER STREET

086-150B

086-151
21 CALLER ST
ROBERT & SUSAN
BAGARELLA

086-141
57 CALLER ST
PEABODY WASTE MATERIAL CORP

086-138
77 WALNUT ST
KATSAPHYSIS WILLIAM & THOMAS

086-136
26 HOWLEY ST
FLOMO FARMOUT TRUSTEE

M/T
154 MARKET
ST HOWLEY STREET TRUST

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

086-150
18 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST,
INC.

086-150A
186 MAIN ST (R)
BOB-KAT TAMING CO INC
RIVERWALK PLACE LLC
637 WASHINGTON ST
BROOKLINE MA

086-152
20 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST, INC

HOWLEY STREET

086-134

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.15' W/ VEG. BERM CASE (ALT 2)
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.60'
TOP OF NORTH WALL 11.05'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

16.21
EXIST. T.O. WALL 12.31'
PROP. T.O.: RIPRAP 10.31'
BERM 12.58'
10' WALKING PATH
16.66
EXIST. T.O. WALL 11.83'
PROP. T.O.: RIPRAP 10.16'
BERM 12.24'
LIMITS OF VEG. BERM SLOPE (ALT 2)
16.59
EXIST. T.O. WALL 11.54'
PROP. T.O.: RIPRAP 9.87'
BERM 11.43'
15.51
EXIST. T.O. WALL 11.29'
PROP. T.O.: RIPRAP 9.50'
BERM 11.00'
10.69
EXIST. T.O. WALL 11.29'
PROP. T.O.: RIPRAP 9.87'
BERM 10.10'
10.84
EXIST. T.O. WALL 10.83'
PROP. T.O.: RIPRAP 8.87'
BERM 9.31'
18.17
EXIST. T.O. WALL 9.15'
PROP. T.O.: RIPRAP 8.67'
BERM 10.36'
22.86
EXIST. T.O. WALL 12.02'
PROP. T.O.: RIPRAP 7.59'
BERM 12.17'
17.73
PROP. T.O.: RIPRAP 8.87'
BERM 11.46'
EXIST. T.O. WALL 11.32'
33.39
EXIST. T.O. WALL 11.53'
PROP. T.O.: RIPRAP 7.54'
BERM 13.06'
28.28
EXIST. T.O. WALL 11.33'
PROP. T.O.: RIPRAP 8.30'
BERM 13.53'
PROP. T.O.: RIPRAP 8.07'
BERM 12.51'
EXIST. T.O. WALL 8.59'
12.07
11.65
EXIST. T.O. WALL 8.11'
PROP. T.O.: RIPRAP 8.06'
BERM 8.50'
EXIST. T.O. WALL 8.27'
PROP. T.O.: RIPRAP 7.55'
BERM 8.19
13.48
10' WALKING PATH
8.90
EXIST. T.O. WALL 8.42'
PROP. T.O.: RIPRAP 4.83'
BERM 8.74

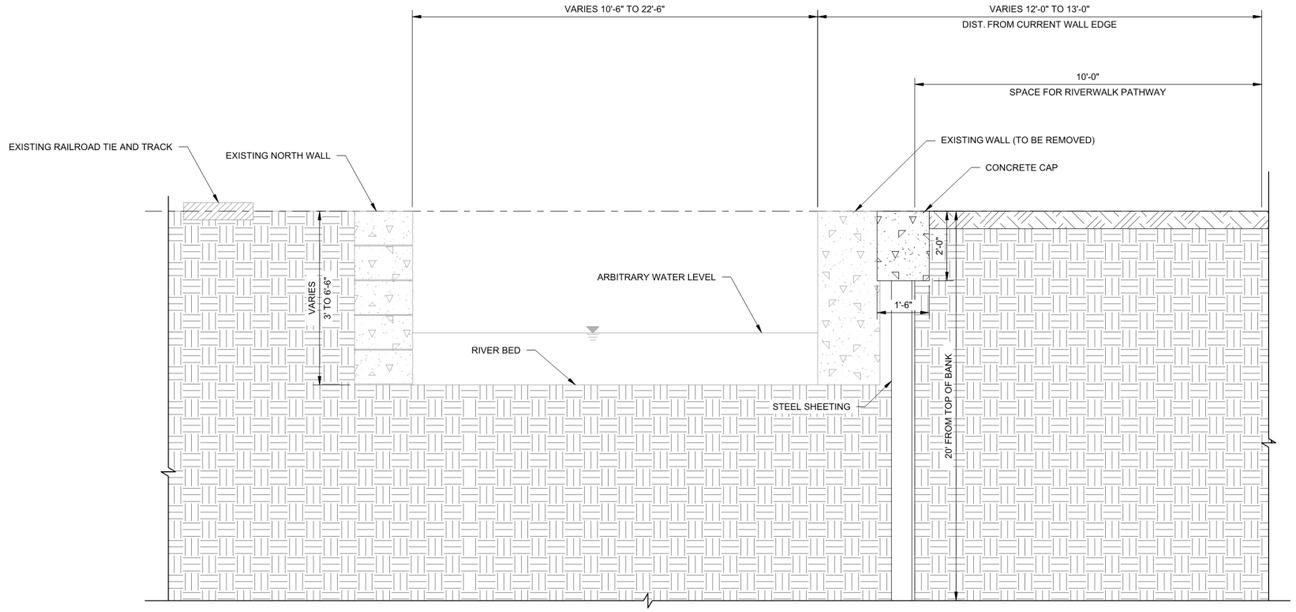
CALLER ST. ELEVATION 10.14'

FIGURE H-6
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE OPTION 2

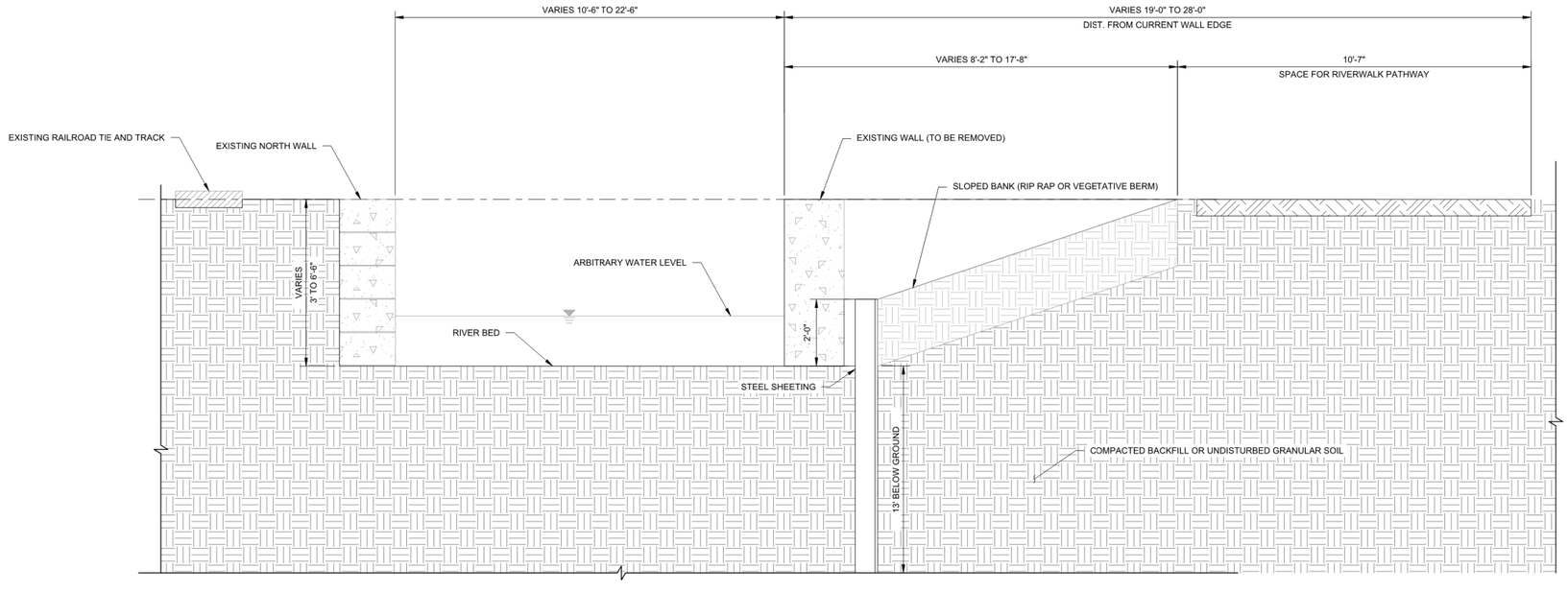
JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson



1 SHEET PILE WALL OPTION 1

SCALE: 1/2"=1'-0"



2 SHEET PILE WALL OPTION 2

SCALE: 1/2"=1'-0"

FIGURE H–7
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE C –
SHEET PILE WALL
JANUARY, 2019 SCALE: AS NOTED

Weston & Sampson℠

N

WALLIS STREET

085-041
15 WALLIS ST
FOSTER E H CONSTRUCTION INC

083-037
45 WALNUT ST
CITY OF PEABODY

085-036
49 WALNUT ST
ANZUONI J & DESALVO J
TRUSTEES

POST OFFICE

085-039A

083-139
0 WALNUT ST
DECKER LOVING CO INC

086-148
85 WALNUT ST
BACKER-LOVING CORP

085-011A
13 WALLIS ST
DIMAMBRO ALFRED JR TRUSTEE

085-072A
17 WALLIS ST
DIMAMBRO ALFRED J TRUSTEE

086-142A
24 CALLER ST
CLARK STEEL IRON CO INC

086-149
0 CALLER ST
VICTORY EUGENE

086-41
27 CALLER ST
PEABODY WASTE MATERIAL CORP

088-138
77 WALNUT ST
KATSIPETSES WILLIAM & THOMAS

085-077
83 MAIN ST
CITY OF PEABODY

085-074

085-075
99 MAIN ST (R)
ATHERTON DAVID G
& TRACY J

085-073
96 MAIN ST
KNIGHTS OF COLUMBUS

085-076
100 MAIN ST (R)
ANGELAKIS CHARLES T & LUZ M

UNKNOWN

085-078
106 MAIN ST
FORTUNE PALACE, INC

085-079
112 MAIN ST
FORTUNE PALACE INC

085-080
116 MAIN ST
PAIGE AMY L ET ALS TRUSTEES

IPM 4"
23 CALLER ST (R)
BOSTON CHIMNEY &
TOWER CO INC

086-143
24 CALLER ST
BOSTON CHIMNEY
& TOWER CO INC

086-144
22 CALLER ST
ALVES CARLOS P
& TERESA D

086-145
12 CALLER ST
KOKORAS NICHOLAS
& GEORGE TRS

086-150B

086-151
21 CALLER ST
ROBERT & SUSAN
BAGARELLA

086-150
18 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST,
INC.

088-158A
100 MAIN ST (R)
BOSTON PLACE LLC
637 WASHINGTON ST
BROOKLINE, MA

086-152
20 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST, INC

086-136
25 HOWLEY ST
CLOUD PATRICIA TRUSTEE

N/F
28 MARKET
HOWLEY STREET TRUST

5M13

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

CALLER STREET

HOWLEY STREET

086-134

NORTH RIVER CANAL

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.16'
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.60'
TOP OF NORTH WALL 11.95'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

12.70
10' WALKING PATH
EXIST. T.O. WALL 12.31'
PROP. T.O. WALL 12.50'
EXIST. T.O. WALL 11.83'
PROP. T.O. WALL 12.50'
EXIST. T.O. WALL 11.54'
PROP. T.O. WALL 12.50'
LIMITS OF SHEET PILE WALL
EXIST. T.O. WALL 11.29'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 11.29'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 10.63'
PROP. T.O. WALL 10.50'
EXIST. T.O. WALL 9.15'
PROP. T.O. WALL 10.00'
EXIST. T.O. WALL 12.02'
PROP. T.O. WALL 12.00'
CALLER ST. ELEVATION 10.14'
12.77
PROP. T.O. WALL 11.50'
EXIST. T.O. WALL 11.32'
EXIST. T.O. WALL 11.53'
PROP. T.O. WALL 11.00'
12.67
EXIST. T.O. WALL 11.33'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 8.59'
PROP. T.O. WALL 8.5'
EXIST. T.O. WALL 8.11'
PROP. T.O. WALL 8.00'
12.67
EXIST. T.O. WALL 8.27'
PROP. T.O. WALL 8.00'
10' WALKING PATH
EXIST. T.O. WALL 8.42'
PROP. T.O. WALL 8.00'

FIGURE H-8
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE C –
SHEET PILE WALL OPTION 1
JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson

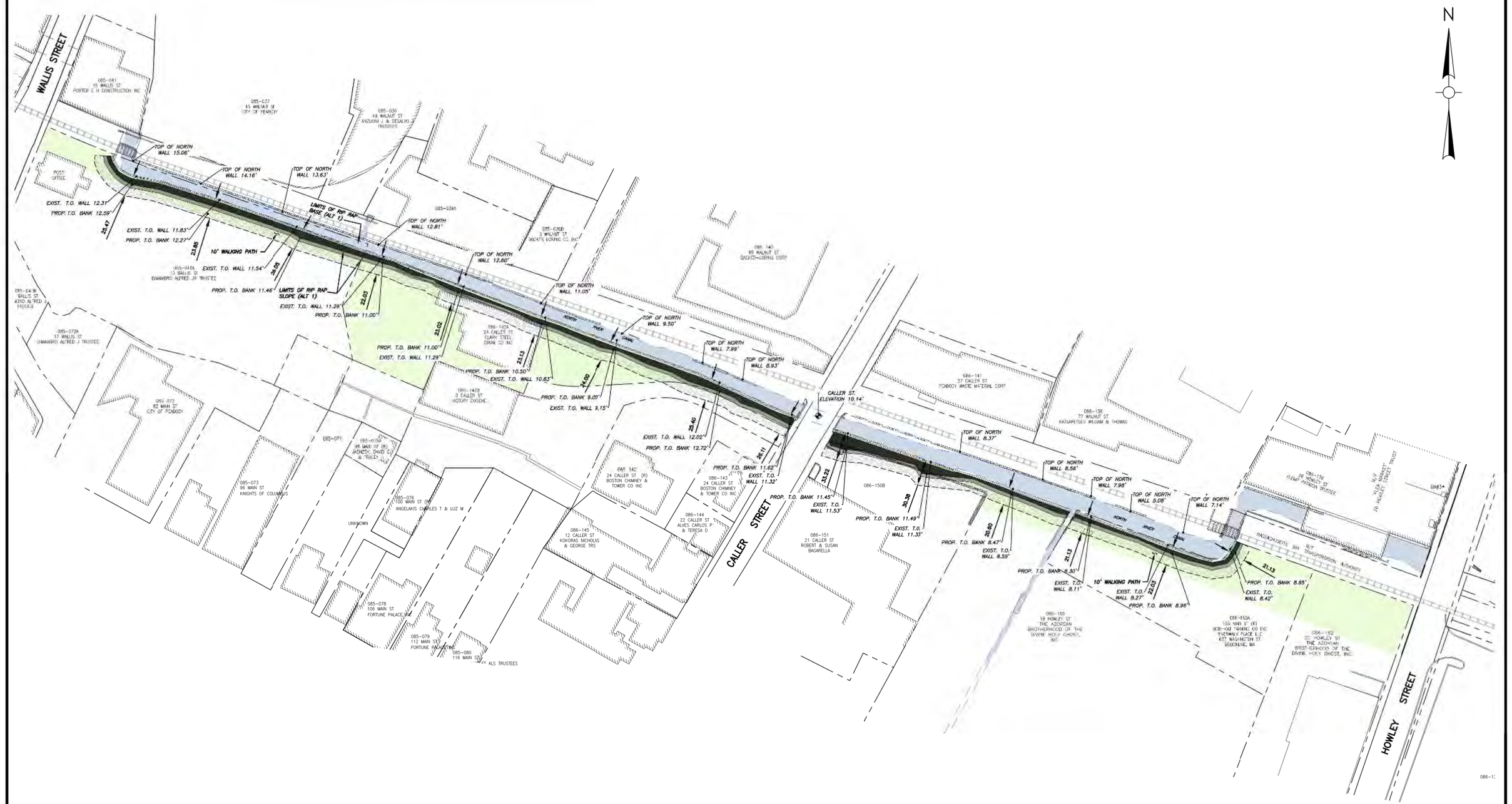
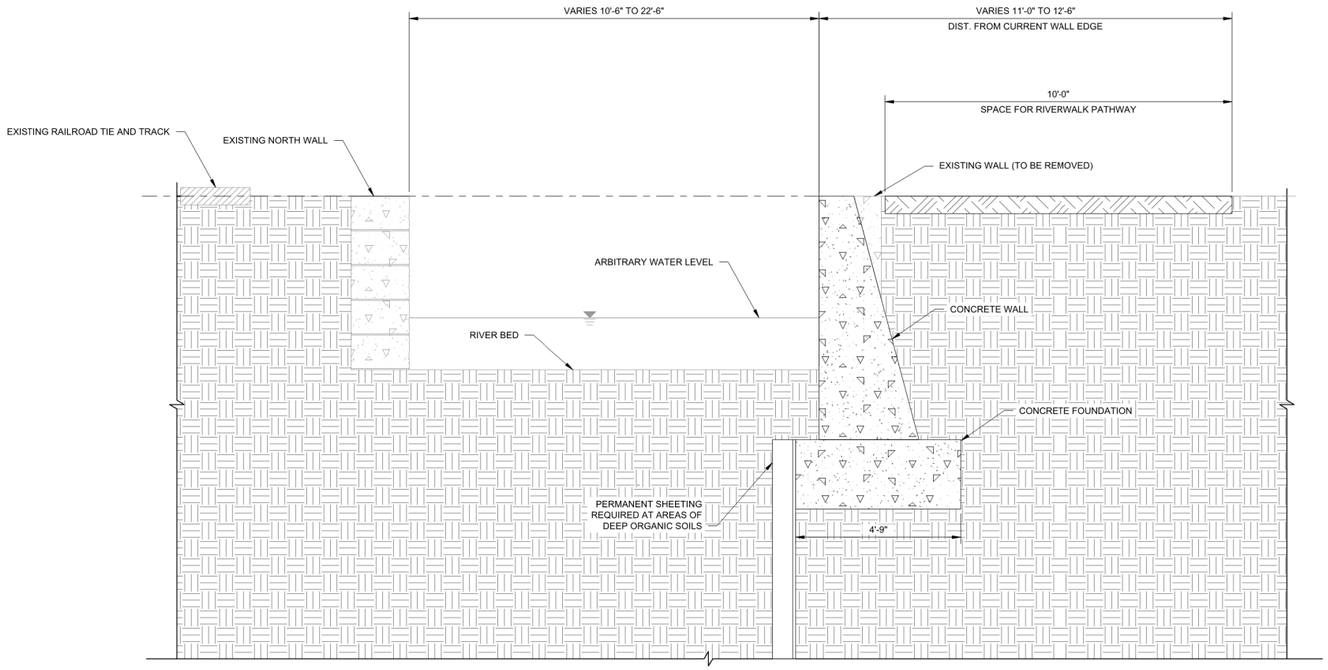


FIGURE H–9
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE C –
SHEET PILE OPTION 2

JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson℠



1 CANTILEVER CONCRETE RETAINING WALL

SCALE: 1/2"=1'-0"

FIGURE H–10
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE D –
CANTILEVER CONCRETE RETAINING WALL
JANUARY, 2019 SCALE: AS NOTED

Weston & Sampson℠

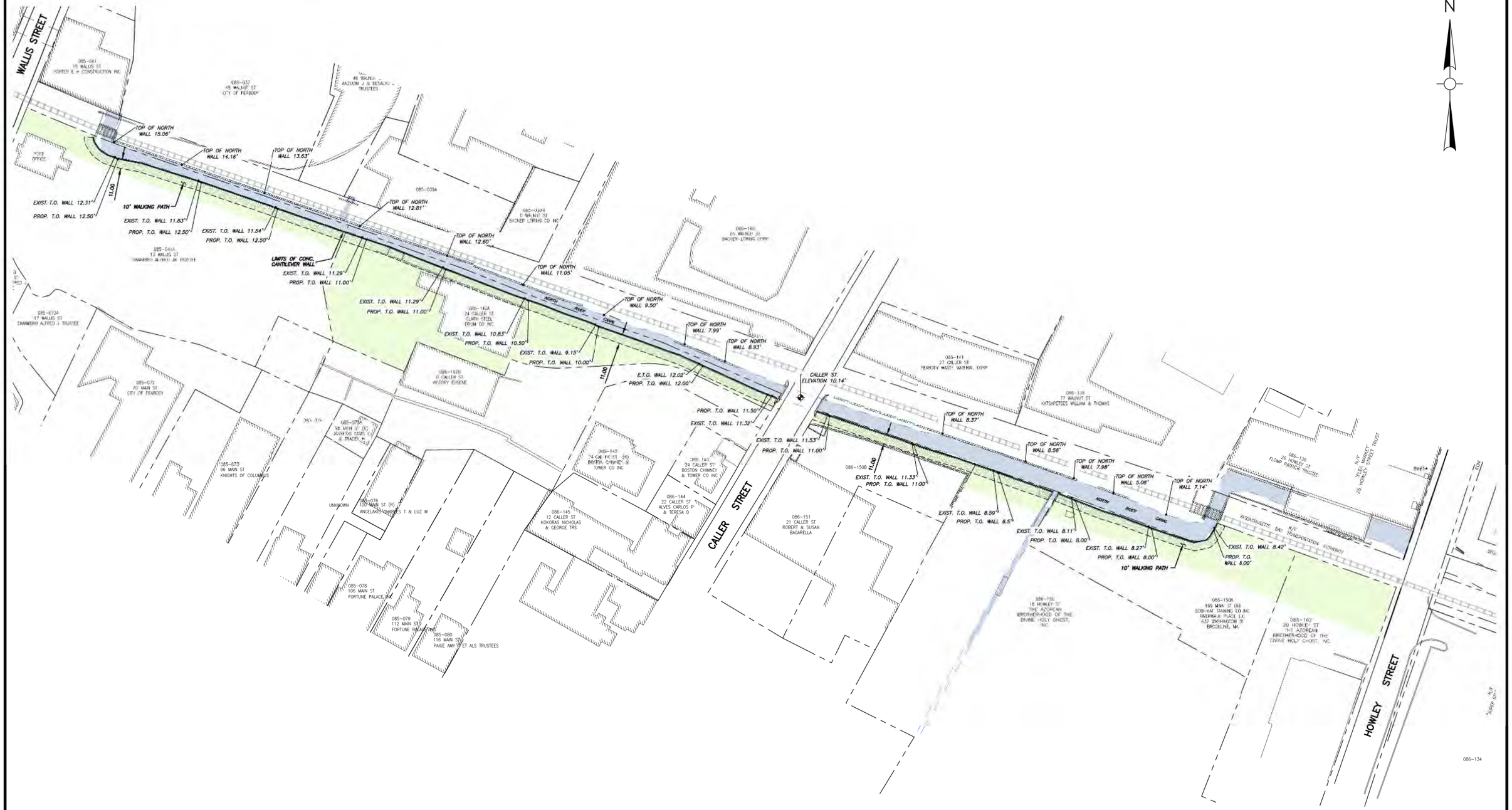
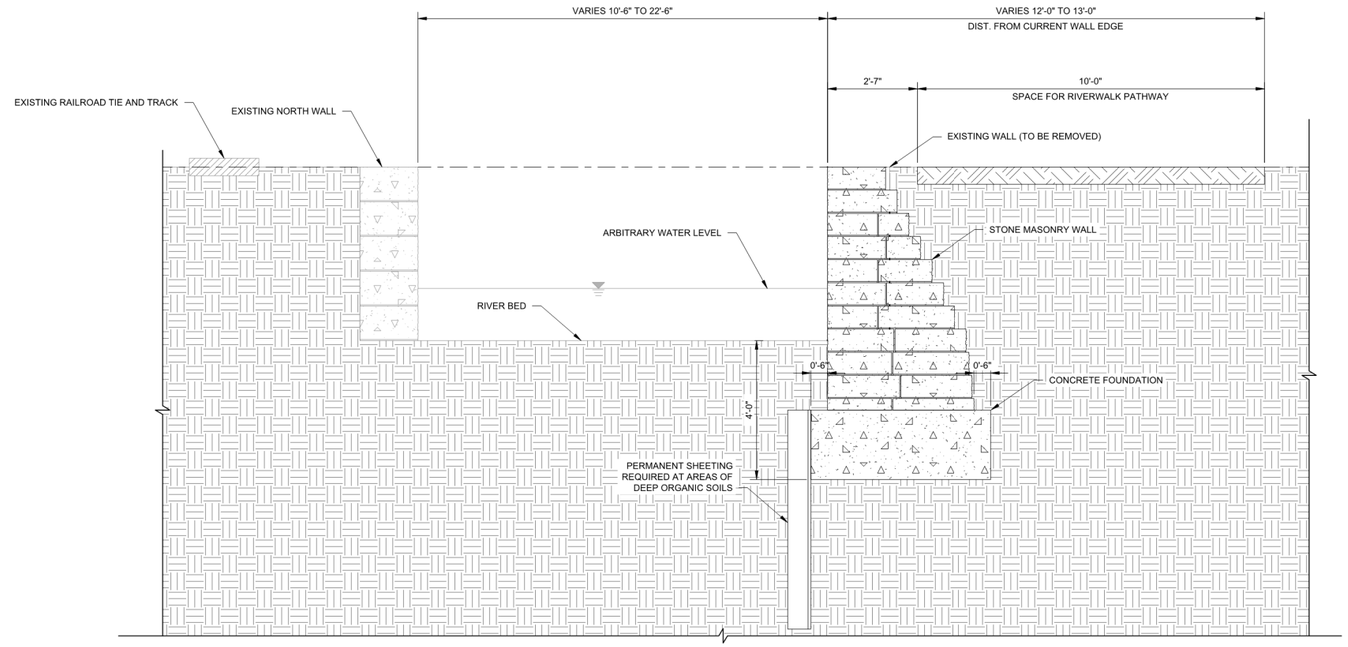


FIGURE H-11
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE D –
CANTILEVER CONCRETE RETAINING WALL
JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson



1 STONE MASONRY WALL
SCALE: 1/2"=1'-0"

FIGURE H–12
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE E –
STONE MASONRY WALL
JANUARY, 2019 SCALE: AS NOTED

Weston & Sampson℠

N

WALLIS STREET

085-041
15 WALLIS ST
PORTER E H CONSTRUCTION INC

085-037
45 WALNUT ST
CITY OF PEABODY

085-036
49 WALNUT ST
ANZUONI J & DESALVO J TRUSTEES

POST OFFICE

085-039A

085-038
0 WALNUT ST
BACKER-LORING CO INC

086-140
65 WALNUT ST
BACKER-LORING CORP

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.16'
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.60'
TOP OF NORTH WALL 11.05'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

11.67
EXIST. T.O. WALL 12.31'
PROP. T.O. WALL 12.50'
10' WALKING PATH
EXIST. T.O. WALL 11.83'
PROP. T.O. WALL 12.50'
EXIST. T.O. WALL 11.54'
PROP. T.O. WALL 12.53'
LIMITS OF BLOCK WALL (ALT 1)
EXIST. T.O. WALL 11.29'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 11.29'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 10.83'
PROP. T.O. WALL 10.50'
11.67
EXIST. T.O. WALL 9.15'
PROP. T.O. WALL 10.00'
EXIST. T.O. WALL 12.02'
PROP. T.O. WALL 12.00'
PROP. T.O. WALL 11.50'
EXIST. T.O. WALL 11.32'
EXIST. T.O. WALL 11.53'
PROP. T.O. WALL 11.00'
11.67
EXIST. T.O. WALL 11.33'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 8.59'
PROP. T.O. WALL 8.5'
EXIST. T.O. WALL 8.11'
PROP. T.O. WALL 8.00'
11.68
EXIST. T.O. WALL 8.27'
PROP. T.O. WALL 8.00'
10' WALKING PATH
EXIST. T.O. WALL 8.42'
PROP. T.O. WALL 8.00'

NORTH RIVER CANAL

CALLER ST. ELEVATION 10.14'

041R
LS ST
ALFRED
TEE

085-072A
13 WALLIS ST
DIMAMBRO ALFRED J TRUSTEE

085-072
67 MAIN ST
CITY OF PEABODY

085-074

085-075A
98 MAIN ST (R)
JACKSON DAVID C
& TRACEY H

085-073
96 MAIN ST
KNIGHTS OF COLUMBUS

UNKNOWN

085-076
100 MAIN ST (R)
ANGELAKIS CHARLES T & LUZ M

086-145
12 CALLER ST
KOKORAS NICHOLAS
& GEORGE TRS

086-142A
24 CALLER ST
FLYNN STEE
DRUM CO INC

086-143
24 CALLER ST
BOSTON CHIMNEY
& TOWER CO INC

086-144
22 CALLER ST
ALVES CARLOS P
& TERESA G

086-141
0 CALLER ST
VICTORY EUGENE

086-143
24 CALLER ST (R)
BOSTON CHIMNEY &
TOWER CO INC

086-140A

086-139
21 CALLER ST
ROBERT & SUSAN
BAGARELLA

086-138
27 CALLER ST
PEABODY DATE MATERIAL CORP

086-138
77 WALNUT ST
KATSAPETSES WILLIAM & THOMAS

086-135
26 HOWLEY ST
FLYNN PATRICIA TRUSTEE

N/F
PEOPLE'S FOREST
26 HOWLEY STREET TRUST

086-134

MASSACHUSETTS SEA N/F
TRANSPORTATION AUTHORITY

086-150
38 HOWLEY ST
THE AZORIAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST,
INC.

086-142
20 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST, INC

086-136A
66 MAIN ST (R)
BOE-KAT TANNING CO INC
RIVERPARK PLACE LLC
837 WASHINGTON ST
BROOKLINE, MA

CALLER STREET

HOWLEY STREET

FIGURE H-13
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE E –
STONE MASONRY WALL

JANUARY, 2019 SCALE: 1" = 50'

Weston & Sampson

APPENDIX I

Wall Alternative Cost Estimates

Alternative A - Rip Rap Slope Option 1

Description	QTY	Units	Price per Unit		Est. Total Cost		Est. Upper Total Cost **
Removal of existing wall	600	CY	$125.00		$75,000		
Excavation	3000	CY	$30.00		$90,000		
Rip Rap Diameters 8-24inch (3ft thick layer)	3556	CY	$81.50		$289,778		
1-ft layer bedding stone	1185	CY	$50.00		$59,259		
Geotextile fabric for perm. erosion control	4444	SY	$5.00		$22,222		
Transportation & Disposal of contaminated soils [1]	4455	Tons	$65 *		$289,575	-	$4,009,500
Water Control	1.00	LS	$100,000.00		$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00		$285,000		
166R Main St. Building Foundation Demo [2]	1	LS	$90,000.00		$90,000		
Mechanical Dry Dredging	1007	CY	$20.00		$20,148		
Dewatering liquid treatment system [3]	1	LS	$230,000.00		$230,000		
Transportation & Disposal of Dredged Material [4]	1496	Tons	$125 *		$187,000	-	$1,346,400
Sum Direct Cost					$1,737,982	-	$6,617,307
GC O&P	20%				$347,596	-	$1,323,461
Subtotal GC					$2,085,579	-	$7,940,769
Contingency	25%				$521,395	-	$1,985,192
Total Construction Cost					$2,606,974	-	$9,925,961
Estimated Total Construction Cost Range *				**~**	**$2,607,000**	**-**	**$9,926,000**

Assumptions:

[1] Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.

[2] Estimate - will need additional info on existing conditions

[3] Assumes no dewatering amendments necessary to be blended with sediments. Assumes groundwater not hazardous, can be discharged on site.

[4] Assumes out of state, non-hazardous disposal facility.

** Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

*** Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

THIS IS A PRELIMINARY COST ESTIMATE USED FOR COMPARATIVE PURPOSES ONLY AND INCLUDES ONLY MAJOR ITEMS.
THIS ESTIMATE MAY NOT BE REPRESENTATIVE OF OVERALL PROJECT COST ESTIMATE DUE TO MINOR ITEMS NOT INCLUDED.

Alternative A - Rip Rap Slope Option 2

Description	QTY	Units	Price per Unit	Est. Total Cost		Est. Upper Total Cost **
Removal of existing wall	600	CY	$125.00	$75,000		
Excavation	1492	CY	$30.00	$44,756		
Rip Rap Diameters 8-24inch (3ft thick layer)	4000	CY	$81.50	$326,000		
1-ft layer bedding stone	1200	CY	$50.00	$60,000		
Geotextile fabric for perm. Erosion control	4500	SY	$5.00	$22,500		
Transportation & Disposal of contaminated soils [1]	2216	Tons	$65 *	$144,015	-	$1,994,058
Water Control	1.00	LS	$100,000.00	$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00	$285,000		
166R Main St. Building Foundation Demo [2]	1	LS	$90,000.00	$90,000		
Mechanical Dry Dredging	1778	CY	$20.00	$35,556		
Dewatering liquid treatment system [3]	1	LS	$230,000.00	$230,000		
Transportation & Disposal of Dredged Material [4]	2640	Tons	$125 *	$330,000	-	$2,376,000
Sum Direct Cost				$1,742,826	-	$5,638,869
GC O&P	20%			$348,565	-	$1,127,774
Subtotal GC				$2,091,392	-	$6,766,643
Contingency	25%			$522,848	-	$1,691,661
Total Construction Cost				$2,614,240	-	$8,458,304
Estimated Total Construction Cost Range *				**~ $2,615,000**	**-**	**$8,459,000**

Assumptions:

[1] Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.

[2] Estimate - will need additional info on existing conditions

[3] Assumes no dewatering amendments necessary to be blended with sediments. Assumes groundwater not hazardous, can be discharged on site.

[4] Assumes out of state, non-hazardous disposal facility.

** Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

*** Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

THIS IS A PRELIMINARY COST ESTIMATE USED FOR COMPARATIVE PURPOSES ONLY AND INCLUDES ONLY MAJOR ITEMS.
THIS ESTIMATE MAY NOT BE REPRESENTATIVE OF OVERALL PROJECT COST ESTIMATE DUE TO MINOR ITEMS NOT INCLUDED.

Alternative B - Vegetative Berm Over Rip Rap Slope Option 1

Description	QTY	Units	Price per Unit		Est. Total Cost		Est. Upper Total Cost **
Removal of existing wall	600	CY	$125.00		$75,000		
Excavation	2899	CY	$30.00		$86,978		
Rip Rap Diameters 8-24inch (3ft thick layer)	2300	CY	$81.50		$187,450		
1-ft layer bedding stone	1400	CY	$50.00		$70,000		
Geotextile fabric for perm. Erosion control	4500	SY	$5.00		$22,500		
Loam and Seed	1200	SY	$5.00		$6,000	-	
Transportation & Disposal of contaminated soils [1]	4305	Tons	$65 *		$279,826		$3,874,514
Water Control	1.00	LS	$100,000.00		$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00		$285,000		
166R Main St. Building Foundation Demo [2]	1	LS	$90,000.00		$90,000		
Mechanical Dry Dredging	1067	CY	$20.00		$21,333		
Dewatering liquid treatment system [3]	1	LS	$230,000.00		$230,000	-	
Transportation & Disposal of Dredged Material [4]	1584	Tons	$125 *		$198,000		$1,425,600
Sum Direct Cost					$1,652,087	-	$6,474,375
GC O&P	20%				$330,417	-	$1,294,875
Subtotal GC					$1,982,505	-	$7,769,250
Contingency	25%				$495,626	-	$1,942,312
Total Construction Cost					$2,478,131	-	$9,711,562
Estimated Total Construction Cost Range *				**~**	**$2,479,000**	-	**$9,712,000**

Assumptions:

[1] Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.

[2] Estimate - will need additional info on existing conditions

[3] Assumes no dewatering amendments necessary to be blended with sediments. Assumes groundwater not hazardous, can be discharged on site.

[4] Assumes out of state, non-hazardous disposal facility.

** Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

*** Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

THIS IS A PRELIMINARY COST ESTIMATE USED FOR COMPARATIVE PURPOSES ONLY AND INCLUDES ONLY MAJOR ITEMS.
THIS ESTIMATE MAY NOT BE REPRESENTATIVE OF OVERALL PROJECT COST ESTIMATE DUE TO MINOR ITEMS NOT INCLUDED.

Alternative B - Vegetative Berm Over Rip Rap Slope Option 2

Description	QTY	Units	Price per Unit		Est. Total Cost		Est. Upper Total Cost **
Removal of existing wall	600	CY	$125.00		$75,000		
Excavation	1351	CY	$30.00		$40,533		
Rip Rap Diameters 8-24inch (3ft thick layer)	2300	CY	$81.50		$187,450		
1-ft layer bedding stone	1400	CY	$50.00		$70,000		
Geotextile fabric for perm. Erosion control	4500	SY	$5.00		$22,500		
Loam and Seed	1000	SY	$5.00		$5,000		
Transportation & Disposal of contaminated soils[1]	2005	Tons	$65 *		$130,309	-	$1,804,275
Water Control	1.00	LS	$100,000.00		$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00		$285,000		
166R Main St. Building Foundation Demo[2]	1	LS	$90,000.00		$90,000		
Mechanical Dry Dredging	1837	CY	$20.00		$36,741		
Dewatering liquid treatment system [3]	1	LS	$230,000.00		$230,000		
Transportation & Disposal of Dredged Material [4]	2728	Tons	$125 *		$341,000	-	$2,455,200
Sum Direct Cost					$1,613,533	-	$5,401,699
GC O&P	20%				$322,707	-	$1,080,340
Subtotal GC					$1,936,239	-	$6,482,039
Contingency	25%				$484,060	-	$1,620,510
Total Construction Cost					$2,420,299	-	$8,102,549
Estimated Total Construction Cost Range*				**~**	**$2,421,000**	-	**$8,103,000**

Assumptions:

[1] Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.

[2] Estimate - will need additional info on existing conditions

[3] Assumes no dewatering amendments necessary to be blended with sediments. Assumes groundwater not hazardous, can be discharged on site.

[4] Assumes out of state, non-hazardous disposal facility.

** Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

*** Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

THIS IS A PRELIMINARY COST ESTIMATE USED FOR COMPARATIVE PURPOSES ONLY AND INCLUDES ONLY MAJOR ITEMS.
THIS ESTIMATE MAY NOT BE REPRESENTATIVE OF OVERALL PROJECT COST ESTIMATE DUE TO MINOR ITEMS NOT INCLUDED.

Alternative C - Sheet Pile Wall Option 1

Description	QTY	Units	Price per Unit		Est. Total Cost		Est. Upper Total Cost **
Sheet Piles	30400	SQFT	$34.00		$1,033,600		
Excavation[1]	400	CY	$30.00		$12,000		
Removal of existing wall	600	CY	$125.00		$75,000		
Concrete Cap (1'6" wide x2' high)	178	CY	$600.00		$106,667		
Transportation & Disposal of contaminated soils[2]	594	Tons	$65 *		$38,610	-	$534,600
Reinforcing steel in cap (100lb/cy)	17778	LB	$2.50		$44,444		
Water Control	1.00	LS	$100,000.00		$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00		$285,000		
166R Main St. Building Foundation Demo[3]	1	LS	$90,000.00		$90,000		
Sum Direct Cost					$1,785,321	-	$2,281,311
GC O&P	20%				$357,064	-	$456,262
Subtotal GC					$2,142,385	-	$2,737,573
Contingency	25%				$535,596	-	$684,393
Total Construction Cost					$2,677,982	-	$3,421,967
Estimated Total Construction Cost Range *				~	**$2,678,000**	-	**$3,422,000**

Assumptions:

[1] *Assumes excavation 1 ft behind existing wall to 10ft below existing top of wall*

[2] *Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.*

[3] *Estimate - will need additional info on existing conditions*

* *Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

** *Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

THIS IS A PRELIMINARY COST ESTIMATE USED FOR COMPARATIVE PURPOSES ONLY AND INCLUDES ONLY MAJOR ITEMS.
THIS ESTIMATE MAY NOT BE REPRESENTATIVE OF OVERALL PROJECT COST ESTIMATE DUE TO MINOR ITEMS NOT INCLUDED.

Alternative C - Sheet Pile Wall Option 2 w/ Vegetative Berm

Description	QTY	Units	Price per Unit	Est. Total Cost		Est. Upper Total Cost **
Sheet Piles	22800	SQFT	$34.00	$775,200		
Excavation	1435	CY	$30.00	$43,050		
Removal of existing wall	600	CY	$125.00	$75,000		
1-ft layer bedding stone	533	CY	$50.00	$26,667		
Geotextile fabric for perm. erosion control	1778	SY	$5.00	$8,889		
Loam and Seed	1200	SY	$5.00	$6,000		
Transportation & Disposal of contaminated soils [1]	2228	Tons	$65 *	$144,788	-	$2,004,750
Water Control	1.00	LS	$100,000.00	$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00	$285,000		
166R Main St. Building Foundation Demo [2]	1	LS	$90,000.00	$90,000		
Sum Direct Cost				$1,554,593	-	$3,373,000
GC O&P	20%			$310,919	-	$674,600
Subtotal GC				$1,865,512	-	$4,047,600
Contingency	25%			$466,378	-	$1,011,900
Total Construction Cost				$2,331,890	-	$5,059,500
Estimated Total Construction Cost Range *				**~ $2,332,000**	-	**$5,060,000**
*Estimated Total Construction Cost Range w/ Rip Rap Slope**				*~ $2,726,000*	-	*$7,214,000*

Assumptions:

[1] *Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.*

[2] *Estimate - will need additional info on existing conditions*

* *Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

** *Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

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Alternative D - Cantilever Concrete Retaining Wall

Description	QTY	Units	Price per Unit	Est. Total Cost		Est. Upper Total Cost **
Removal of existing wall	600	CY	$125.00	$75,000		
Excavation[1]	1900	CY	$30.00	$57,000		
Placing wall (concrete)	1400	CY	$1,000.00	$1,400,000		
Reinforcing steel (100lb/cy)	140000	LB	$2.50	$350,000		
Gravel borrow backfill	500	CY	$41.00	$20,500		
Transportation & Disposal of contaminated soils[2]	2822	Tons	$65 *	$183,398	-	$2,539,350
Water Control	1.00	LS	$100,000.00	$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00	$285,000		
Steel Sheet Piling[3]	7300	SQFT	$35.00	$255,500		
166R Main St. Building Foundation Demo[4]	1	LS	$90,000.00	$90,000		
Mechanical Dry Dredging	850	CY	$20.00	$17,000		
Dewatering liquid treatment system[5]	1	LS	$230,000.00	$230,000		
Transportation & Disposal of Dredged Material[6]	1262	Tons	$125 *	$157,781	-	$1,136,025
Sum Direct Cost				$3,221,179	-	$6,555,375
GC O&P	20%			$644,236	-	$1,311,075
Subtotal GC				$3,865,415	-	$7,866,450
Contingency	25%			$966,354	-	$1,966,613
Total Construction Cost				$4,831,768	-	$9,833,063
Estimated Total Construction Cost Range*				**~ $4,832,000**	-	**$9,834,000**

Assumptions:

[1] *Assumes excavation of organic and fill soils down to native soil*

[2] *Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.*

[3] *Only assumed to be used on properties 166R Main & 24 Caller for support of excavation to remove existing organic fill and soils*

[4] *Estimate - will need additional info on existing conditions*

[5] *Assumes no dewatering amendments necessary to be blended with sediments. Assumes groundwater not hazardous, can be discharged on site.*

[6] *Assumes out of state, non-hazardous disposal facility.*

* *Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

** *Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

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Alternative E - Stone Masonry Wall

Description	QTY	Units	Price per Unit	Est. Total Cost		Est. Upper Total Cost **
Removal of existing wall	600	CY	$125.00	$75,000		
Excavation[1]	2100	CY	$30.00	$63,000		
Stone masonry	1500	CY	$700.00	$1,050,000		
Gravel borrow backfill	500	CY	$41.00	$20,500		
Transportation & Disposal of contaminated soils[2]	3119	Tons	$65 *	$202,703	-	$2,806,650
Concrete Foundation	550	CY	$366.00	$201,300		
Reinforcing steel (100lb/cy)	55000	LB	$2.50	$137,500		
Water Control	1.00	LS	$100,000.00	$100,000		
MCP Regulatory Compliance	1.00	LS	$285,000.00	$285,000		
Steel Sheet Piling[3]	7300	SQFT	$35.00	$255,500		
166R Main St. Building Foundation Demo[4]	1	LS	$90,000.00	$90,000		
Mechanical Dry Dredging	850	CY	$20.00	$17,000		
Dewatering liquid treatment system[5]	1	LS	$230,000.00	$230,000		
Transportation & Disposal of Dredged Material[6]	1262	Tons	$125 *	$157,781	-	$1,136,025
Sum Direct Cost				$2,885,284	-	$6,467,475
GC O&P	20%			$577,057	-	$1,293,495
Subtotal GC				$3,462,341	-	$7,760,970
Contingency	25%			$865,585	-	$1,940,243
Total Construction Cost				$4,327,926	-	$9,701,213
Estimated Total Construction Cost Range *				**~ $4,328,000**	-	**$9,702,000**

Assumptions:

[1] *Assumes excavation of organic and fill soils down to native soil*

[2] *Assumes only impacted soils associated with wall repair activities are removed from the site are transported and disposed of at a licensed, out-of-state non-hazardous disposal/recycling facility. This does not include any soils that may need to be removed from the site associated with the construction of the proposed Riverwalk, etc.*

[3] *Only assumed to be used on properties 166R Main & 24 Caller for support of excavation to remove existing organic fill and soils*

[4] *Estimate - will need additional info on existing conditions*

[5] *Assumes no dewatering amendments necessary to be blended with sediments. Assumes groundwater not hazardous, can be discharged on site.*

[6] *Assumes out of state, non-hazardous disposal facility.*

* *Transportation and Disposal cost ranges for impacted soils/sediments:*

A) In-state, non-hazardous disposal facility = $65/ton

B) Out-of-state, hazardous disposal facility = $450/ton

C) Soil/Sediment subject to federal/EPA land ban disposal restrictions = $900/ton

** *Upper cost range assumes all impacted soil/sediment subject to federal/EPA land ban disposal restrictions*

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APPENDIX J

Resilience Evaluation Report

Weston & Sampson

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REPORT

March 2019

CITY OF
Peabody
MASSACHUSETTS

Municipal Vulnerability Preparedness Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park – Resilience Evaluation



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EXECUTIVE SUMMARY

To address the City's priority action of addressing flooding along the North River Canal and to enable the City to address climate change and continue its efforts to increase resilience against flooding in the watershed, Weston & Sampson conducted an evaluation of the floodplain along the proposed 1,600-foot long park adjacent to the canal. The evaluation assessed the suitability and potential benefit of incorporating additional flood storage capacity in both the rehabilitation alternatives for the southern canal wall as well as on nearby public and private properties. This evaluation considered both existing and future potential climate conditions. In general, increasing flood storage has the potential to reduce peak flood levels, thereby decreasing potential damage downstream and, to a lesser degree, upstream of the storage site. Based on our evaluation, we have identified the following conclusions:

- Under existing climate conditions and under expected mid-century conditions, flooding in the North River Canal will largely be a function of runoff generated upstream – riverine flooding. However, by the end of the 21st century, tidal flooding due to sea level rise is expected to equal or exceed riverine flooding in the project area. Ultimately, the creation of additional flood storage may provide a modest benefit to the properties and infrastructure in the study area in the short- and medium-term, but those benefits are significantly reduced over the long-term.
- The creation of additional flood storage in and/or near the North River Canal is only effective in areas of riverine flooding. Projects that create compensatory storage and projects that floodproof flood prone properties will have a greater and longer lasting benefit the further upstream they are.
- The relative benefit of compensatory storage created by the eight alternatives for rehabilitating the North River Canal's southern wall should be considered in the cost-benefit analysis and alternative selection process.
- There may be value in conducting a detailed assessment of potential site-specific compensatory storage and flood control designs, including geotechnical, contamination/remediation, hydrologic and hydraulic, city planning, and cost-benefit analyses among others.
- Given the significant total riverine flood volumes in the early- and mid-century periods and the relatively modest compensatory storage that could be created by the southern retaining wall alternatives and the individual site projects explored above, it would be worth evaluating the cost-benefit of floodproofing individual buildings rather than eliminating flooding on a parcel scale. This type of floodproofing would also allow individual property owners to take on some responsibility for flooding impacts on their property.
- In light of the anticipated significant increase in tidal flooding in the study area by the end of the century, as opposed to riverine flooding, it may be worth evaluating "retreat" alternatives in more detail. On a related note, it may be worth evaluating the potential benefit of a tide gate to limit tidal flooding under future climate conditions.

1.0 INTRODUCTION

The City of Peabody has suffered from recurring flooding since the 1950's with most significant flooding occurring downtown in Peabody Square in the vicinity of Foster Street and Walnut Street. Post-World War II development as well as the North River Canal's poor condition and limited ability to handle storm flows in downtown Peabody are major contributors to the flooding problem in Peabody Square (City of Peabody, 2002). With significant floods occurring in 1954, 1968, 1979, 1987, and 1996, the City's Hazard Mitigation Plan has identified flooding as the City's top natural hazard mitigation priority (MAPC, 2016). Under climate change, flooding events have become more frequent, with several events occurring within the past fifteen years, including the Mother's Day Storm of 2006 which incapacitated the downtown area for more than a week. More recently, in March 2010, October 2011, and December 2014, downtown flooding occurred from short duration and high intensity rain events. Flooding events in Peabody regularly put a strain on area businesses and on Fire and Police Department staff who must respond to emergencies.

End-of-century climate change projections indicate that the annual precipitation will increase by as much as 7 inches and there will be up to four additional 1-inch storms each year (NECSC, 2018). In the highly urbanized Peabody Square, this increased precipitation will exacerbate stormwater runoff and result in increased peak streamflows in the North River Canal, leaving the City even more vulnerable to riverine flooding.

Climate change projections indicate that, by 2100, mean sea level rise in Boston Harbor since 2000 is unlikely to exceed (83% probability) 4.0 feet although it could be as high as 10.2 feet (NECSC). This is in addition to the documented increase in relative sea level rise of more than 11 inches (2.83 millimeters or 0.11 inches annually) that occurred in Boston Harbor between 1921 and 2018 (NOAA gage #8443970).

The 11.5-square-mile North River watershed drains land primarily east of Route 1, flowing downstream through Salem until it reaches Salem Sound of the North Coastal Basin. Closer to Salem, the North River Canal is tidally influenced. However, sea level rise is expected to cause the zone of tidal influence to migrate upstream in the North River Canal. Peabody Square, which is already prone to significant flooding during storm events, could experience an even higher likelihood of extreme flooding under scenarios involving both high tides and extreme precipitation.

Participants at the City of Peabody's April 11, 2018 Municipal Vulnerability Preparedness (MVP) Workshop identified seven "highest priority" actions. At the top of their list was:

> *"Evaluate and assess alternatives for managing commonly flooded areas and flood-impacted public safety concerns located throughout the City, including along the North River Canal, within the Lawrence Brook Watershed, in the downtown area, and along various brook channels (Horsley Witten Group, 2018)."*

To address the City's priority action of addressing flooding along the North River Canal and to enable the City to address climate change and continue its efforts to increase resilience against flooding in the watershed, Weston & Sampson conducted an evaluation of the floodplain along the proposed 1,600-foot long park adjacent to the canal, identified in Figure 1. The evaluation assessed the suitability of incorporating additional flood storage capacity under existing and future potential climate conditions.

Increasing flood storage has the potential to reduce peak flood levels, thereby decreasing potential damage downstream and, to a lesser degree, upstream of the storage site. This evaluation consists of three sub-tasks: 1) identify a suitable range of design events under existing and potential future climate scenarios, 2) identify flood levels throughout the study area associated with each of the selected design events, and 3) conduct a GIS-based analysis of potential opportunities for flood storage.

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2.0 CLIMATE SCENARIO SELECTION

Weston & Sampson collaborated with both the City of Peabody and the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), the funding agency, to identify a suitable range of design events that considered both existing and potential future climate scenarios. Selection of suitable design events considered multiple sources of flooding, including rainfall-driven runoff from the North River watershed, tidal influences and sea level rise (SLR), and storm surge. The selection process also included significant research into regional and local evaluations of the potential impact of climate change on a variety of meteorological and hydrological processes. A detailed discussion of the selection process is described in a Weston & Sampson memo, "MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park 2018 Resiliency Evaluation – Climate Scenario Selection," dated January 10, 2019. That memo is included in Appendix A. Ultimately, six climate scenarios were selected for incorporation into the compensatory storage analysis.

- Scenario 1A: Existing Conditions, 50-year flood
- Scenario 1B: Existing Conditions, 100-year flood
- Scenario 2: 2050 Moderate Climate Change for precipitation and SLR, 50-year flood
- Scenario 3: 2050 High Climate Change for precipitation and SLR, 100-year flood
- Scenario 4: 2100 Moderate Climate Change for precipitation and SLR, 50-year flood
- Scenario 5: 2100 High Climate Change for precipitation and SLR, 100-year flood

These six scenarios offer a broad range of possible outcomes under climate change and will enable a more robust analysis of resiliency alternatives. Scenarios 1A and 1B, which represent existing conditions during the 50- and 100-year flood events, respectively, provide a baseline for comparison of the future scenarios. They also represent a "best-case scenario," during which any flood storage measures will have the maximum impact. As climate change advances through the remainder of the 21st century and results in increased SLR and more extreme precipitation events, those benefits are expected to decrease.

The future climate scenarios (Scenarios 2 through 5) were selected to evaluate the potential future benefit of flood storage as a function of the degree to which climate change will occur. We have developed a moderate scenario and a high impact scenario. Under those scenarios, changes in rainfall and riverine discharge are consistent with a medium emissions pathway (RCP4.5) and a high emissions pathway (RCP8.5), respectively. Estimates of sea level rise are consistent with "Intermediate-High" and "High" scenarios, respectively, as defined in Table 6 of the Massachusetts Climate Change Projections (NECSC, 2018), which is reproduced in the graphic below. These moderate and high scenarios were chosen to give the City a sense for how the effectiveness of flood storage measures might change depending on the severity of future climate change impacts. The moderate scenario was paired with 50-year flooding conditions as the smaller storm was determined to offer a more achievable condition for which to develop flood mitigation designs at this site. The high scenario was paired with the 100-year flooding conditions to highlight the effectiveness of flood mitigation designs under worst-case conditions. We have also selected time horizons that represent potential climate conditions during both mid-century (2050) and end of century (2100) to give the City an idea of the effectiveness of flood storage measures over time.

Relative mean sea level (feet NAVD88)	
Scenario	Cross-walked probabilistic projections
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)
	• Extremely unlikely to exceed (95% probability) given a medium emissions pathway (RCP 4.5) • Unlikely to exceed (83% probability) given a medium emissions pathway (RCP 4.5) • About as likely as not to exceed (50% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible higher ice sheet contributions to sea level rise
Intermediate - High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)
	• Unlikely to exceed (83% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible higher ice sheet contributions to sea level rise • About as likely as not to exceed (50% probability) given a high emissions pathway (RCP 8.5) when accounting for higher possible ice sheet contributions to sea level rise
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)
	• Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5) when accounting for possible higher ice sheet contributions to sea level rise • Extremely unlikely to exceed (95% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible higher ice sheet contributions to sea level rise
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)
	• Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP8.5) when accounting for possible higher ice sheet contributions to sea level rise

This graphic is copied from Table 6 of the Massachusetts Climate Change Projections (NECSC, 2018).

3.0 FLOODING PROFILES

For each of the six design events identified above, Weston & Sampson determined flood levels throughout the 1,600-foot long study area. The methodologies varied for each event, based on the best available estimates of riverine flood levels and/or discharge magnitudes and on estimated high tide levels. The methodology and datasets used to prepare flooding profiles are described on a scenario-by-scenario basis below. Flood profiles for each scenario are provided in Appendix B.

3.1 Scenario 1A – Existing Conditions, 50-year Flood

Existing 50-year flood elevations are controlled by precipitation and the resulting runoff. Riverine flooding levels, caused by upgradient precipitation, were determined from the effective FEMA Flood Insurance Study (25009CV004B), which was updated most recently on July 16, 2014. These 50-year flood levels ranged from 16.6 ft. NAVD88 upstream of Wallis Street to El. 11.0 at Howley Street. *Note that all elevations identified in this report reference the height in feet above mean sea level on the North American Vertical Datum of 1988 (NAVD88).* Coastal flooding does not impact the study area during existing 50-year flood conditions.

3.2 Scenario 1B – Existing Conditions, 100-year Flood

Existing 100-year flood elevations are controlled primarily by precipitation and the resulting runoff. Riverine flooding levels, caused by upgradient precipitation, were determined from the effective FEMA Flood Insurance Study. These 100-year flood levels ranged from 17.4 ft. upstream of Wallis Street to El. 11.5 ft. at Howley Street. Coastal flooding does not significantly impact the study area during existing 100-year flood conditions.

3.3 Scenario 2 – 2050 conditions under a moderate climate change scenario

Precipitation under this scenario saw an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 9.4 inches (Cambridge, Part 1 Appendix, 2015), a 23.7% increase. It was assumed that this change would result in a corresponding increase in generated runoff. A 23.7% increase in riverine discharge in the project area would cause the FEMA 50-year flood flow to increase from 880 to 1,089 cubic feet per second (cfs). Based on the discharges associated with the 100-year (1,030 cfs) and 500-year (1,470 cfs) events, as reported in the FEMA Flood Insurance Study, the 50-year flood under this future climate scenario would be approximately equal to the current 153-year flood event. Weston & Sampson interpolated between the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 50-year riverine flood levels ranged from 17.6 ft. upstream of Wallis Street to El. 11.6 at Howley Street, an increase of 0.6 to 1.0 ft. over Scenario 1A.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2050 under this scenario is expected to be El. 1.7 ft NAVD88 or 1.7 feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 11.67 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding only at the very downstream end of the project area. The estimated flood profile was adjusted accordingly.

3.4 Scenario 3 – 2050 conditions under a high climate change scenario

Increases to the 100-year riverine discharge were assumed to reach 35%, the maximum predicted increase for the 2055 time horizon (BRAG, 2016). A 35% increase in riverine discharge in the project area would result in an increase in the FEMA 100-year flood flow from 1,030 to 1,391 cfs. Based on the

discharges associated with the 100- and 500-year events, as reported in the FEMA Flood Insurance Study, the 100-year flood under this future climate scenario would be approximately equal to the current 428-year flood event. Weston & Sampson interpolated between the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 100-year riverine flood levels ranged from 18.5 ft. upstream of Wallis Street to El. 12.2 at Howley Street, an increase of 0.7 to 1.1 ft. over Scenario 1B.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2050 under this scenario is expected to be El. 2.4 ft NAVD88 or 2.4 feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 12.37 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding only at the very downstream end of the project area. The estimated flood profile was adjusted accordingly.

3.5 Scenario 4 – 2100 conditions under a moderate climate change scenario

Precipitation under this scenario saw an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 10.9 inches (Cambridge, Part 1 Appendix, 2015), a 43.4% increase. It was assumed that this change would result in a corresponding increase in generated runoff. A 43.4% increase in riverine discharge in the project area would cause the FEMA 50-year flood flow to increase from 880 to 1,262 cfs. Based on the discharges associated with the 100-year (1,030 cfs) and 500-year (1,470 cfs) events, as reported in the FEMA Flood Insurance Study, the 50-year flood under this future climate scenario would be approximately equal to the current 311-year flood event. Weston & Sampson interpolated between the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 50-year riverine flood levels ranged from 18.1 ft. upstream of Wallis Street to El. 12.0 at Howley Street, an increase of 1.0 to 1.5 ft. over Scenario 1A.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2100 under this scenario is expected to be El. 5.0 ft NAVD88 or 5.0 feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 14.97 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding up to the Caller Street bridge crossing. The estimated flood profile was adjusted accordingly.

3.6 Scenario 5 – 2100 conditions under a high climate change scenario

Increases to the 100-year riverine discharge were assumed to reach 70%, the maximum predicted increase for the 2085 time horizon (BRAG, 2016). A 70% increase in riverine discharge in the project area would cause the FEMA 100-year flood flow to increase from 1,030 to 1,751 cfs. Based on the discharges associated with the 100- and 500-year events, as reported in the FEMA Flood Insurance Study, the 100-year flood under this future climate scenario would be approximately equal to the current 755-year flood event. Weston & Sampson extrapolated from the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 100-year riverine flood levels ranged from 19.7 ft. upstream of Wallis Street to El. 13.0 at Howley Street, an increase of 1.5 to 2.3 ft. over Scenario 1B.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2100 under this scenario is expected to be El. 7.6 ft NAVD88 or 7.6

feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 17.57 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding upstream as far as the railroad bridge crossing near Wallis Street. The estimated flood profile was adjusted accordingly.

4.0 FLOODING EXTENTS

It is important to note that the areas of riverine and tidal flooding presented in Table 1 were calculated only for flooding within the study area. It is true that riverine flooding in the subject area will decrease under future climate conditions. However, that is only because tidal flooding is expected to increase significantly. In fact, the total area subject to flooding of any kind is expected to increase under future climate conditions. In addition, while this evaluation focused only on our 1600-foot long study area, riverine flooding is likely to increase significantly in upstream areas.

Table 1: Summary of Area Flooded			
Scenario	Area (acres) Subject to Flooding		
	Riverine Flooding	Tidal Flooding	Total
1A	17.8	0.0	17.8
1B	19.4	0.0	19.4
2	19.6	0.4	20.0
3	22.4	0.8	23.2
4	11.2	12.4	23.6
5	2.9	25.4	28.3

*Areas calculated for inundation extents within the study area only.

The flooding anticipated under all six scenarios evaluated is expected to impact several residences and businesses in the study area. Table 2 summarizes the number of buildings impacted by both riverine and tidal flooding.

Table 2: Summary of Buildings Flooded			
Scenario	Number of Buildings Flooded		
	Riverine Flooding	Tidal Flooding	Total
1A	23	0	23
1B	25	0	25
2	28	2	28
3	32	2	32
4	17	18	32
5	6	33	39

*The total number of buildings flooded may not equal the sum of buildings subject to riverine flooding and tidal flooding as some buildings may be subject to both.

As shown in Table 2, under current climate conditions (Scenarios 1A and 1B) all buildings in the floodplain of the study area are expected to be impacted by riverine flooding, caused by stormwater runoff generated upstream. This condition remains largely true through 2050 (Scenarios 2 and 3), where only 2 buildings are affected by tidally influenced flooding. However, as tidal influences extend significantly further upstream into the study area near the end of the century (Scenarios 4 and 5), more buildings are impacted by tidewater moving up the North River Canal rather than stormwater runoff coming down from the North River and Proctor Brook watersheds. Even though the number of buildings impacted by riverine flooding is expected to decrease under late-century climate conditions (Scenarios 4 and 5), the total number of buildings impacted is still expected to increase. In addition, while not evaluated in this report, increased riverine flooding and association impacts would be expected upstream of the study area under future climate conditions.

It is also important to note that the increased tidal flooding extents identified for late-century climate conditions (Scenarios 4 and 5) in particular may also cause a backwater effect further upstream both within the study area and beyond. And even though the predicted riverine flood level exceeds the predicted MHHW, the presence of the tidal backwater reduces the discharge capacity of the North River Canal, resulting in worse flooding than what is represented in Tables 1 and 2 and elsewhere in this report.

5.0 FLOODING IMPACTS

To further evaluate the potential impacts to flooded buildings, Weston & Sampson considered the estimated depth of flooding at each building. By subtracting the gridded dataset of flood levels in the project area for each scenario by the best available ground elevation data (LiDAR), we developed a gridded GIS dataset of the depth of flooding throughout the 1,600-foot long project area for each scenario, as shown in Figures 2A through 2F.

We estimated the potential impacts to buildings flooded under each scenario by considering how many buildings are flooded to maximum depths of less than 2 feet, between 2 and 5 feet, and more than 5 feet. The maximum flooding depth for each building was estimated by subtracting the maximum predicted flood elevation by the lowest ground elevation (LiDAR) within each building's footprint, or partial footprint for those buildings straddling the line between riverine and tidal flooding. These comparisons are summarized in Table 3.

Table 3: Summary of Building Flooding Depths						
Scenario	Number of Buildings Flooded					
	Depth of Riverine Flooding (ft.)			Depth of Tidal Flooding (ft.)		
	<= 2	2 – 5	>=5	<= 2	2 – 5	>=5
1A	9	12	2	0	0	0
1B	8	15	2	0	0	0
2	10	15	3	1	0	1
3	13	16	3	0	1	1
4	5	11	1	7	8	3
5	3	2	1	5	9	19

*The total number of buildings flooded may not equal the sum of buildings subject to riverine flooding and tidal flooding as some buildings may be subject to both.

As Table 3 indicates, a significant portion of affected buildings experience less than 2 feet of flooding under all scenarios. Those buildings subject to shallow riverine flooding conditions are most likely to benefit from compensatory storage, floodproofing, or other flood resiliency projects. However, with the exception of Scenario 5, the majority of buildings subject to riverine flooding experience a maximum of 2-5 feet of flooding. The projects needed to eliminate or reduce flooding damage to those structures would likely be more significant in scope and costlier. The most challenging situations, those involving buildings subject to more than 5 feet of riverine flooding, are projected to occur less frequently, representing 8-17% of impacted buildings depending on the scenario.

Table 3 also indicates the fact that the impacts of tidally-influenced flooding are projected to be relatively uncommon through the middle of the century. However, of those 18 and 33 buildings likely to be impacted by tidal flooding by 2100 – Scenarios 4 and 5, respectively – the majority of those buildings

are projected to be inundated by more than 2 feet, making resilience or floodproofing projects more challenging and costlier.

As one of the goals of this project was to evaluate the potential benefit of creating compensatory storage, Weston & Sampson also evaluated the volume of flooding experienced on a parcel-by-parcel basis. A total of 58 parcels were determined to fall partially or fully within the study area; they are shown in Figure 3. The flood volume on each parcel within the study area was estimated by multiplying the area of each portion of parcel expected to be flooded by the average depth of flooding. Table 4 summarizes the estimated flood volume by parcel for each of the six scenarios.

In total, Scenarios 1A, 1B, 2, 3, 4, and 5 are associated with 23.3, 30.8, 32.5, 45.2, 19.9, and 4.7 acre-feet of riverine flooding, respectively. It is telling to note that riverine flooding volumes in the study area peak under mid-century conditions (Scenarios 2 and 3), before sharply declining late century (Scenarios 4 and 5) as tidal flooding takes on a far more significant role. This observation, combined with the large total volume of riverine flooding in the early- and mid-century scenarios, suggests that creating compensatory storage and then developing flood control structures to eliminate flooding in the study area may be difficult. Alternative flood mitigation measures such as floodproofing individual buildings or retreat may be required instead. It is also important to note that the depth of flooding at buildings and the volume of flooding on parcels upstream of the study area are expected to increase under future climate conditions.

Table 4: Summary of Parcel Flooding Volumes						
Parcel ID	Estimated Flooding Volume (acre-feet) by Scenario					
Total	1A	1B	2	3	4	5
085-008	23.312	30.762	32.473	45.212	19.911	4.655
085-008A	0.021	0.041	0.046	0.098	0.073	T
085-008B	0.333	0.416	0.433	0.549	0.502	T
085-009	0.076	0.117	0.126	0.198	0.169	T
085-010	0.025	0.052	0.058	0.102	0.085	T
085-011	0.059	0.106	0.124	0.279	0.213	T
085-011	0.175	0.271	0.304	0.520	0.425	0.090
085-016	0.175	0.271	0.304	0.520	0.425	0.090
085-026	0.000	0.004	0.005	0.013	0.009	0.017
085-028	0.036	0.071	0.081	0.124	0.105	0.148
085-032	0.102	0.153	0.166	0.257	0.225	T
085-033	0.131	0.172	0.182	0.245	0.220	T
085-034	0.062	0.115	0.129	0.207	0.175	T
085-035	0.119	0.170	0.180	0.252	0.221	T

Table 4 cont.: Summary of Parcel Flooding Volumes						
Parcel ID	Estimated Flooding Volume (acre-feet) by Scenario					
Total	1A	1B	2	3	4	5
085-036	0.494	0.603	0.625	0.780	0.716	T
085-037	1.490	1.787	1.853	2.281	2.115	T
085-038	3.612	4.122	4.261	5.061	4.761	T
085-038	0.351	0.500	0.566	0.848	0.716	0.392
085-039X	0.351	0.500	0.566	0.848	0.716	0.392
085-041	1.493	2.006	2.119	2.851	2.548	T
085-041	0.464	0.546	0.593	0.786	0.692	0.290
085-041A	0.464	0.546	0.593	0.786	0.692	0.290
085-042	0.242	0.402	0.464	0.983	0.730	T
085-043	NF	0.008	0.016	0.494	0.258	0.989
085-044	0.358	0.587	0.652	0.939	0.809	1.138
085-045	0.093	0.127	0.136	0.175	0.157	0.198
085-050A	0.100	0.139	0.149	0.197	0.175	0.228
085-060	0.028	0.045	0.050	0.070	0.061	0.080
085-060B	NF	NF	NF	0.008	0.000	0.026
085-065	0.000	0.024	0.038	0.140	0.086	0.213
085-066	NF	NF	NF	NF	NF	0.001
085-067	NF	NF	NF	0.002	NF	0.033
085-068	NF	NF	NF	NF	NF	0.010
085-068	NF	NF	NF	0.000	NF	0.016
085-072	NF	NF	NF	0.000	NF	0.016
085-280	NF	NF	NF	NF	NF	T
085-700-701	0.000	0.003	0.003	0.016	0.010	T
086-001	NF	NF	NF	NF	NF	T
086-002	0.041	0.071	0.078	0.140	0.112	T
086-020X	NF	NF	NF	0.001	0.000	5
086-136	NF	NF	NF	0.000	NF	T
086-137	2.024	2.413	2.091	2.066	T	T
086-138	0.031	0.052	0.058	0.100	T	T

Table 4 cont.: Summary of Parcel Flooding Volumes						
Parcel ID	Estimated Flooding Volume (acre-feet) by Scenario					
Total	1A	1B	2	3	4	5
086-140X	0.095	0.154	0.170	0.322	T	T
086-141	3.416	4.485	5.003	7.241	0.354	T
086-142	0.392	0.609	0.675	0.989	T	T
086-142A	0.056	0.122	0.164	0.401	T	T
086-142B	0.994	1.355	1.463	2.037	1.260	T
086-143	0.075	0.204	0.275	0.641	0.096	T
086-144	NF	0.000	0.002	0.037	T	T
086-150	NF	NF	NF	NF	NF	T
086-150A	3.844	5.147	5.458	7.350	T	T
086-150B	1.040	1.405	1.483	1.996	T	T
086-151X	NF	NF	NF	0.000	T	T
086-155	0.067	0.115	0.134	0.340	T	T
086-160	0.000	0.000	0.000	0.001	T	T
086-162	0.016	0.030	0.033	0.052	T	T
086-600-647	0.350	0.613	0.448	0.568	T	T
086-002	0.016	0.083	0.113	0.300	T	T

NF – Not Flooded. T – Tidal flooding only; volume not calculated.

6.0 FLOOD MITIGATION

As described in detail above, the anticipated impacts of flooding under the six evaluated scenarios are significant. Riverine flooding in the project area is caused by upstream stormwater runoff exacerbated by insufficient channel capacity (Metcalf & Eddy-AECOM, 2008). Mitigating these impacts can be accomplished through a variety of approaches, some of which are discussed in the following sub-sections.

6.1 Channel Improvements

Channel improvements consist of modifications that might be made to the North River Canal and/or Proctor Brook channel to increase their hydraulic capacities to discharge stormwater runoff downstream. Improvements may take the form of channel widening, modification of stream crossings, and the construction of subterranean conduits among others. These channel improvement concepts and the potential benefit to riverine flooding impacts are not the focus of this project but were studied at length by the City in 2008 (Metcalf & Eddy-AECOM, 2008). If such channel improvements were undertaken to increase the discharge capacity of the North River Canal, downstream flooding may increase so coordination with downstream communities will be necessary.

6.2 Compensatory Storage

“Compensatory storage” or “compensatory flood storage” are regulatory terms used by FEMA and by the Massachusetts Department of Environmental Protection, respectively, to describe the development of additional flood storage that is designed to offset the construction of new or improved buildings and structures within the nearby regulatory floodway. It is important to note two key caveats in evaluating the potential benefit of compensatory storage. First, the benefits are generally only felt downstream or cross-stream. It is unlikely that the benefit of additional flood storage and reduced downstream discharge would propagate upstream of a project site. And second, compensatory storage provides little to no benefit in a tidally-influenced reach as occurs in a portion of the study area under Scenarios 2, 3, 4, and 5.

Weston & Sampson has evaluated the potential benefit of creating compensatory storage specifically through its rehabilitation of the North River Canal’s southern retaining wall as well as other hypothetical projects in several adjacent parcels. As the creation of compensatory storage may be paired with the construction of flood control measures designed to protect one or more parcels from riverine flooding, Weston & Sampson has estimated the potential benefit of the various compensatory storage measures described below in terms of both the volume of storage created but also in terms of the maximum number of parcels that might be removed from the floodplain without increasing downstream flooding impacts. The maximum number of parcels that could be protected was determined for each scenario by sorting the parcels in ascending order of their total flooded volumes and adding them together one at a time, starting with the least flooded parcel, until the total volume equaled the created compensatory storage. Note that no consideration was given to the feasibility or cost of the structures or measures that would be required to protect those parcels. Nor was any consideration given to the value or current use of a parcel or portion of a parcel that could be protected.

6.2.1 *Southern Retaining Wall Alternatives*

The City of Peabody intends to repair the south side of the North River Canal. Weston & Sampson evaluated a total of eight (8) alternatives, including multiple variations of riprapped slopes, vegetative berms, and sheet pile walls, as well as a concrete cantilever retaining wall and a stone masonry wall.

- Alternative A consists of 3-foot thick layer of 8- to 24-inch rip rap placed on a slope of 1 vertical to 1.5 horizontal. This alternative requires the removal of the existing south wall. Two options are considered for the location of the bottom of the rip rap slope. Option 1 is to set the bottom of the slope at the location of the existing wall which will provide some additional flood storage. Option 2 is to set the bottom of the slope into the river, providing no additional flood storage and requiring fill within the waterway.
- Alternative B is similar to Alternative A except the rip rap slope for this alternative will stop at approximately 3.5 feet above the river bed with a vegetative berm extending to the top of the slope at a slope of 1 vertical to 3 horizontal. This alternative requires the removal of the existing south wall. Alternative B, like Alternative A, has the same two options for the location of the bottom of slope.
- Alternative C Option 1 consists of a sheet pile wall installed behind the existing wall to an approximate depth of 20 feet below the top of slope. A concrete coping would be constructed along the top of the sheet pile wall and the existing wall structure would be removed, providing a small increase in flood storage. Alternative C Option 2 consists of a sheet pile wall installed behind the existing wall, extending 2-feet above ground and 13-feet below ground. A rip rap slope or vegetated berm, much like Alternative A and B, would then extend from the top of the sheet pile to the top of bank, creating additional flood storage.
- Alternative D consists of removing the existing stone masonry wall and constructing a concrete cantilever retaining wall in the same location. The stem of the concrete wall will be approximately 14 inches wide at the top and about 30 inches wide at the base, extending down to a concrete footing 4 feet below the streambed. This alternative would provide no additional flood storage space.
- Alternative E consists of removing the existing stone masonry wall and constructing a new stone masonry wall on a concrete footing in the same location. The stem of the wall will be approximately 20 inches wide at the top and 4 feet at the base, extending down to a concrete footing 4 feet below the streambed. This alternative would provide no additional flood storage space.

Table 5A summarizes the compensatory storage associated with each of the eight alternatives as well as the potential maximum number of parcels that could be protected as a result.

Of the eight wall alternatives evaluated, six of them involved the creation of additional flood storage. The volume of that new storage ranged from 0.037 acre-feet (Alternatives A, Option 1 and Alternative B, Option 2) to 0.735 acre-feet (Alternative B, Option 1. As shown in Table 5A, the number of parcels that might be protected with the compensatory storage associated with the various wall options ranged from 3 to 19, depending on the climate scenarios. However, the number of parcels benefited does not necessarily tell the whole story as the number of parcels impacted by riverine flooding varies considerably under the various climate scenarios. The potential benefit of each wall alternative's created compensatory storage is therefore compared against the percentage of parcels that might be protected in Table 5B.

Table 5A: Southern Retaining Wall Alternatives Compensatory Storage (# Parcels)							
Wall Alternative	Compensatory Storage Created (acre-feet)	Maximum # Of Parcels Protected by Scenario					
		1A	1B	2	3	4	5
Alt A – Rip Rap Option 1	0.661	18	15	14	17	11	11
Alt A – Rip Rap Option 2	0.037	6	5	5	9	4	3
Alt B – Vegetative Berm Option 1	0.735	19	16	15	17	11	12
Alt B – Vegetative Berm Option 2	0.037	6	5	5	9	4	3
Alt C – Sheet Pile Wall Option 1	0.312	13	11	11	14	7	9
Alt C – Sheet Pile Wall Option 2	0.735	19	16	15	17	11	12
Alt D – Concrete Cantilever Wall	0.000	---	---	---	---	---	---
Alt E – Stone Masonry Wall	0.000	---	---	---	---	---	---

Table 5B: Southern Retaining Wall Alternatives Compensatory Storage (% of Parcels)							
Wall Alternative	Compensatory Storage Created (acre-feet)	Maximum # Of Parcels Protected by Scenario					
		1A	1B	2	3	4	5
Alt A – Rip Rap Option 1	0.661	41%	33%	30%	32%	31%	55%
Alt A – Rip Rap Option 2	0.037	14%	11%	11%	17%	11%	15%
Alt B – Vegetative Berm Option 1	0.735	43%	35%	33%	32%	31%	60%
Alt B – Vegetative Berm Option 2	0.037	14%	11%	11%	17%	11%	15%
Alt C – Sheet Pile Wall Option 1	0.312	30%	24%	24%	26%	20%	45%
Alt C – Sheet Pile Wall Option 2	0.735	43%	35%	33%	32%	31%	60%
Alt D – Concrete Cantilever Wall	0.000	---	---	---	---	---	---
Alt E – Stone Masonry Wall	0.000	---	---	---	---	---	---

As shown in Table 5B, an estimated 44 and 46 parcels experience riverine flooding in the study area during the 50-year and 100-year storm events, respectively, under existing climate conditions (Scenarios 1A and 1B). The number of impacted parcels that could benefit from compensatory storage is expected to increase to 46 and 53 by mid-century (Scenarios 2 and 3) before declining sharply to 35 and 20 by the end of the century. The decrease in the number of parcels subjected to riverine flooding that would benefit from compensatory storage is attributed to the anticipated rise in sea level and associated tidal flooding. Despite increased overall flooding in late century, compensatory storage will not provide a benefit in flooding conditions that are driven by the ocean.

The percentage of parcels that may be protected from riverine flooding by taking advantage of the compensatory storage created by the various wall alternatives ranges from 11% to 60% with an average of 27%. As the retaining wall runs nearly the entire length of the 1,600-foot long site, it is not unreasonable to expect that most parcels are located cross-stream or downstream of the wall and could therefore potentially take advantage of the compensatory storage created.

6.2.2 *Public Property*

In addition to additional storage that may be created by repairs, rehabilitation, and/or replacement of the existing retaining wall on the south side of the canal, Weston & Sampson evaluated the potential benefit of developing compensatory storage on two City-owned parcels near the North River Canal – the East End Peabody Veterans Memorial Park and the Mill Street Municipal Parking Lot (Figure 4).

The East End Peabody Veterans Memorial, created on the site of a former tannery, was unveiled in a dedication ceremony in May 2013. The park includes a paved circular walkway, benches, granite boulders, and an elevated wooden deck, although the site's land cover is generally grass with some trees (The Salem News, 2013). Creating additional flood storage at this site would involve excavating material, primarily in grass covered areas, and then restoring the existing public open space.

Weston & Sampson estimated the limits of the hypothetical storage area, as shown in Figure 4, based on a 25-foot setback from the property boundary and manually modifying it to avoid the more developed portions of the park like the wooden deck and stage and the impervious gathering area near the Walnut Street entrance. The area of the potential storage site is 0.53 acres, approximately 40% of the parcel. Based on LiDAR ground elevations, the average elevation of the potential storage site is El. 11.8. The FEMA Flood Insurance Study river profile of the North River indicates that the canal bottom is at approximately El. 8.5; we assumed that the potential storage site could be excavated down to El. 10.0, providing 1.5 vertical feet between the canal bottom and newly created floodplain. Based on these assumptions, a total of approximately 0.95 acre-feet of compensatory storage could be created at this site. Table 6 summarizes the potential benefit of that created storage on parcels subject to riverine flooding in the study area.

Table 6: Veterans Memorial Park Compensatory Storage

Wall Alternative	Maximum % Of Parcels Protected by Scenario					
	1A	1B	2	3	4	5
Maximum # of Parcels Benefited*	21	18	16	19	12	13
Total # of Parcels Subject to Riverine Flooding	44	46	46	53	35	20
Maximum % of Parcels Benefited*	48%	39%	35%	36%	34%	65%

*In calculating the number of parcels benefited, parcels were assumed to be protected in such a way that they remain completely dry.

The Mill Street Municipal Parking Lot is located at the corner of Wallis Street and Mill Street and contains parking spaces for approximately 55 vehicles. Creating additional flood storage at this site would require excavating a portion of the site and then repaving and otherwise returning it to its existing use. It is important to note that compensatory storage created at this site will not provide a benefit until mid-century under 100-year flood conditions and late-century under 50-year flood conditions. The reason the benefit will be delayed is that this area is not expected to flood until mid- to late-century, so the

created compensatory storage will not be accessible to the river overflows until that time, as shown in Figures 2D and 2F.

Weston & Sampson estimated the limits of the hypothetical storage area, as shown in Figure 4, based on a 25-foot setback from the property boundary. The area of the potential storage site is 0.23 acres, approximately 35% of the parcel. Based on LiDAR ground elevations, the average elevation of the potential storage site is El. 16.6. The FEMA Flood Insurance Study river profile of the North River indicates that the canal bottom is at approximately El. 9.0. While there is approximately 7.6 vertical feet between the canal bottom and the existing land surface, we assumed that the site could only be excavated down 2.5 feet in order to support re-grading the site as necessary to maintain its existing use as a parking lot. Based on these assumptions, a total of approximately 0.58 acre-feet of compensatory storage could be created at this site. Table 7 summarizes the potential benefit of that created storage on parcels subject to riverine flooding in the study area.

Table 7: Mill Street Municipal Parking Lot Compensatory Storage

Wall Alternative	Maximum % Of Parcels Protected by Scenario					
	1A	1B	2	3	4	5
Maximum # of Parcels Benefited*	17	14	14	16	10	11
Total # of Parcels Subject to Riverine Flooding	44	46	46	53	35	20
Maximum % of Parcels Benefited	39%	30%	30%	30%	29%	55%

*In calculating the number of parcels benefited, parcels were assumed to be protected in such a way that they remain completely dry.

6.2.3 *Private Lots*

In addition to the two public parcels, Weston & Sampson also evaluated the potential benefit of creating additional flood storage on the privately-owned 24 Caller Street parcel. The existing parcel usage consists of a mixture of buildings, outbuildings, on-site storage, impervious pavement, bare earth, grass and tree covers. Creating additional flood storage would likely require the removal of the storage and equipment on the western half of the parcel, behind the two primary buildings.

Weston & Sampson estimated the limits of the hypothetical storage area, as shown in Figure 4, based on a 25-foot setback from the property boundary and two existing primary buildings. The area of the potential storage site is 0.19 acres, approximately 19% of the parcel. Based on LiDAR ground elevations, the average elevation of the potential storage site is El. 13.5. The FEMA Flood Insurance Study river profile of the North River indicates that the canal bottom is at approximately El. 7.0; we assumed that the potential storage site could be excavated down to El. 8.5, providing 1.5 vertical feet between the canal bottom and newly created floodplain. Based on these assumptions, a total of approximately 0.95 acre-feet of compensatory storage could be created at this site. As the hypothetical compensatory storage created at this site is the same as the Veterans Memorial Park site above, Table 6 summarizes the potential benefit of that created storage on parcels subject to riverine flooding in the study area.

6.3 Elevate and Retreat

In addition to the general study area-wide and site-specific examples of compensatory storage described above, Weston & Sampson also considered the resilient design concepts of elevating and retreating. Both options are designed to remove public and private infrastructure from repeated impacts by flooding. In this case, the MHHW is expected to move inland, inundating more than half of the studied reach of the North River on a regular basis by the end of the 21st century.

Elevating would involve raising existing public and private buildings up on piers, allowing the buildings to remain in their current locations, but elevating them above the anticipated flood prone area. Retreating would involve the selective abandonment and removal of some buildings, coupled with the development of new public and private structures at higher elevations further from the North River Canal.

An example of where either elevation or retreat may be useful is in the northern floodplain from Caller Street to Howley Street. That block currently contains five buildings, three of which are located within approximately 50 feet of the North River Canal. Under end-of-century, 50-year flood conditions (Scenario 4), portions of four of those five buildings, totaling approximately 52% of the buildings' total ground floor square footage is expected to be inundated. Similarly, under end-of-century, 100-year flood conditions (Scenario 5), portions of all five buildings, totaling approximately 84% of their combined ground floor square footage is expected to be inundated.

Raising these buildings above the anticipated flood prone elevation may preserve their continued usefulness. Alternatively, the block could be reconstructed with existing buildings being largely abandoned and removed and new buildings being constructed at an appropriate elevation along Walnut Street, with recreation, parking or other uses consistent with frequent flooding being located in the back of those lots along the North River Canal.

7.0 CONCLUSIONS

Weston & Sampson has conducted an evaluation of the proposed 1,600-foot long park adjacent to the North River Canal to assess the suitability of incorporating additional flood storage capacity under existing and future potential climate conditions. We have evaluated the potential flooding impacts associated with six different design flood-climate change projection scenarios, and we have assessed how those flooding impacts might change a result of the construction of each of eight wall rehabilitation alternatives. We have also assessed the potential benefit of developing compensatory storage in nearby publicly- and privately-owned parcels and we have considered the potential benefit of other flood mitigation alternatives, including elevation and retreat. Based on our evaluation, we have identified the following conclusions:

- Riverine flood levels and associated impacts to property were only evaluated within the study area. Riverine flooding and associated impacts are expected to increase upstream of the study area under all future climate conditions. Those increases were not evaluated as part of this project.
- Under existing climate conditions and under expected mid-century conditions, flooding in the North River Canal will largely be a function of runoff generated upstream – riverine flooding. However, by the end of the 21st century, tidal flooding due to sea level rise is expected to equal or exceed riverine flooding in the project area. Ultimately, the creation of additional flood storage may provide a modest benefit to the properties and infrastructure in the study area in the short- and medium-term, but those benefits are significantly reduced over the long-term.
- The creation of additional flood storage in and/or near the North River Canal is only effective in areas of riverine flooding. Projects that create compensatory storage and projects that floodproof flood prone properties will have a greater and longer lasting benefit the further upstream they are.
- The relative benefit of compensatory storage created by the eight alternatives for rehabilitating the North River Canal's southern wall should be considered in the cost-benefit analysis and alternative selection process.
- There may be value in conducting a detailed assessment of potential site-specific compensatory storage and flood control designs, including geotechnical, contamination/remediation, hydrologic and hydraulic, city planning, and cost-benefit analyses among others.
- Given the significant total riverine flood volumes in the early- and mid-century periods and the relatively modest compensatory storage that could be created by the southern retaining wall alternatives and the individual site projects explored above, it would be worth evaluating the cost-benefit of floodproofing individual buildings rather than eliminating flooding on a parcel scale. This type of floodproofing would also allow individual property owners to take on some responsibility for flooding impacts on their property.
- In light of the anticipated significant increase in tidal flooding in the study area by the end of the century, as opposed to riverine flooding, it may be worth evaluating "retreat" alternatives in more detail. On a related note, it may be worth reevaluating the potential benefit of a tide gate to limit tidal flooding under future climate conditions.

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FIGURES

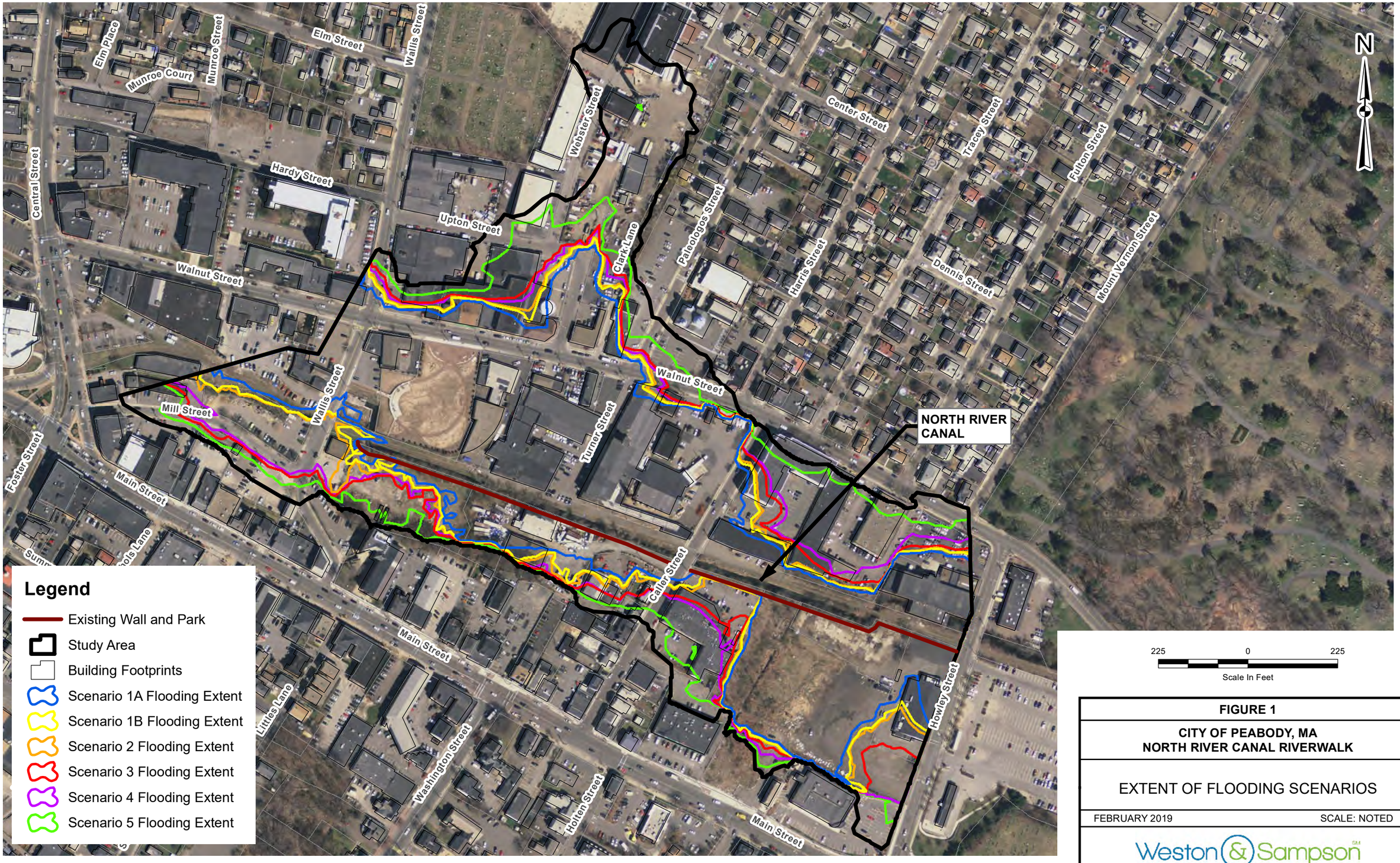


FIGURE 1

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

EXTENT OF FLOODING SCENARIOS

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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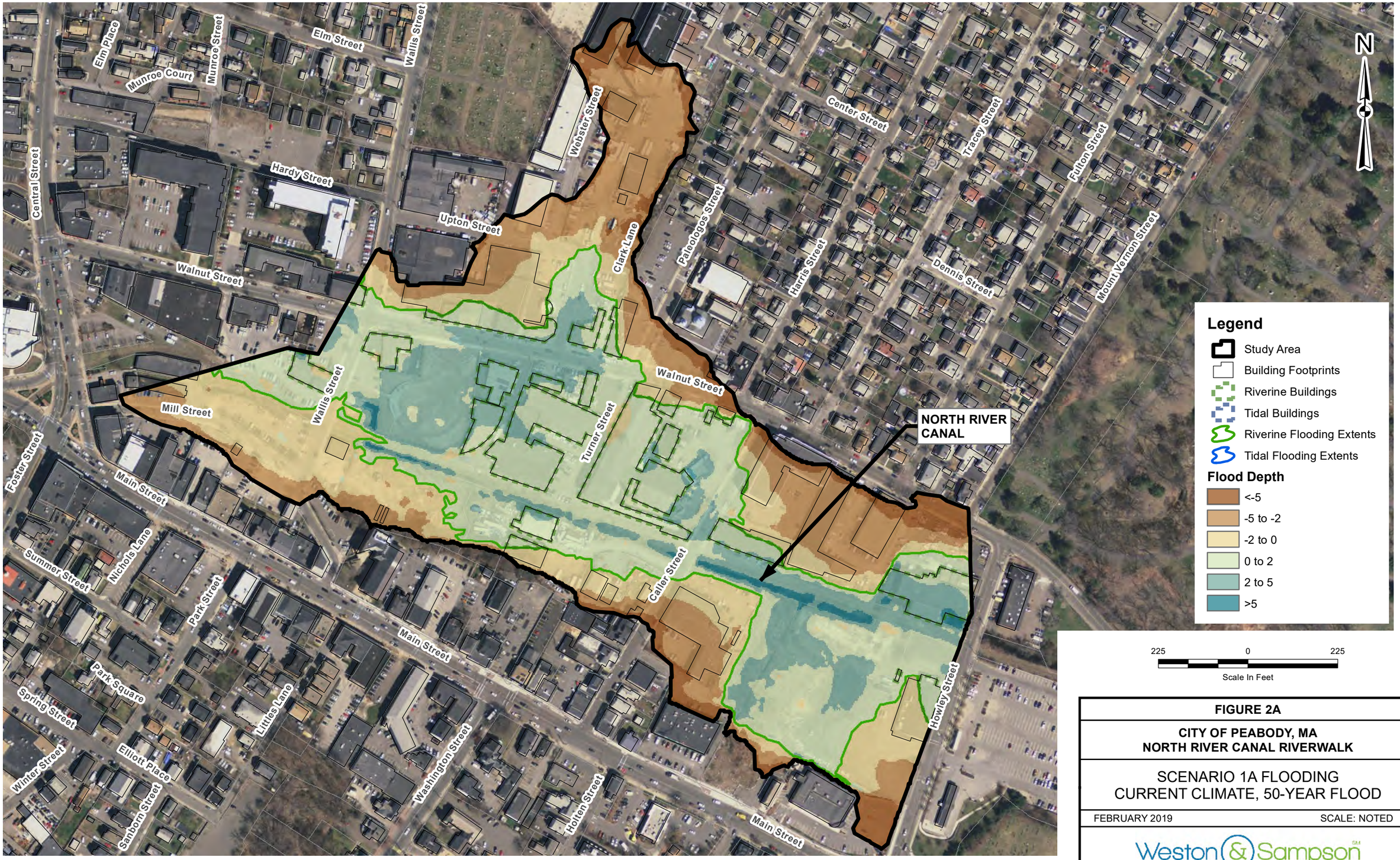


FIGURE 2A

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 1A FLOODING
CURRENT CLIMATE, 50-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson℠

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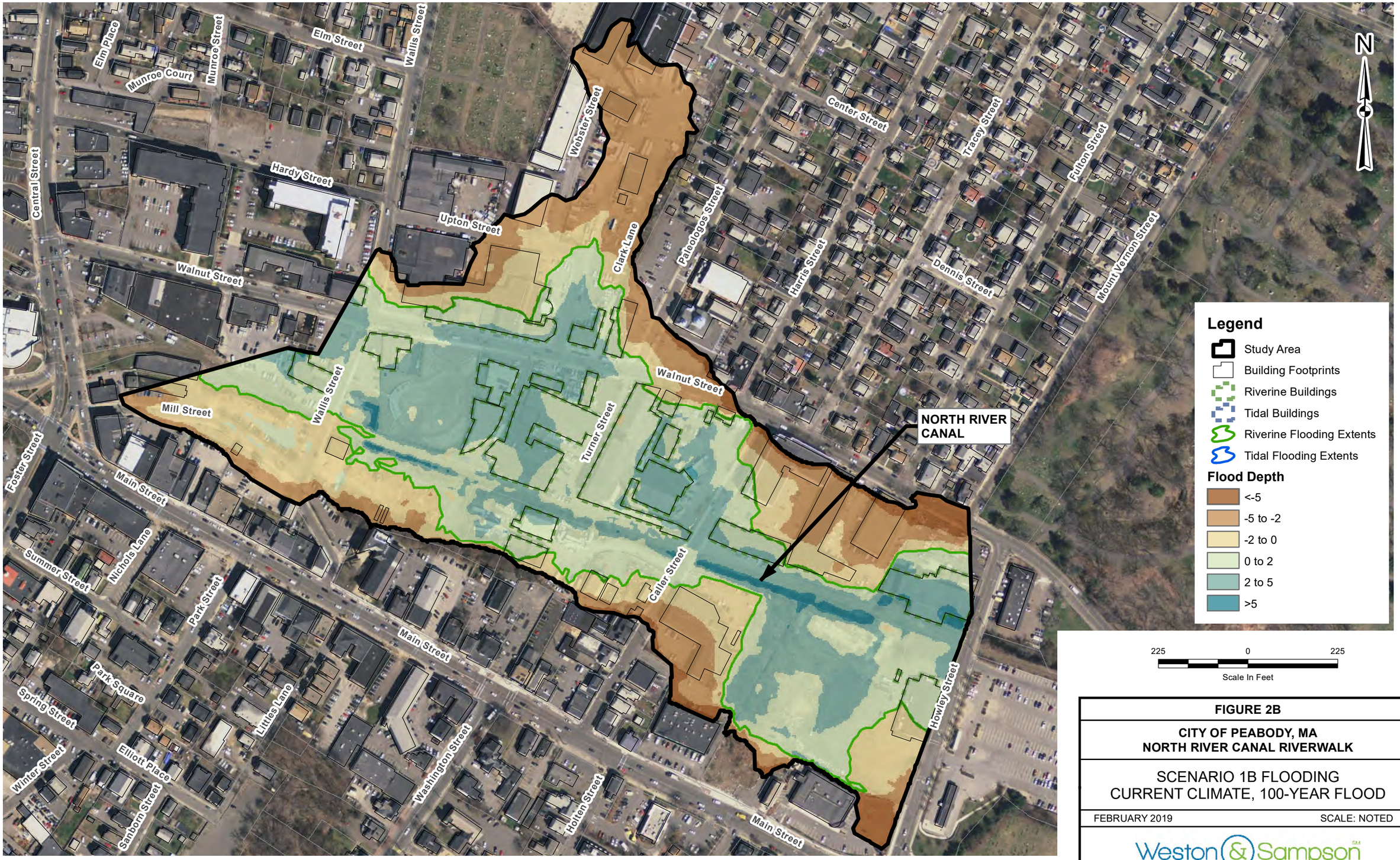


FIGURE 2B

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 1B FLOODING
CURRENT CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

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FIGURE 2C

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 2 FLOODING
2050 CLIMATE, 50-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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FIGURE 2D

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 3 FLOODING
2050 CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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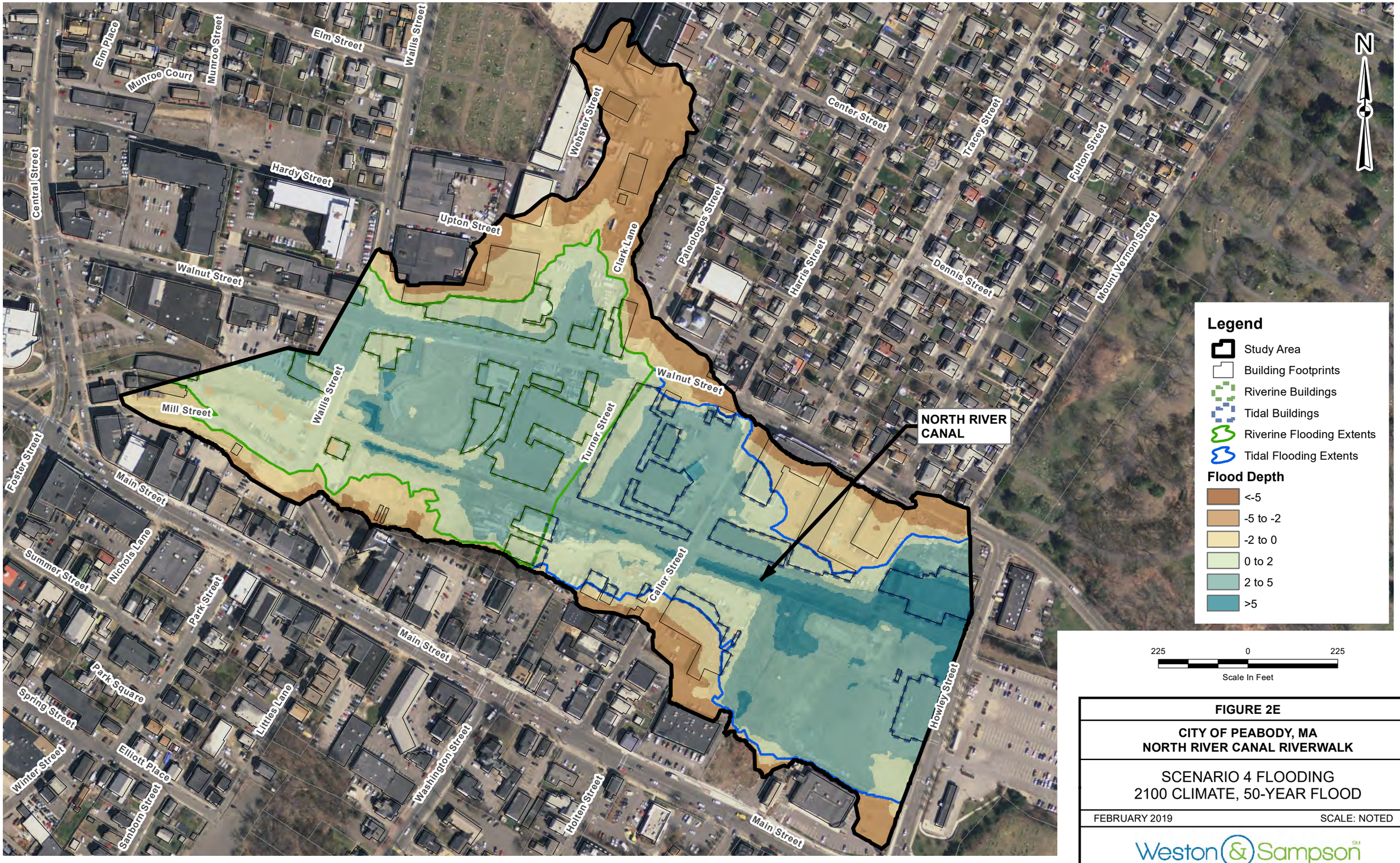


FIGURE 2E

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 4 FLOODING
2100 CLIMATE, 50-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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FIGURE 2F

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 5 FLOODING
2100 CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson℠

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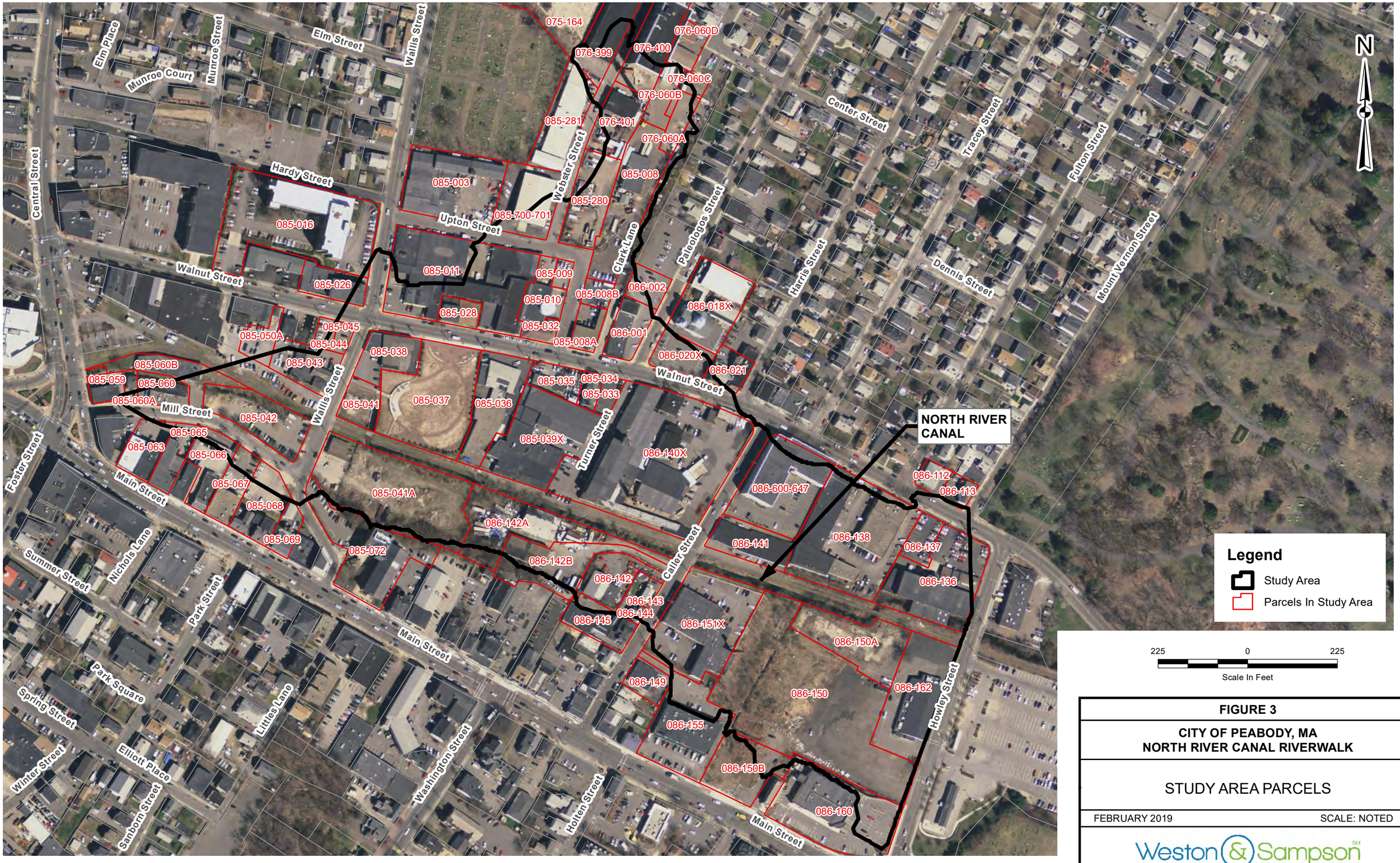


FIGURE 3

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

STUDY AREA PARCELS

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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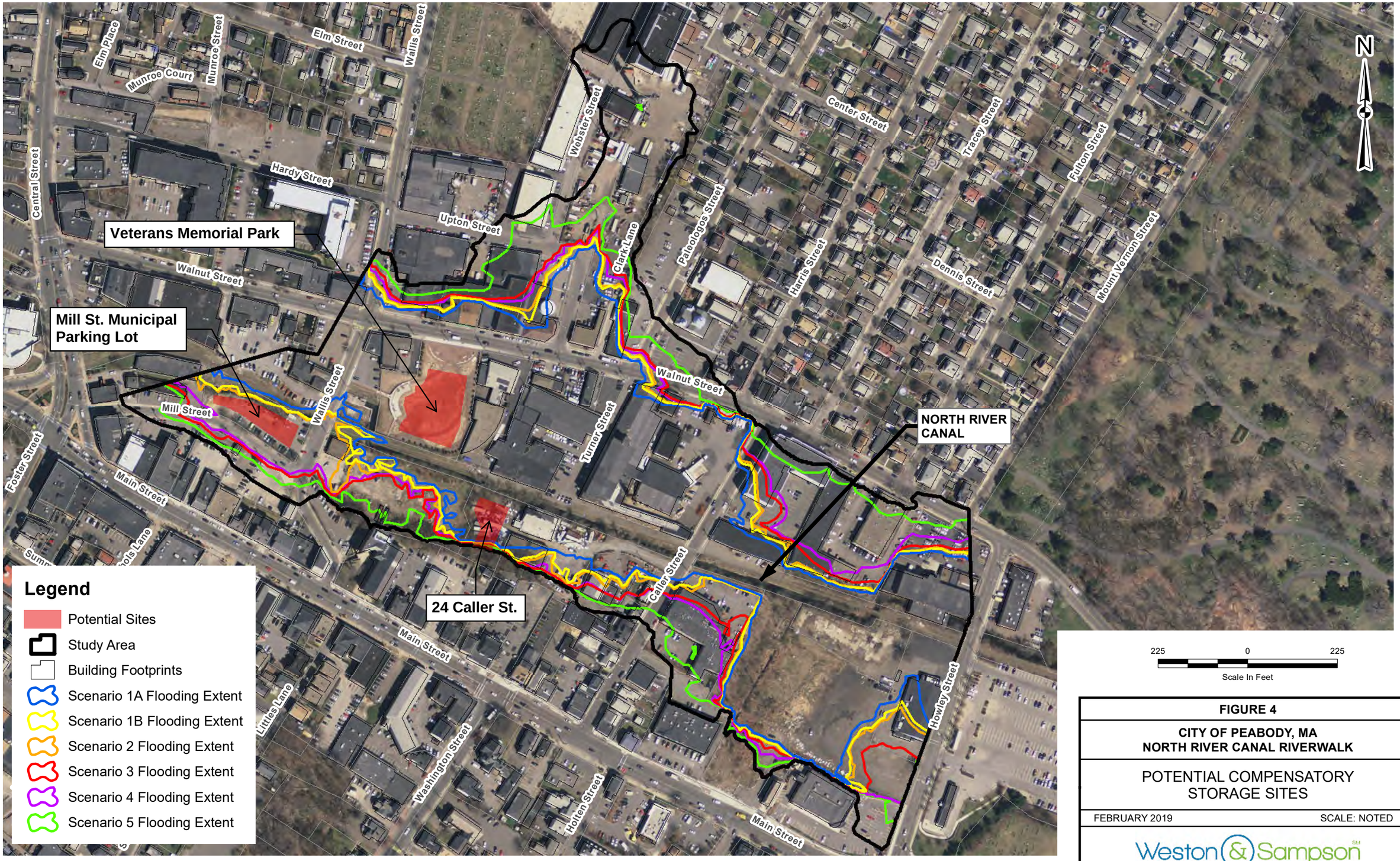


FIGURE 4

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

POTENTIAL COMPENSATORY STORAGE SITES

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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RESILIENCE EVALUATION REPORT

APPENDIX A

Climate Scenario Selection Memo

Weston & Sampson

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

MEMORANDUM

TO:	Brendan Callahan, City of Peabody and Margot Mansfield, MA Executive Office of Energy & Environmental Affairs
FROM:	Andrew Walker, P.H., C.F.M., and Kathleen Baskin, P.E., Weston & Sampson Engineers
DATE:	January 25, 2019
SUBJECT:	MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park 2018 Resiliency Evaluation – Climate Scenario Selection

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Background

Task 1, the "Preliminary Resiliency Evaluation," of the MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park Project Scope of Services notes that "Weston & Sampson will work with the City of Peabody to select two future climate scenarios that represent a likely range of potential future flooding conditions." Ultimately, Weston & Sampson selected two existing conditions scenarios and four future conditions scenarios to evaluate. This memo serves to identify the selected climate scenarios and the basis for their selection.

Flooding due to precipitation and sea level rise (SLR) were considered in the selection of climate scenarios discussed in this memorandum. Flooding in the project area is largely due to high flows in the North River Canal caused by precipitation in the upgradient watersheds of Procter Brook and the North River (Metcalf & Eddy-AECOM, 2008). Precipitation events are projected to be more extreme due to climate change, which would exacerbate riverine flooding in the project area. Currently tidal influences at Mean Higher High Water (MHHW) extend approximately 230 feet upstream of Howley Street (Metcalf & Eddy-AECOM, 2008). SLR is expected to extend tidal influences further upstream into the project area.

Coastal storm surge, the phenomenon of rising water commonly associated with low pressure weather systems, can cause increased inland flooding. Weston & Sampson considered incorporation of results of hydrodynamic modeling from the Woods Hole Group to provide more information on coastal impacts within the project area including risk-based site-specific mapping of SLR, coastal storm surge heights, and overland flow pathways. There is an existing hydrodynamic model with SLR within the project area (known as the Boston Harbor Flood Risk Model (BH-FRM)) that was completed in 2015, as well as a new study being prepared by the Woods Hole Group for the Massachusetts Department of Transportation (MassDOT) for the entire Massachusetts coastline that will supersede the BH-FRM. Based on conversations with the Woods Hole Group, coastal storm surge is unlikely to have a significant impact on this project area. Regardless, updated

projections of coastal surge under future climate scenarios are not expected to be available for this project area until April 2019 at the earliest; incorporation of these model projections would result in a schedule that would not provide sufficient time to complete the current project within the timeframe allowed by the grant funding. Therefore, the influence of coastal storm surge could not be incorporated into the scenarios selected in Task 1.

Scenario Selection

Based on discussions with representatives from the City of Peabody and the project funder, the Massachusetts Executive Office of Energy & Environmental Affairs (MA EOEEA), during the project kickoff meeting on October 3, 2018; feedback from the client, funder, and project team members during calls on November 7 and 13, 2018; and on our initial review of recent studies regarding projected regional climate change impacts, Weston & Sampson has identified a total of six climate scenarios:

- Scenario 1A: Existing Conditions, 50-year flood
- Scenario 1B: Existing Conditions, 100-year flood
- Scenario 2: 2050 "Low-Intermediate" Climate Change for precipitation and SLR, 50-year flood
- Scenario 3: 2050 "High" Climate Change for precipitation and SLR, 100-year flood
- Scenario 4: 2100 "Low-Intermediate" Climate Change for precipitation and SLR, 50-year flood
- Scenario 5: 2100 "High" Climate Change for precipitation and SLR, 100-year flood

While Weston & Sampson is recommending more than two climate change scenarios, which was originally proposed, the six scenarios selected present a broad range of possible outcomes under climate change and will enable a more robust analysis of resiliency alternatives. Scenarios 1A/1B, which represent existing conditions during the 50- and 100-year flood events, respectively, will provide a baseline for comparison of the future scenarios. They will also represent a "best-case scenario," during which any flood storage measures will have the maximum impact. As climate change advances through the remainder of the 21st century and results in increased SLR and more extreme precipitation events, those benefits are expected to decrease.

The future climate scenarios (Scenarios 2 through 5) were selected to evaluate the potential future benefit of flood storage as a function of the degree to which climate change will occur. In general, predicted impacts of climate change are presented as a range of likely values based on various combinations of potential future greenhouse gas emissions, energy use, population growth, air pollutants, land use, and other societal trends. We have selected a "low-intermediate" scenario known as RCP4.5 and a "high" impact scenario known as RCP8.5. They were chosen to give the City a sense for how the effectiveness of flood storage measures might change depending on the severity of future climate change impacts. The "low-intermediate" scenario was paired with 50-year flooding conditions as the smaller storm was determined to offer a more achievable condition for which to develop flood mitigation designs at this site. The "high" scenario was paired with the 100-year flooding conditions to highlight the effectiveness of flood mitigation designs under worst-case conditions.

We have selected time horizons that represent potential climate conditions both mid-century (2050) and end of century (2100) to give the City an idea of effectiveness of flood storage measures over time. These time

horizons also take advantage of published climate change predictions of relative SLR and riverine flood discharge as reported in regional climate studies. The studies reviewed in support of this project are summarized and described in Appendix A. The climate projections (precipitation and SLR) for the selected climate scenarios are based on the following sources and described in detail in the following section.

- FEMA Flood Insurance Study (25009CV004B)
- NOAA tide gage data for Boston and Beverly Harbors
- City of Cambridge Climate Change Vulnerability Assessment, Part 1 Appendix: Climate Projections & Scenario Development (Cambridge, 2015)
- Climate Change and Sea Level Rise Projections for Boston - The Boston Research Advisory Group Report (BRAG, 2016)
- Northeast Climate Science Center (NECSC), Massachusetts Climate Change Projections (NECSC, 2018)

Scenario 1A – Existing Conditions, 50-year Flood

Existing 50-year flood elevations are controlled by precipitation and the resulting runoff. Riverine flooding levels, caused by upgradient precipitation, will be determined from the effective FEMA Flood Insurance Study (25009CV004B), which was updated most recently on July 16, 2014. These 50-year flood levels range from 16.5 ft. NAVD88 at Wallis Street to El. 12.5 ft. at the railroad crossing upstream of Howley Street and El. 11.0 at Howley Street. Coastal flooding is not expected to impact the study area during 50-year flood conditions.

Scenario 1B – Existing Conditions, 100-year Flood

Existing 100-year flood elevations are controlled primarily by precipitation and the resulting runoff as well as by some tidal influences in the downstream end of the project area, specifically, up to approximately 230 feet above of Howley Street. Riverine flooding levels, caused by upgradient precipitation, will be determined from the effective FEMA Flood Insurance Study (25009CV004B), which was updated most recently on July 16, 2014. These 100-year flood levels range from 17.5 ft. NAVD88 at Wallis Street to El. 14.5 ft. at the railroad crossing upstream of Howley Street and El. 11.5 at Howley Street. Coastal flooding levels are assumed equal to MHHW, which was estimated from NOAA tide gage data for Boston and Beverly Harbors to be 4.76 above mean sea level, corresponding to approximately El. 9.97 ft. NAVD88 (Metcalf & Eddy-AECOM, 2008).

Scenario 2 - Mid-century (2050) conditions under a “low-intermediate” climate change scenario (RCP4.5)

Precipitation under this scenario will see an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 9.4 inches for the 2050s time-horizon (Cambridge, Part 1 Appendix, 2015). The resulting increase in expected riverine flows will be estimated. One methodology may be to apply the unit hydrograph method to the rainfall-runoff parameters identified in the Peabody Square study (M&E and AECOM, 2008). This increase in river discharge will be converted to a flood level by interpolating/extrapolating from flooding profiles contained in the FEMA Flood Insurance Study of the project area. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 1.7 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 11.67 ft.

Scenario 3 - Mid-century (2050) conditions under a “high” climate change scenario (RCP8.5)

Increases to the 100-year riverine discharge are assumed to reach 35%, the maximum predicted increase for the 2055 time horizon (BRAG, 2016). This increase in river discharge will be converted to a flood level by interpolating/extrapolating from flooding profiles contained in the FEMA Flood Insurance Study of the project area. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 2.4 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 12.37 ft.

Scenario 4 - Late-century (2100) conditions under a “low-intermediate” climate change scenario (RCP4.5)

Precipitation under this scenario will see an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 10.9 inches for the 2070 time horizon (Cambridge, Part 1 Appendix, 2015). The same methodology to evaluate increases in riverine flows for Scenario 2 is likely to be used for this scenario. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 5.0 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 14.97 ft.

Scenario 5 – Late-century (2100) conditions under a “high” climate change scenario (RCP8.5)

Increases to the 100-year riverine discharge are assumed to reach 70%, the maximum predicted increase for the 2085 time horizon (BRAG, 2016). The same methodology to evaluate increase in riverine discharge for Scenario 3 will be used for this scenario. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 7.6 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 17.57 ft.

List of References

Bosma, Kirk; Ellen Douglas; Paul Kirshen; Katherine McArthur; Steven Miller; and Chris Watson; 2015. MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery, June 2015.

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Metcalf & Eddy-AECOM, 2008. Preliminary Design of Flood Mitigation Facilities for Peabody Square Area, April 2008.

National Oceanic and Atmospheric Administration, 2012. NOAA Technical Report OAR CPO-1: Global Sea Level Rise Scenarios for the United States National Climate Assessment, December 2012.

Northeast Climate Science Center (NECSC), 2018. Massachusetts Climate Change Projections, March 2018.

Appendix A

Review of Relevant Reports and Data Sets

Table 1 – Summary of Recent Regional Climate Studies Reviewed

Date	Author	Title	Available Data
2016	BRAG	Climate Change and Sea Level Rise Projections for Boston	SLR for RCP4.5 and RCP8.5 in 2050, 2100 100-year flood probability for RCP4.5 and RCP8.5 in 2050, 2100 Change in 100-year river discharge for 2055, 2085
2015	City of Cambridge	Climate Change Vulnerability Assessment, Part 1 Appendix: Climate Projections & Scenario Development	24-hour design rainfall depths for 2000 and for RCP4.5, and RCP8.5 in 2030s, 2070s Relative SLR for RCP8.5 in 2050, 2100
2018	Northeast Climate Science Center	Massachusetts Climate Change Projections	# of Days with significant precipitation for RCP8.5 in 2050, 2100 SLR for "Intermediate-High" and "High" scenarios in 2050 and 2100
2018	Bosma	Email communication to Kathleen Baskin of W&S	SLR for RCP8.5 in 2050, 2100
2015	Bosma et al.	MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery	Superseded by Bosma, 2018
2017	City of Cambridge	Climate Change Vulnerability Assessment, Part 2	N/A
2017	City of Cambridge	Climate Change Vulnerability Assessment, Part 2 – Sea Level Rise and Storm Surge	SLR for 2030, 2070 River discharge for 2070
2015	City of Cambridge	Climate Change Vulnerability Assessment, Part 1	SLR for 2030, 2070
2013	MA Office of Coastal Zone Management	Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning	SLR for RCP4.5 and RCP8.5 in 2050, 2100
2012	National Oceanic and Atmospheric Administration	NOAA Technical Report OAR CPO-1: Global Sea Level Rise Scenarios for the United States National Climate Assessment	N/A

Note:

- *Sources highlighted in gray and available data in red text were used to identify riverine and coastal flooding elevations in (Scenarios 2-5).*
- *"N/A" indicates source had no future climate projections relevant to this project.*

Boston Research Advisory Group (BRAG), 2016. Climate Change and Sea Level Rise Projections for Boston - The Boston Research Advisory Group Report, prepared for Climate Ready Boston, June 1, 2016.

Initial impression: very valuable, includes change in percent likelihood of the current 100-year coastal storm event as well as the riverine 2-year and 100-year flood events

Review Bosma et al., 2015 for river discharge values

- Climate scenarios RCP 2.6, RCP 4.5, and RCP 8.5
- "The amount and rate of RSLR in Boston during the first half of the 21st century is nearly independent of emissions. The most likely estimates of RSLR from 2000 to 2050 (associated with exceedance probabilities of 83%, 50%, and 17%) are 19, 32 and 45 cm (7.5, 13 and 18 inches, respectively), thus a 2050 range of 19 cm to 45 cm (7.5 to 18 in) can be considered, but higher RSLR approaching 75 cm (30 in) is possible."
- "After ~2050 the scenarios diverge sharply, with substantially more RSLR under the higher emissions pathways. Under the highest emissions pathway (RCP8.5), the most likely estimates of RSLR from 2000 to 2100 in Boston are 97, 149 and 226 cm (3.2, 4.9 and 7.4 ft). Under the moderate-emissions RCP4.5 pathway, RSLR estimates from 2000 to 2100 are 74, 111 and 156 cm (2.4, 3.6 and 5.1 ft). Thus a 2100 range of 74 cm to 226 cm (2.5 to 7.4 ft) can be considered."
- "The maximum physically plausible sea-level rise from 2000 to 2100 at Boston was estimated to range from 1.9 m and 3.2 m (6.2 and 10.5 ft) in this analysis. This is substantially more than the maximum RSLR of 2.08 m (6.83 ft) from 2003 to 2100 under the highest emissions scenario reported in a recent study," Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning by CZM (2013).

Table 1-1. *RSL projections for Boston, MA (in ft, relative to 2000) categorized by exceedance probabilities.*

			LIKELY RANGE					MAXIMUM
	0.99	0.95	0.833	0.5	0.167	0.05	0.01	0.001
RCP8.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.1	1.5	1.8	2.1	2.4
2070	0.6	1.0	1.5	2.2	3.1	3.7	4.3	4.8
2100	1.6	2.4	3.2	4.9	7.4	8.6	9.5	10.5
2200	18.9	19.9	21.4	26.1	32.8	34.1	35.3	36.9
RCP4.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.0	1.4	1.7	2.0	2.3
2070	0.4	0.9	1.3	1.9	2.6	3.1	3.6	4.1
2100	0.9	1.7	2.4	3.6	5.1	6.1	7.0	8.0
2200	5.5	6.2	7.2	10.9	16.5	18.0	19.3	20.9
RCP2.6								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.6	1.0	1.4	1.7	2.0	2.3
2070	0.3	0.7	1.1	1.7	2.3	2.7	3.1	3.6
2100	0.4	1.2	1.8	2.8	3.8	4.6	5.3	6.2
2200	3.6	4.4	5.2	6.4	7.7	8.8	9.9	11.8

- "…results suggest that incorporating fixed median SLR estimates for 2100, rather than accounting for the full distribution, halves the height of the expected 1% annual probability flood and underestimates it by over 1 m."

Table 2-1 *Current and future annual probability of today's (circa 2000) 100-year flood for 2030s, 2050s, and 2100 under two concentration pathways (RCP4.5 and RCP8.5). Values in parentheses represent the 10-90 percentile range. Flood heights (in ft NAVD88) for a 1% probability flood for 2030s, 2050s, and 2100 under two concentration pathways (RCP4.5 and RCP8.5). Values in parentheses represent the 10-90 percentile range.*

Extreme Event	Current (2000)	2030		2050		2100	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
Future annual probability of today's 100-year flood	1%	2.5% (1.5-4.0)	2.8% (1.4-4.5)	8.7% (2.4-17)	14% (2.9-29)	75/yr (22%-daily)	230/yr (5/yr-daily)
Flood heights for 1% flood (ft NAVD88)	9.2	9.8 (9.5-10.1)	9.8 (9.5-10.1)	10.5 (9.8-10.8)	10.5 (9.8-10.8)	13.8 (10.8-14.1)	17.4 (12.1-17.4)

- Discussion of storm events cites CCVA and BWSC scenarios B2 (medium) and A1Fi (precautionary)
- River flooding values based on a synthesis of Hodgkins and Dudley (2013), Demaria et al. (2015), BWSC (2015), and Bosma et al. (2015)

Table 3-3: *Best available estimates for changes in river floods (as percent) in Boston associated with anticipated climate changes. The basis for these estimates are discussed in Appendix A.*

Flood Type	2055	2085
Small floods (e.g., 2-year recurrence interval)	0 to 20%	20% to 50%
Design floods (e.g., 100-year)	-10% to 35%	15% to 70%
Flood frequency (floods/year)	increases	increases

City of Cambridge, 2015. Climate Change Vulnerability Assessment (CCVA), Climate Projections & Scenario Development, November 2015.

Initial impression: very useful design rainfall depth information

- CCVA used three time horizons: present day, 2030 and 2070
- 100-year storm in 1971-2000 equivalent to 25-year storm in 2055-2084 and the 25-year storm becomes the 10-year storm
- High emissions scenario RCP 8.5; low emissions scenario RCP 4.5
- Provides 10-, 25-, and 100-year design rainfall depths for baseline, 2030, and 2070 horizons

Precipitation Changes	Baseline	2030s (2015-2044)		2070s (2055-2084)	
	1971-2000	Lower	Higher	Lower	Higher
Annual Precipitation (in.)	45	48	48	51.5	54
Summer Precipitation (in.)	9.5	9.8	9.8	10.1	10.3
Winter Precipitation (in.)	11.4	12.6	12.7	14.1	15.4
# days per year > 2 in. rain in 24 hrs (days)	2	3	3	3	3
Max. 5-day precipitation per year (in.)	6	6.5	6.6	7	7.2
24-hr design storms					
10yr	4.9	5.6		6.4	
25 yr	6.2	7.3		8.2	
100 yr	8.9	10.2		11.7	
48-hr design storms					
10yr	5.5	6.4		7.2	
25 yr	7	8.6		9.8	
100 yr	10	13.2		15.7	

Table 3: Precipitation projections [12]

- Provides RSLR estimates for “highest” and “intermediate-high” climate scenarios at decadal intervals

Scenarios	2020	2030	2040	2050	2060	2070	2080	2090	2100
Global SLR (from 2013-2020) "Highest" (feet)	0.21	0.61	1.10	1.70	2.40	3.21	4.11	5.12	6.23
Global SLR (from 2013-2020) "Intermediate-High" (feet)	0.14	0.38	0.68	1.04	1.46	1.93	2.48	3.05	3.69
Land subsidence (feet) @ 0.04 in./yr.	0.02	0.06	0.09	0.12	0.15	0.19	0.22	0.25	0.29
Total Relative SLR - "Highest" (feet)	0.24	0.66	1.19	1.82	2.56	3.39	4.33	5.37	6.52
Total Relative SLR – "Intermediate-High" (feet)	0.16	0.44	0.77	1.16	1.61	2.12	2.68	3.30	3.98

Table 4: "Highest" and "Intermediate-High" scenario projections for relative SLR in Boston (2013-2100) [19,20]

Northeast Climate Science Center (NECSC), 2018. Massachusetts Climate Change Projections, March 2018.

Initial impression: sea level rise predictions are useful to this project

- Based on 28 climate scenarios from 14 downscaled regional climate models; ranges are presented for 10th to 90th percentile simulated results
- Peabody straddles the Ipswich and North Coastal Basins, but the project site is in the North Coastal Basin
- Predictions of Days with Precipitation Over 1", Days Over 2", and Days Over 4", reported seasonally and annually, for mid-century and end of century

NORTH COASTAL BASIN

North Coastal Basin		Observed Baseline 1971-2000 (Days)	Mid-Century: Projected Change in 2030s (Days)	Mid-Century: Projected Change in 2050s (Days)	End of Century: Projected Change in 2070s (Days)	End of Century: Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	8	+<1[77] to +2	+<1[77] to +3	+1 to +3	+1 to +4
	Winter	2	+<1[77] to +1	+<1[77] to +1	+<1[77] to +2	+<1[77] to +2
	Spring	2	+0 to +1	+0 to +1	+<1[77] to +1	+<1[77] to +1
	Summer	2	+0 to +1	+0 to +1	+0 to +1	+0 to +1
	Fall	2	-0.29 to +1	+0 to +1	+0 to +1	+0 to +1
Days with Precipitation Over 2"	Annual	1	+<1[77] to +1	+0 to +1	+<1[77] to +1	+<1[77] to +1
	Winter	<1[77]	+0 to +<1[77]	+<1[77] to +<1[77]	+0 to +<1[77v]	+<1[77] to +<1[77]
	Spring	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Summer	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Fall	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
Days with Precipitation Over 4"	Annual	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Winter	0	+0 to +0	+0 to +0	+0 to +<1[77]	+0 to +<1[77]
	Spring	0	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Summer	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Fall	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]

[77] Over the observed period, there were some years with at least 1 day with seasonal precipitation over a certain threshold while in all the other years that threshold wasn't crossed seasonally at all.

- Predictions of total precipitation reported seasonally and annually, for mid-century and end of century
- Does not present predictions of precipitation based on frequency and duration (i.e. the projected 100-year, 24-hour event)
- Provides sea level rise estimates for both 2050 and 2100 for multiple climate change scenarios

Table 7, Figure 1: Relative (or local) mean sea level projections for the Boston, MA tide station based on four National Climate Assessment global scenarios with associated probabilistic model outputs from the Northeast Climate Science Center. Each of the scenarios—Intermediate, Intermediate-High, High, and Extreme—is cross-walked with two to three probabilistic model outputs. Modeling considered two future concentrations of greenhouse gas emissions (referred to as representative concentration pathways [RCP]) and two methods of accounting for Antarctic ice sheet contributions to sea level rise. A 19-year reference time period for sea level (tidal epoch) centered on the year 2000 was used to minimize biases caused by tidal, seasonal, and inter-annual climate variability. Sea level projections for the Boston tide station are referenced to the North American Vertical Datum of 1988 (NAVD88).

Relative mean sea level (feet NAVD88) for Boston, MA					
Scenario	**Probabilistic projections**	**2030**	**2050**	**2070**	**2100**
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)	0.7	1.4	2.3	4.0
Intermediate- High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)	0.8	1.7	2.9	5.0
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)	1.2	2.4	4.2	7.6
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)	1.4	3.1	5.4	10.2

Massachusetts Sea Level Rise Projections, 2018 (Bosma, 2018) (Email correspondence)

Initial impression: useful to this project

- Future sea-level projections for Boston Harbor are based on a methodology which provides complete probability distributions for different greenhouse gas concentration trajectories (representative concentration pathways, or RCPs)[1].
- Analysis (DeConto and Kopp, 2017)[5] consisted of a probabilistic assessment of future relative sea level rise under two future atmospheric greenhouse gas concentration scenarios, medium (RCP4.5) and high (RCP8.5)[6].
- Assessment included two model approaches for projecting Antarctic ice sheet based on: expert elicitation (Kopp, 2014[1]) and new, process-based numerical ice sheet model simulations (Deconto and Pollard, 2016[7]; Kopp, 2017[8]).
- These projections can be used for detailed, site specific hydrodynamic modeling[12] to map storm surge impacts and influences of localized processes along the coast.
- On their own, these projections provide insight to overall trends in rising sea levels along the Massachusetts coastline.

The following values are presented as an elevation of the mean sea level in feet NAVD88 for the RCP8.5 climate scenario.

2030 = 1.2 feet NAVD88

2050 = 2.4 feet NAVD88

2070 = 4.2 feet NAVD88

2100 = 7.6 feet NAVD88

These projections are considered the standard by the Massachusetts Office of Coastal Zone Management, and are being used by the Massachusetts Department of Transportation (MassDOT) in its statewide modeling of sea level rise and can be applied in Peabody.

Note that these values represent the elevation of mean sea level and can be used to estimate the change in mean sea level from the baseline year, 2000. For instance, mean sea level in 2050 is expected to be El. 2.4 ft. NAVD88 or 2.4 feet higher than existing conditions. However, that increase may not be linear across the entire tide cycle; high tide and low tide in 2050 may be more or less than 2.4 feet above baseline conditions. Despite this cautionary note, Weston & Sampson will assume that changes in MHHW conditions are the same as changes in mean sea level, to take advantage of these most up-to-date estimates of sea level rise for the project region.

Massachusetts Sea Level Rise Projections, 2018 (Bosma, 2018) (continued)

List of References

[1] Kopp, R. E., R. M. Horton, C. M. Little, J. X. Mitrovica, M. Oppenheimer, D. J. Rasmussen,B. H. Strauss, and C. Tebaldi (2014), Probabilistic 21st and 22nd century sea level projections at a global network of tide gauge sites, Earth's Future, 2, 383–406.

[5] DeConto, R. M. and R.E. Kopp. (2017). Massachusetts Sea Level Assessment and Projections. Technical memorandum.

[6] Van Vuuren, D. P., Edmonds, J., Kainuma, M., Riahi, K., Thomson, A., Hibbard, K., Lamarque, J.-F. (2011), The representative concentration pathways: an overview. *Climatic Change*, 109, 5-31.

[7] DeConto, R. M., and Pollard, D. (2016). Contribution of Antarctica to past and future sea-level rise. Nature, 531(7596), 591–597.

[8] Kopp, R. E., DeConto, R. M., Bader, D. A., Hay, C. C., Horton, R. M., Kulp, S., Oppenheimer, M., Pollard, D., and Strauss, B. H. (2017). Evolving Understanding of Antarctic Ice-Sheet Physics and Ambiguity in Probabilistic Sea-Level Projections, Earth's Future, 5.

[9] A tidal datum epoch is a 19-year astronomical cycle over which tidal height observations are taken and reduced to obtain mean values in order to establish the various datums (e.g., mean higher high water, etc.) (NOAA Tides and Currents).

[10] Sweet, W.V., R. Horton, R.E. Kopp, A.N. LeGrande, and A. Romanou, 2017: Sea level rise. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 333-363.

[11] Sweet, W.V., R.E. Kopp, C.P. Weaver, J. Obeysekera, R.M. Horton, E.R. Thieler, and C. Zervas, 2017: Global and Regional Sea Level Rise Scenarios for the United States. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services.

[12] e.g., Bosma, K., E. Douglas, P. Kirshen, K. McArthur, S. Miller, S., and C. Watson (2015), Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery. MassDOT, Boston MA.

City of Cambridge, 2017. Climate Change Vulnerability Assessment, Part 2. February 2017.

Initial impression: not useful to this project

- Does not state sea level rise estimates or changes in precipitation
- References the Boston Harbor Flood Risk Model as presented in MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery, (Bosma et al, 2015).

City of Cambridge, 2017. Climate Change Vulnerability Assessment, Part 2 – Sea Level Rise and Storm Surge, February 2017.

Initial impression: Sea level rise (SLR) estimates are from a "highest" SLR scenario but may be useful to our project; review Bosma et al., 2015 for river discharge methodology

- Boston Harbor Flood Risk Model (BH-FRM) is comprised of the Advanced Circulation Model (ADCIRC) and the Simulating Waves Nearshore Model (SWAN)
- Model was developed by Woods Hole Group for a MassDOT-funded project (Bosma et al, 2015)
- Risk-based model using Monte Carlo simulations
- SLR scenarios for 2030 and 2070 based on the "Highest" SLR scenario as published in the NOAA Technical Report OAR CPO-1: Global Sea Level Rise Scenarios for the United States National Climate Assessment, December 2012 (NOAA, 2012)
- Mean sea level rise of 0.66 feet by 2030 and 3.39 feet by 2070
- Storm climatology up to 2050 based on present climate; storm climatology after 2050 based on 21st century projections by Dr. Kerry Emmanuel of Massachusetts Institute of Technology
- Use ICM-2D model to evaluate impact of tidal backwatering and river flooding on the City's drainage system
- River discharge associated with a 24-hour 100-year event under 2070 climate conditions as explained in: Bosma et al, 2015.

City of Cambridge, 2015. Climate Change Vulnerability Assessment, Part 1. November 2015.

Initial impression: relatively little information useful to this project

- Up to 8 inches of SLR by 2030 and up to 3.4 feet by 2070
- Precipitation event information references 2014 NCA
- Between 1958 and 2012, 1% rainfall events occurred 71% more frequently
- 100-year storm in 1971-2000 equivalent to 25-year storm in 2055-2084
- Riverine flood modeling methodology unclear

Massachusetts Office of Coastal Zone Management (CZM), 2013. Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, December 2013.

Initial impression: very useful estimates of RSLR for Boston; could compare to more recent estimates

- Local historical sea level trends
- Global sea level rise predictions associated with four climate change scenarios: highest, intermediate-high, intermediate-low, and lowest
- Recommendation: use multiple climate scenarios and time horizons, consider land subsidence impact on sea level rise (RSLR)
- "the estimated vertical land movement values for the NOAA Boston long-term tide gauge station of -0.84 mm/yr (Zervas et al., 2013)"
- Provides estimates of Boston RSLR for seven time horizons and four climate scenarios

Table 3. Relative sea level rise estimates for Boston, MA. Global scenarios were adjusted to account for local vertical land movement with 2003 as the beginning year of analysis.

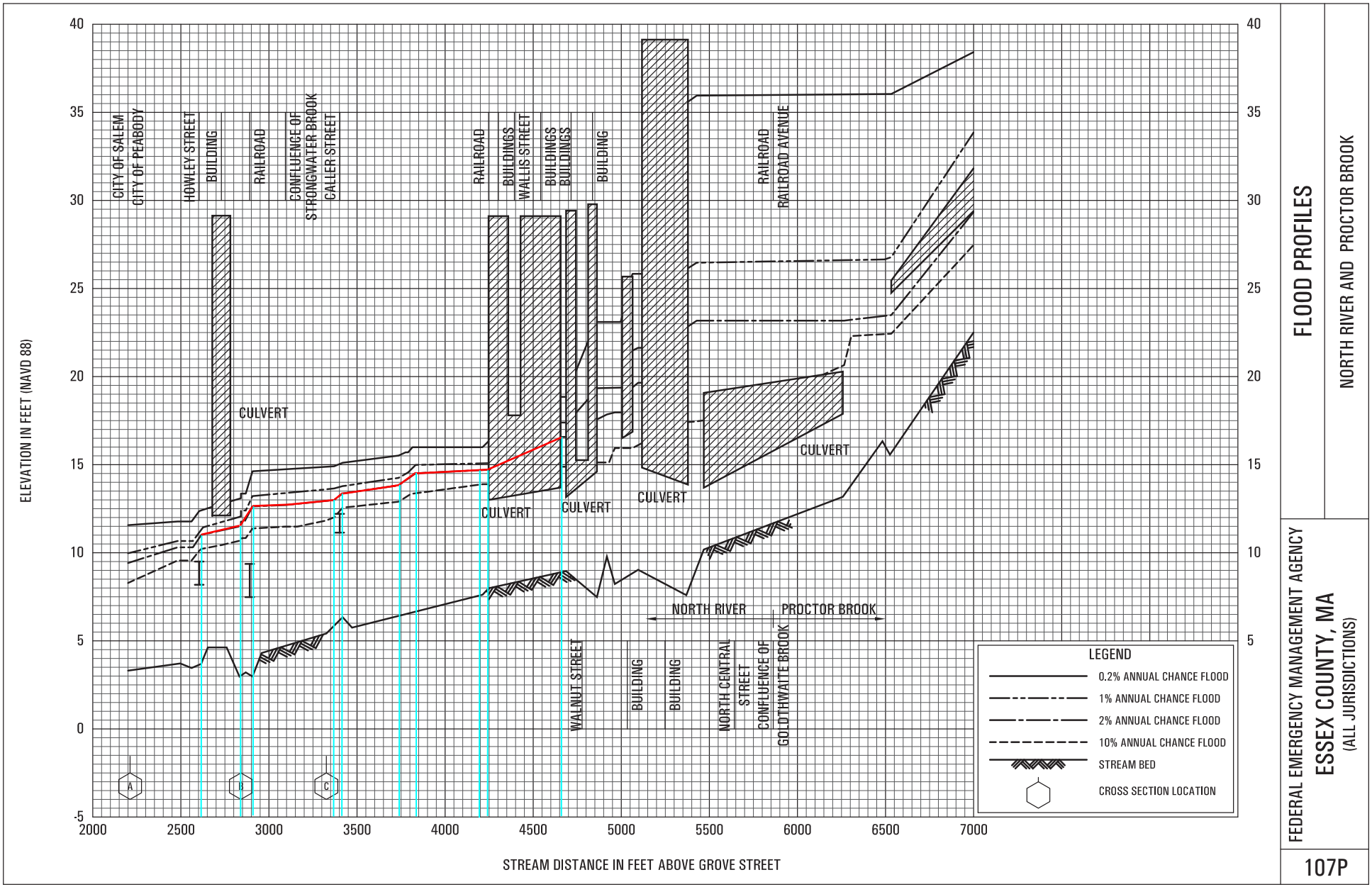
Scenario	2025		2038		2050		2063		2075		2088		2100	
	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
Highest	0.49	0.15	1.08	0.33	1.81	0.55	2.80	0.85	3.92	1.19	5.33	1.63	6.83	2.08
Intermediate High	0.36	0.11	0.73	0.22	1.19	0.36	1.80	0.55	2.47	0.75	3.32	1.01	4.20	1.28
Intermediate Low	0.24	0.07	0.43	0.13	0.65	0.20	0.92	0.28	1.21	0.37	1.55	0.47	1.91	0.58
Lowest (Historic Trend)	0.18	0.06	0.29	0.09	0.39	0.12	0.50	0.15	0.60	0.18	0.71	0.22	0.81	0.25
Range	0.31	0.09	0.79	0.24	1.42	0.43	2.30	0.70	3.32	1.01	4.62	1.41	6.02	1.83

RESILIENCE EVALUATION REPORT

APPENDIX B

River Profiles

Scenario 1A



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

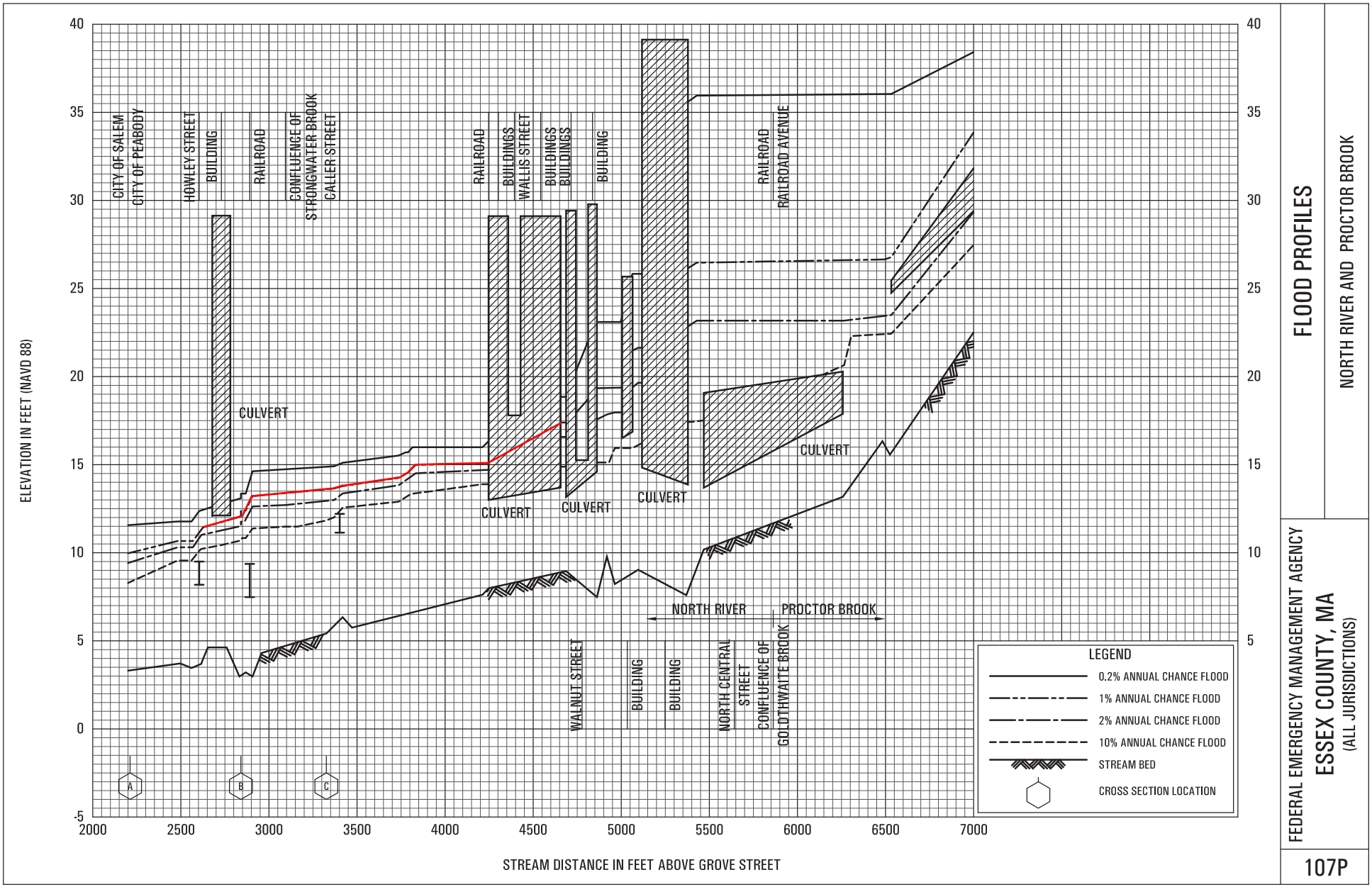
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

(ALL JURISDICTIONS)

107P

Scenario 1B



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

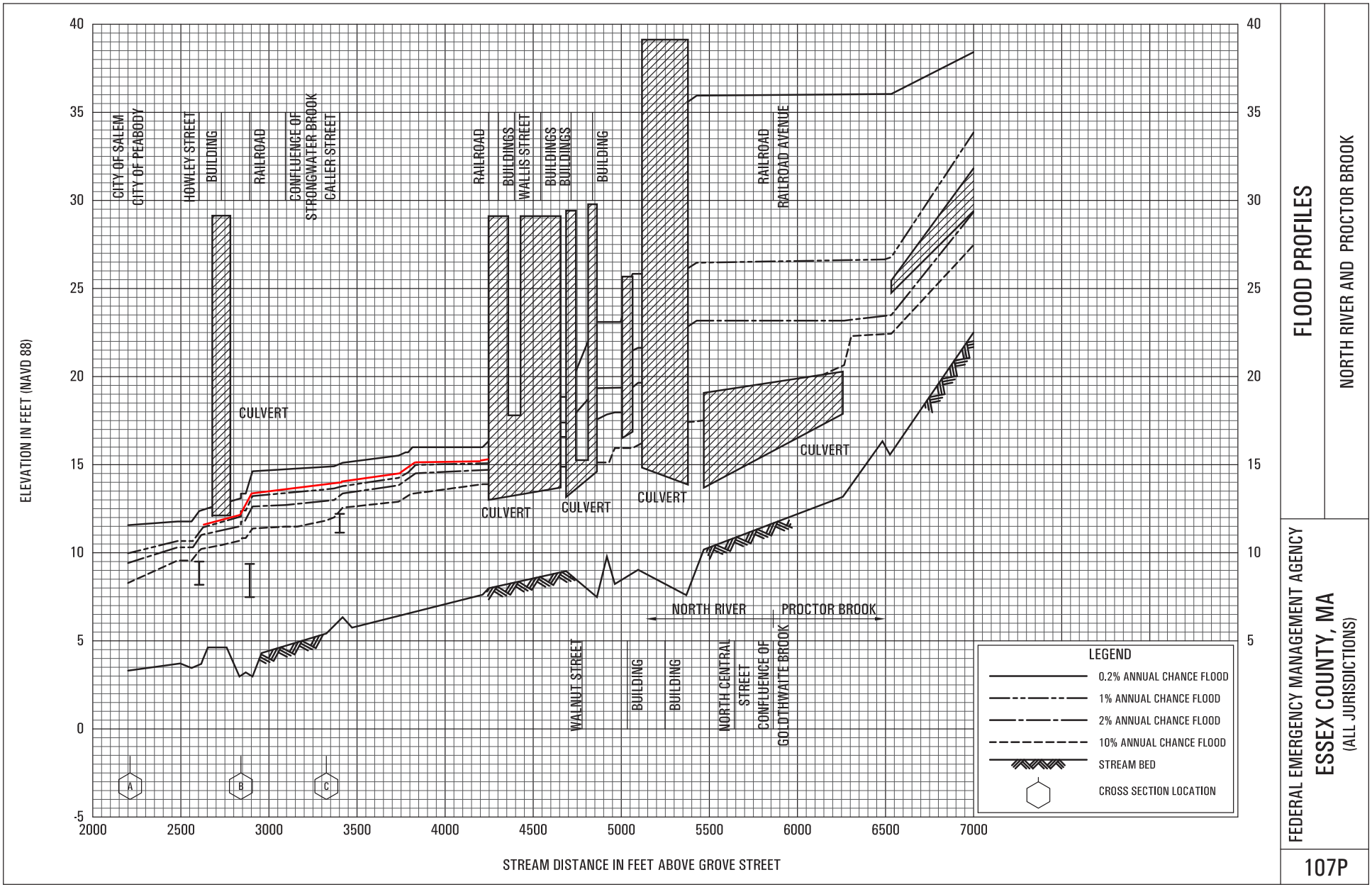
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

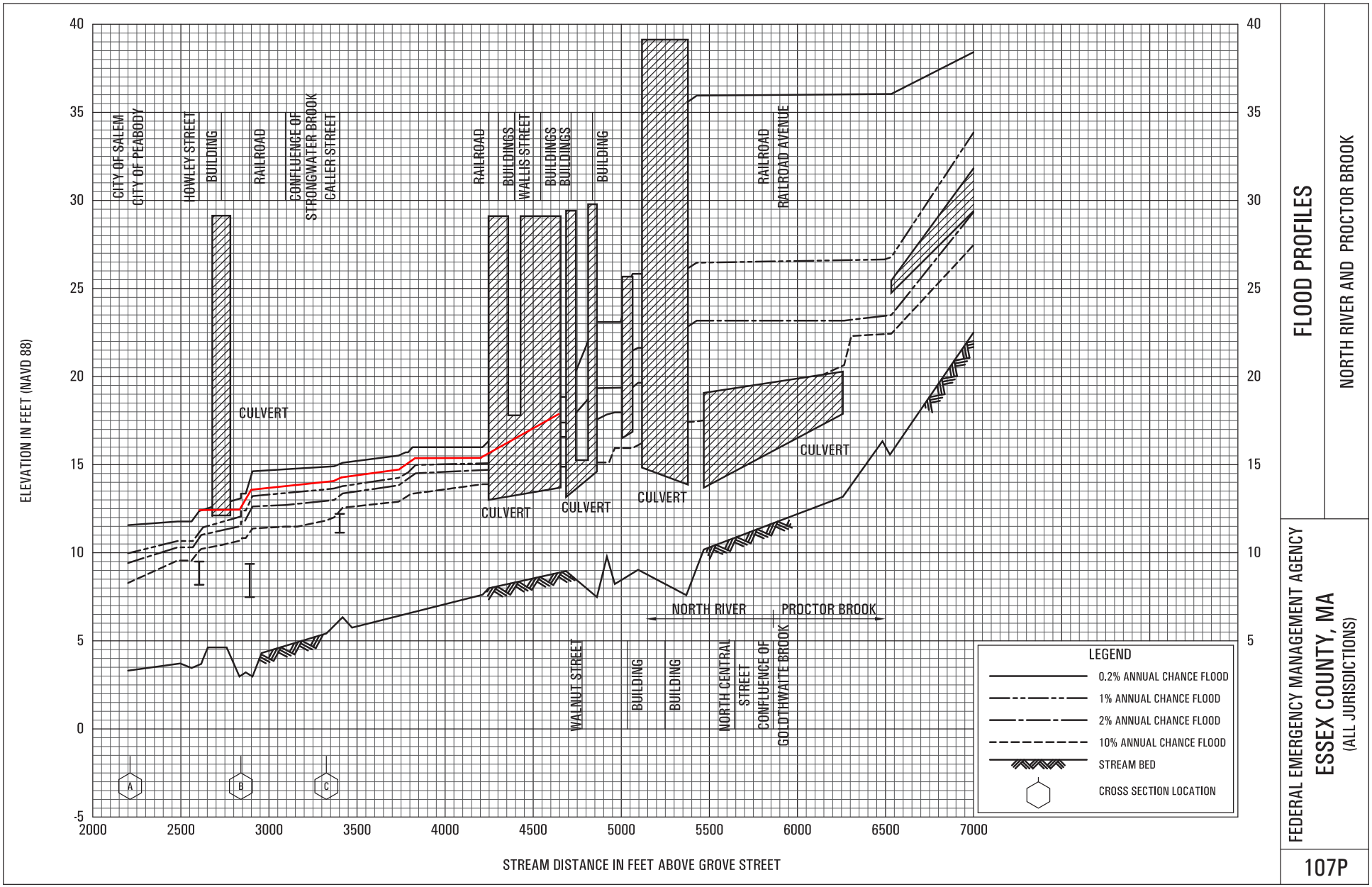
(ALL JURISDICTIONS)

107P

Scenario 2


ELEVATION IN FEET (NAVD 88)
STREAM DISTANCE IN FEET ABOVE GROVE STREET
CITY OF SALEM
CITY OF PEABODY
HOWLEY STREET
BUILDING
RAILROAD
CONFLUENCE OF STRONGWATER BROOK
CALLER STREET
RAILROAD
BUILDINGS
WALLIS STREET
BUILDINGS
BUILDINGS
BUILDING
RAILROAD
RAILROAD AVENUE
CULVERT
CULVERT
CULVERT
CULVERT
CULVERT
NORTH RIVER
PROCTOR BROOK
WALNUT STREET
BUILDING
BUILDING
NORTH CENTRAL STREET
CONFLUENCE OF GOLDTHWAITE BROOK
A
B
C
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION
FLOOD PROFILES
NORTH RIVER AND PROCTOR BROOK
FEDERAL EMERGENCY MANAGEMENT AGENCY
ESSEX COUNTY, MA
(ALL JURISDICTIONS)
107P

Scenario 3



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

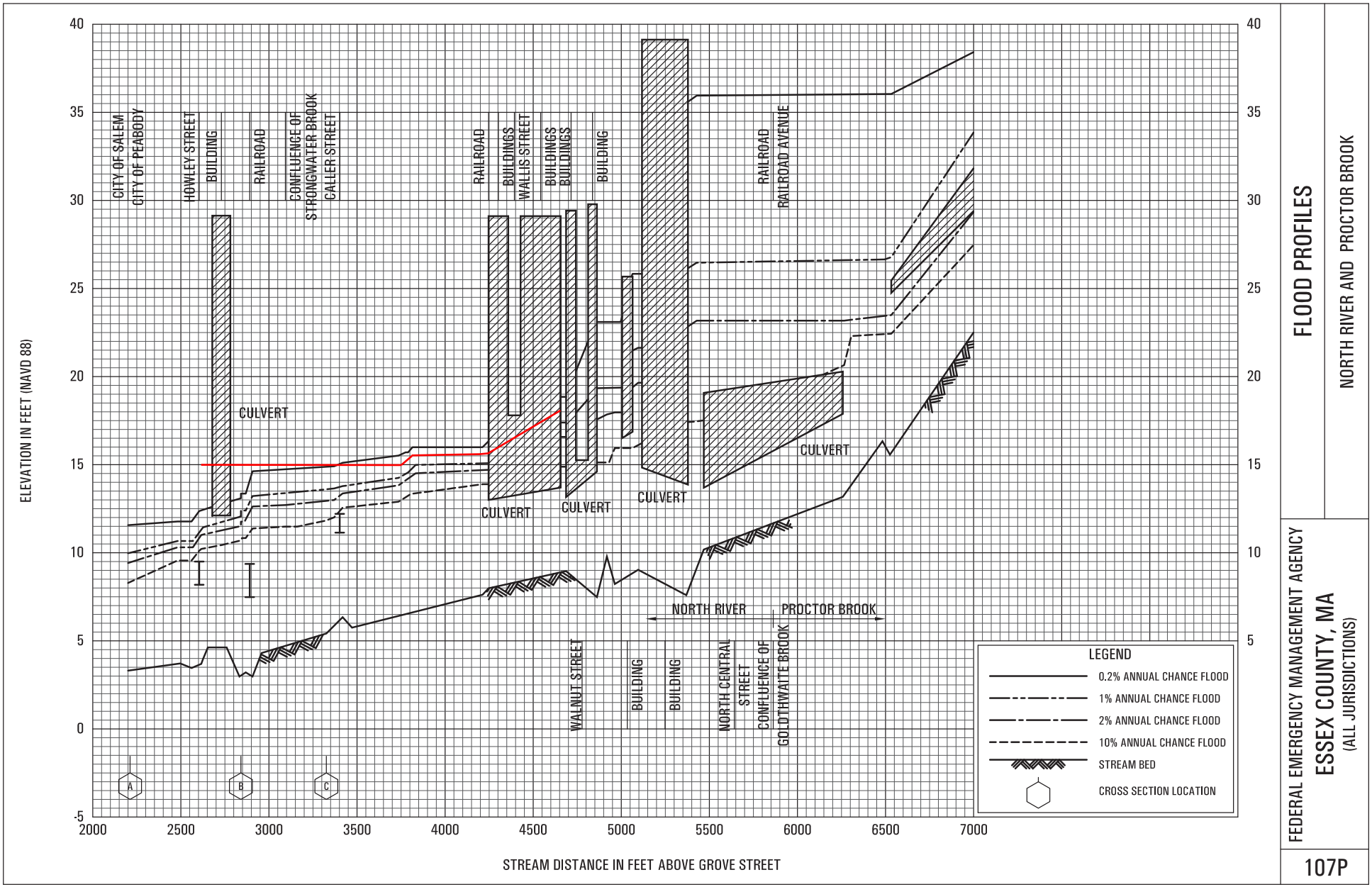
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

(ALL JURISDICTIONS)

107P

Scenario 4



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

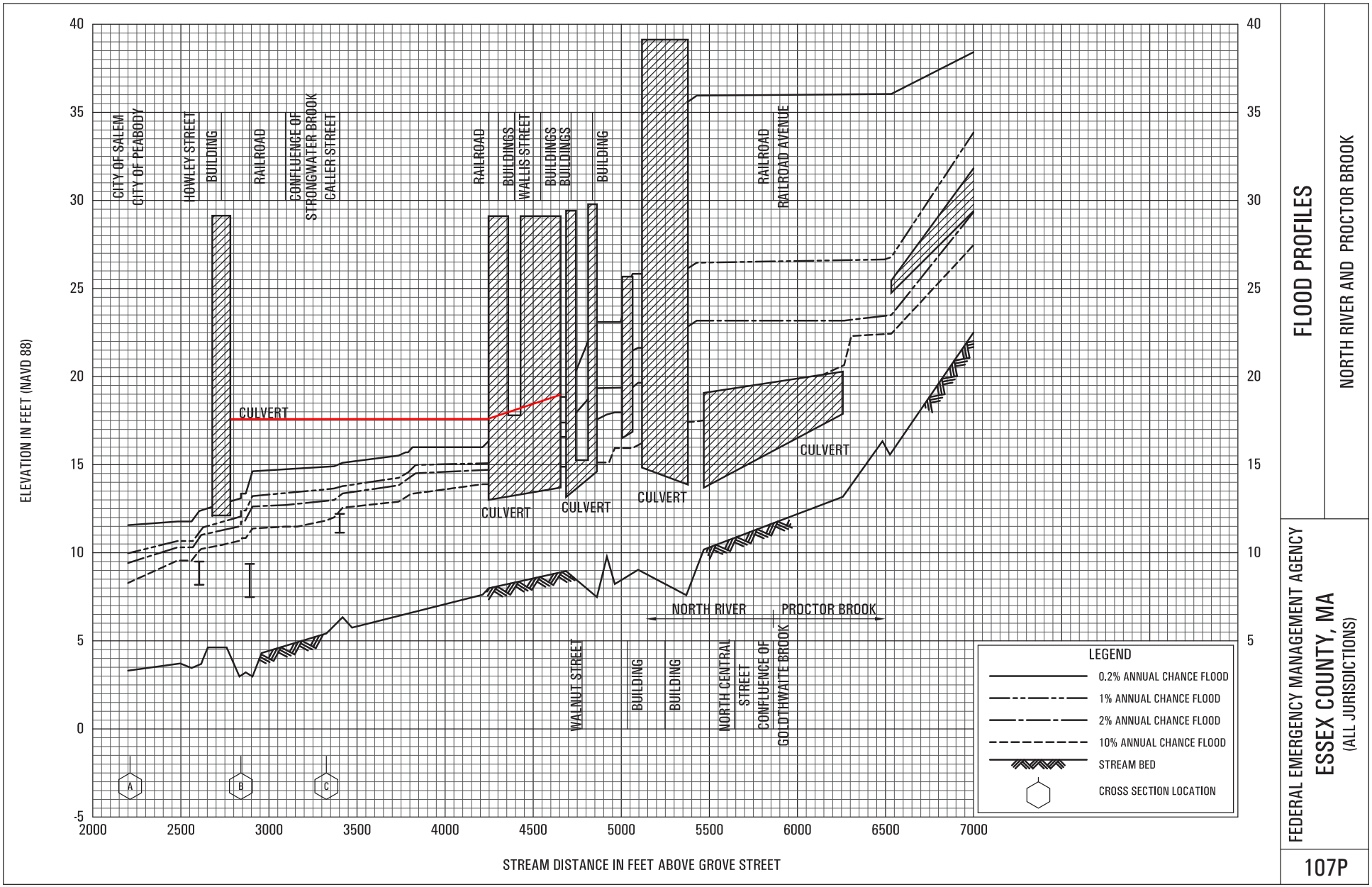
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

(ALL JURISDICTIONS)

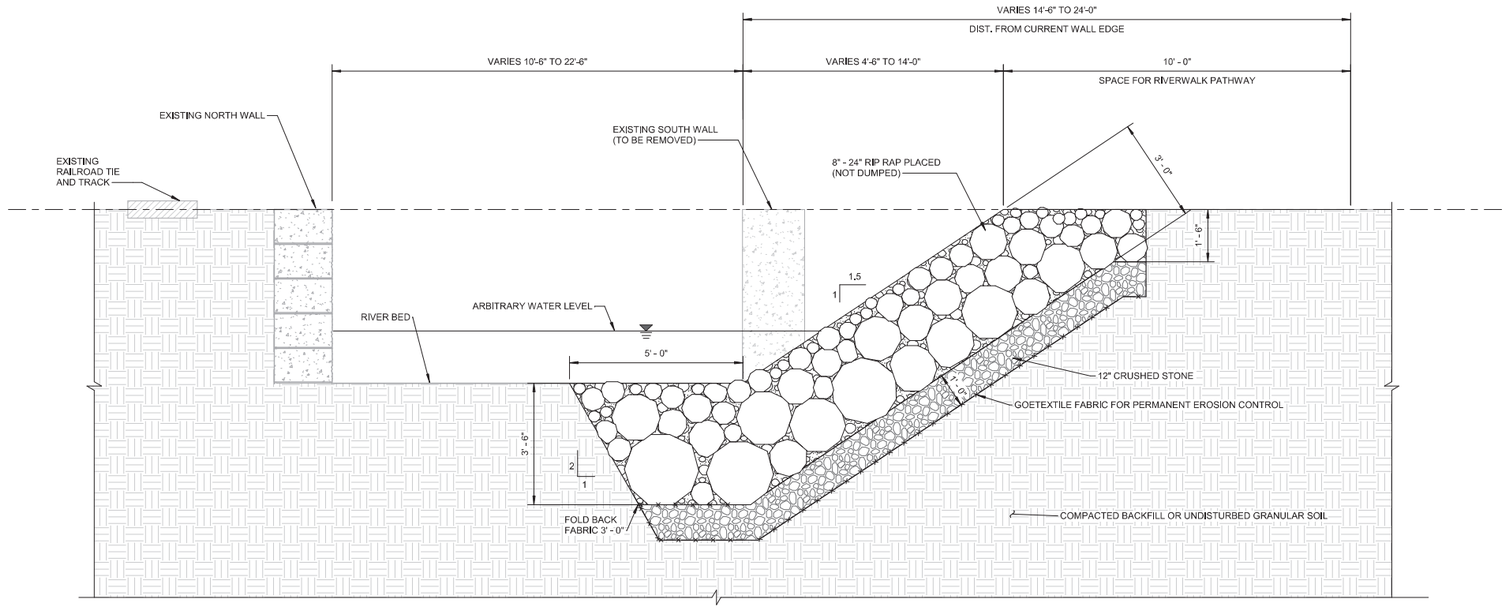
107P

Scenario 5

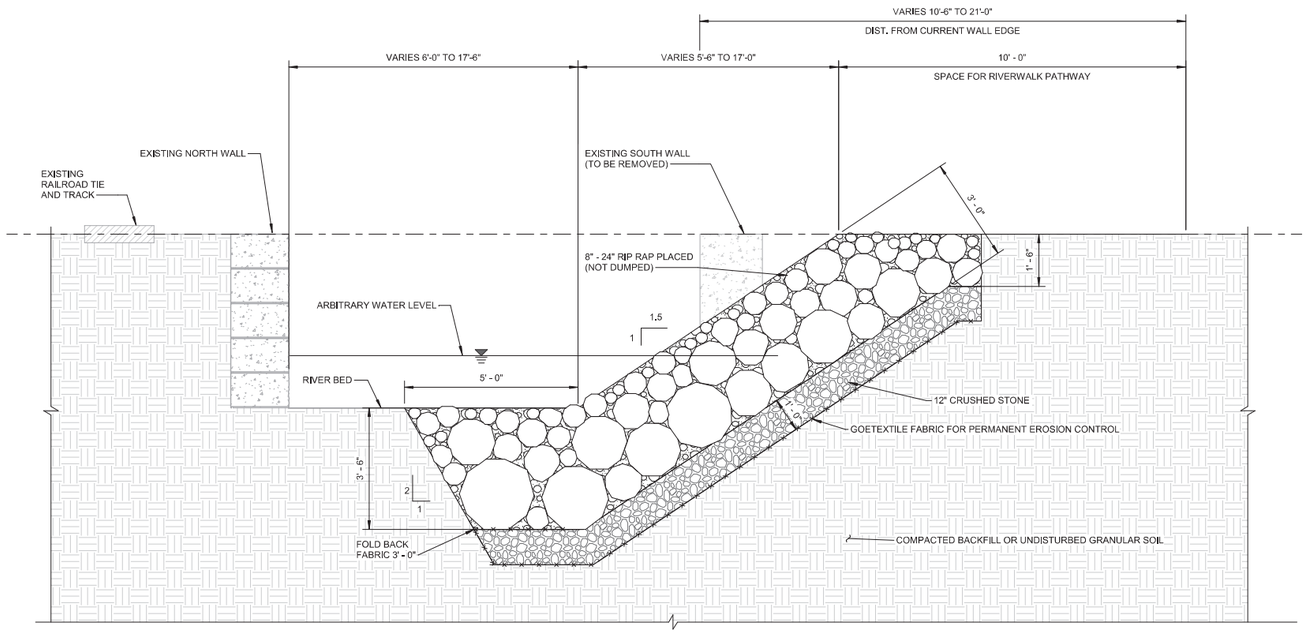

FLOOD PROFILES
NORTH RIVER AND PROCTOR BROOK
FEDERAL EMERGENCY MANAGEMENT AGENCY
ESSEX COUNTY, MA
(ALL JURISDICTIONS)
107P
ELEVATION IN FEET (NAVD 88)
STREAM DISTANCE IN FEET ABOVE GROVE STREET
CITY OF SALEM
CITY OF PEABODY
HOWLEY STREET
BUILDING
RAILROAD
CONFLUENCE OF STRONGWATER BROOK
CALLER STREET
RAILROAD
BUILDINGS
WALLIS STREET
BUILDINGS
BUILDINGS
BUILDING
RAILROAD
RAILROAD AVENUE
CULVERT
CULVERT
CULVERT
CULVERT
CULVERT
NORTH RIVER
PROCTOR BROOK
WALNUT STREET
BUILDING
BUILDING
NORTH CENTRAL STREET
CONFLUENCE OF GOLDTHWAITE BROOK
A
B
C
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION

APPENDIX C

Wall Alternatives Typical Cross-Sections



1 RIP RAP SLOPE OPTION 1



2 RIP RAP SLOPE OPTION 2

FIGURE H–1
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE A –
RIP RAP SLOPE DETAILS
JANUARY, 2019

Weston & Sampson

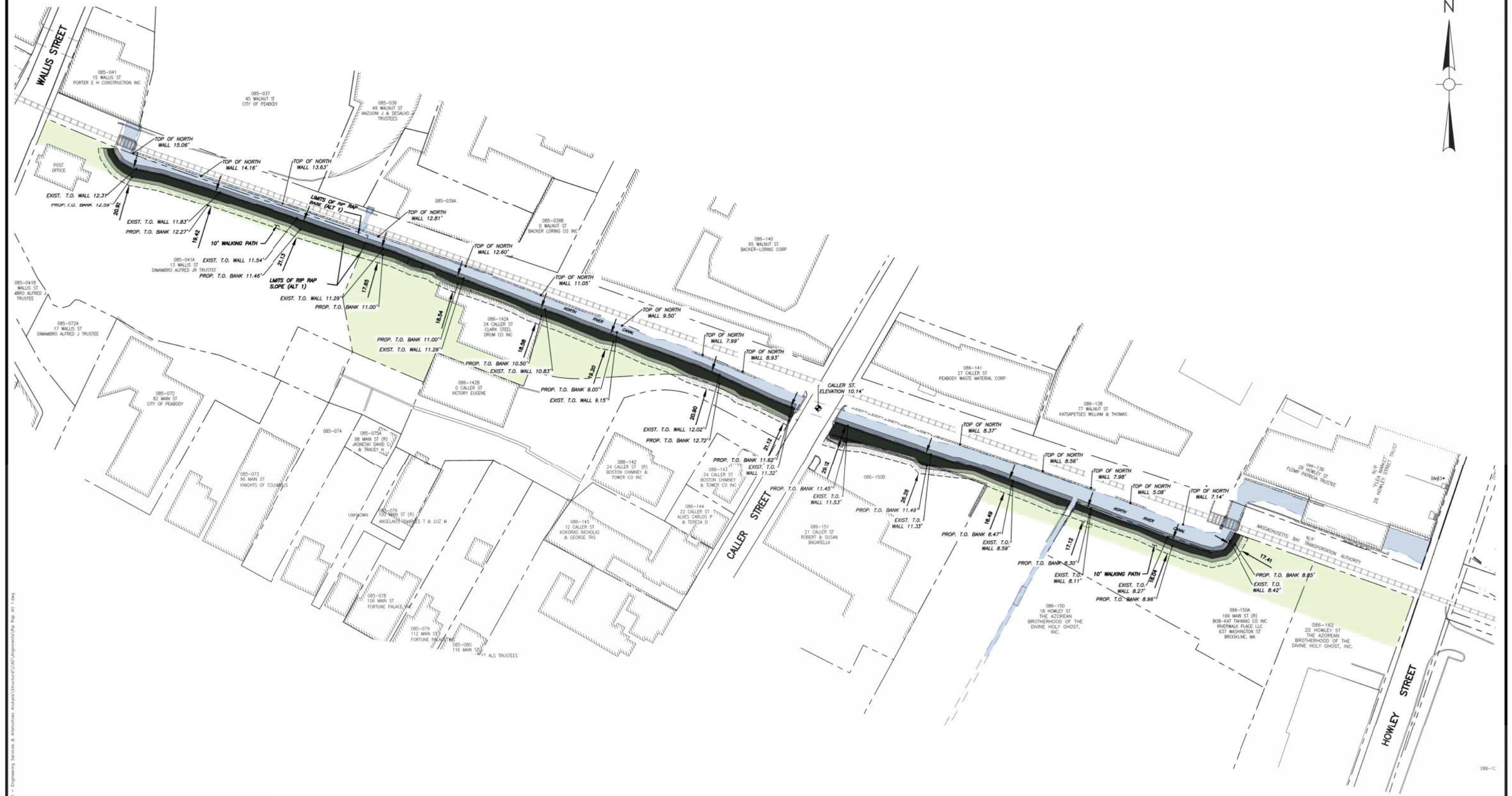


FIGURE H-2
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE A –
RIP RAP SLOPE OPTION 1

JANUARY, 2019

Weston & Sampson

\\wsbo3.local\WSE\Projects\MA\Peabody MA MVP Action Grant 2018\Task 2 - Engineering Services & Alternatives Analysis\Structural\CAD\Alignments\Alt Rip Rap Alt 1.dwg

N

WALLIS STREET

085-041
15 WALLIS ST
PORTER E H CONSTRUCTION INC

085-037
45 WALNUT ST
CITY OF PEABODY

085-036
49 WALNUT ST
ANZUONI J & DESALVO J
TRUSTEES

POST OFFICE

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.16'
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.60'
TOP OF NORTH WALL 11.05'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

LIMITS OF RIP RAP BASE (ALT 2)
LIMITS OF RIP RAP SLOPE (ALT 2)

10' WALKING PATH

16.35
PROP. T.O. BANK 12.51'
EXIST. T.O. WALL 12.31'

15.65
PROP. T.O. BANK 12.14'
EXIST. T.O. WALL 11.83'

16.26
EXIST. T.O. WALL 11.54'
PROP. T.O. BANK 11.42'

14.74
PROP. T.O. BANK 11.00'
EXIST. T.O. WALL 11.29'

13.10
EXIST. T.O. WALL 11.29'
PROP. T.O. BANK 9.85'

13.83
EXIST. T.O. WALL 10.83'
PROP. T.O. BANK 9.63'

17.37
EXIST. T.O. WALL 9.15'
PROP. T.O. BANK 9.37'

20.48
PROP. T.O. BANK 12.69'
EXIST. T.O. WALL 12.02'

16.72
PROP. T.O. BANK 11.53'
EXIST. T.O. WALL 11.32'

28.55
EXIST. T.O. WALL 11.53'
PROP. T.O. BANK 13.01'

22.95
EXIST. T.O. WALL 11.33'
PROP. T.O. BANK 15.04'

12.28
EXIST. T.O. WALL 8.59'
PROP. T.O. BANK 8.54'

13.46
EXIST. T.O. WALL 8.11'
PROP. T.O. BANK 8.12'

14.09
EXIST. T.O. WALL 8.27'
PROP. T.O. BANK 8.39'

13.42
PROP. T.O. BANK 8.52'
EXIST. T.O. WALL 8.42'

085-039A

085-039B
0 WALNUT ST
BACKER LORING CO INC

086-140
65 WALNUT ST
BACKER-LORING CORP

085-041A
13 WALLIS ST
DIMAMBRO ALFRED JR TRUSTEE

085-072A
17 WALLIS ST
DIMAMBRO ALFRED J TRUSTEE

086-143A
24 CALLER ST
CLARK STEEL DRUM CO INC

086-141
27 CALLER ST
PEABODY WASTE MATERIAL CORP

086-138
77 WALNUT ST
KATSAPETSES WILLIAM & THOMAS

085-072
82 MAIN ST
CITY OF PEABODY

085-074

085-075A
98 MAIN ST (R)
JASNESKI DAVID C.
& TRACEY H.

085-073
96 MAIN ST
KNIGHTS OF COLUMBUS

086-142B
0 CALLER ST
VICTORY EUGENE

086-142
24 CALLER ST (R)
BOSTON CHIMNEY &
TOWER CO INC

086-143
24 CALLER ST
BOSTON CHIMNEY
& TOWER CO INC

086-144
22 CALLER ST
ALVES CARLOS P
& TERESA D

086-145
12 CALLER ST
KOKORAS NICHOLAS
& GEORGE TRS

086-150B

086-151
21 CALLER ST
ROBERT & SUSAN
BAGARELLA

086-150
18 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST,
INC.

086-150A
166 MAIN ST (R)
BOB-KAT TANNING CO INC
RIVERWALK PLACE LLC
637 WASHINGTON ST
BROOKLINE, MA

086-156
26 HOWLEY ST
FLOMO PATRICIA TRUSTEE

N/F
TLEA MARKET
26 HOWLEY STREET TRUST

086-162
20 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST, INC.

086-134

085-078
106 MAIN ST
FORTUNE PALACE INC

085-079
112 MAIN ST
FORTUNE PALACE INC

085-080
116 MAIN ST
PAGE AMY LEE ET ALS TRUSTEES

UNKNOWN
085-076
100 MAIN ST (R)
ANGELAKIS CHARLES T & LUZ M

CALLER ST.
ELEVATION 10.14'

CALLER STREET

HOWLEY STREET

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
N/F

NORTH RIVER CANAL

CONCRETE

BM#3

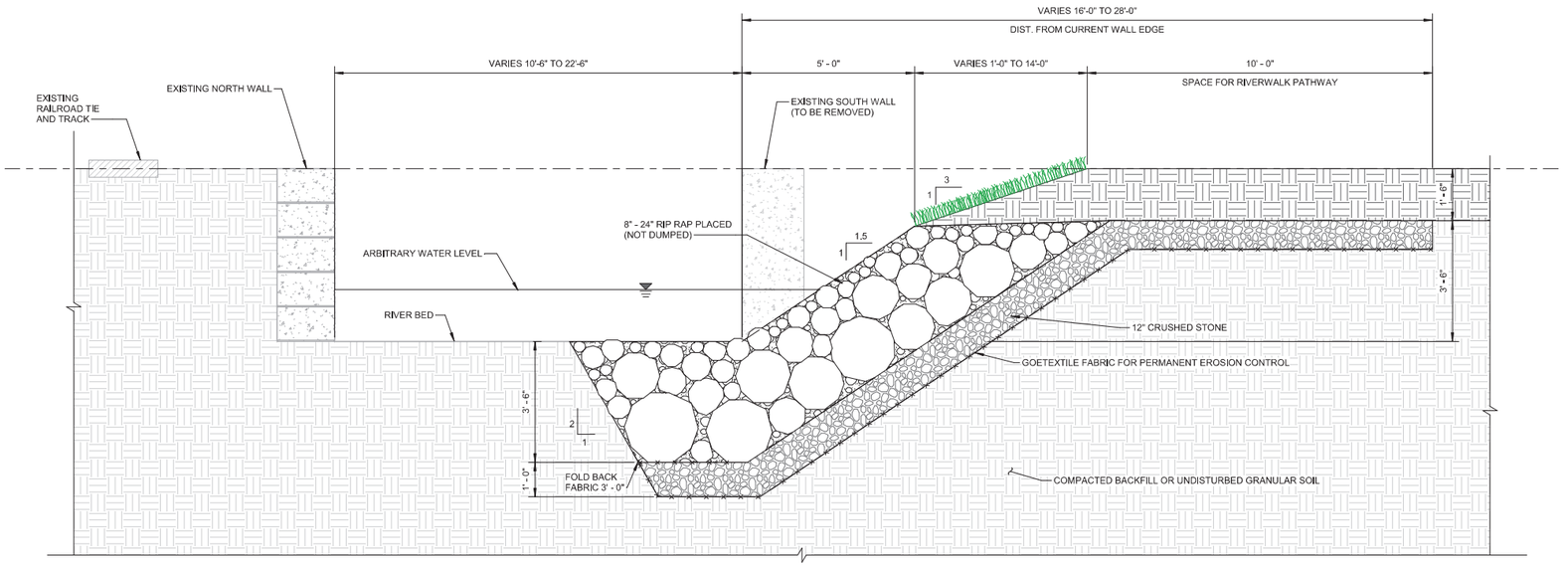
FIGURE H-3
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE A –
RIP RAP SLOPE OPTION 2

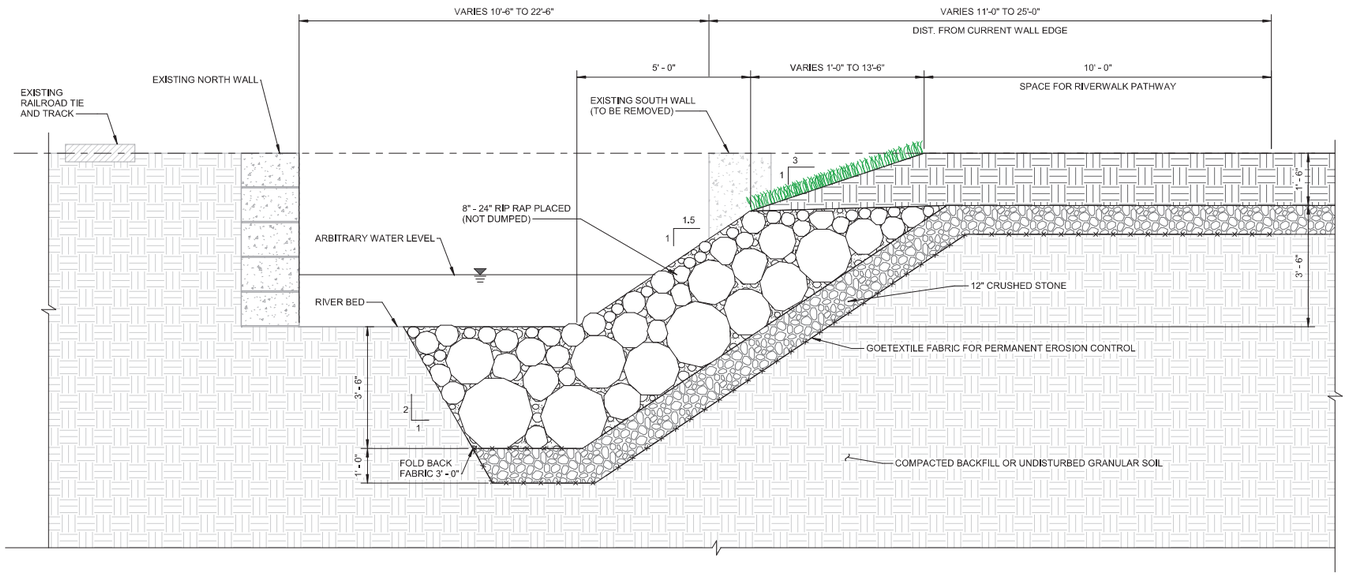
JANUARY, 2019

Weston & Sampson℠

\\wse03.local\WSE_Projects\MA\Peabody MA\MVP Action Grant 2018\Task 2 - Engineering Services & Alternatives Analysis\Structural\CAD\Alignments\Rip Rap Alt 2.dwg



1 VEGETATIVE BERM ABOVE RIP RAP SLOPE OPTION 1



2 VEGETATIVE BERM ABOVE RIP RAP SLOPE OPTION 2

FIGURE H-4
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE DETAILS
JANUARY, 2019

Weston & Sampson

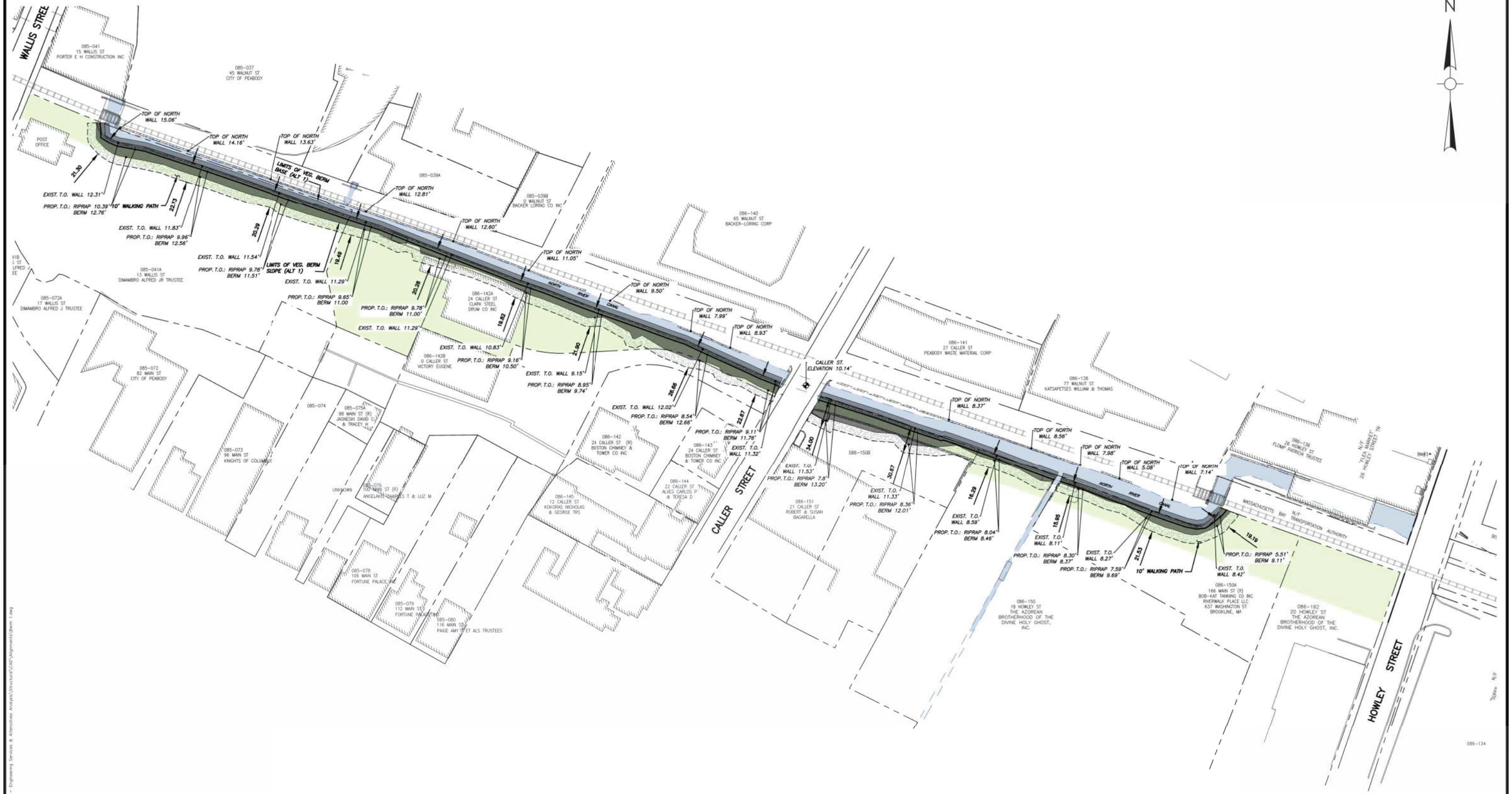


FIGURE H–5
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE OPTION 1
JANUARY, 2019

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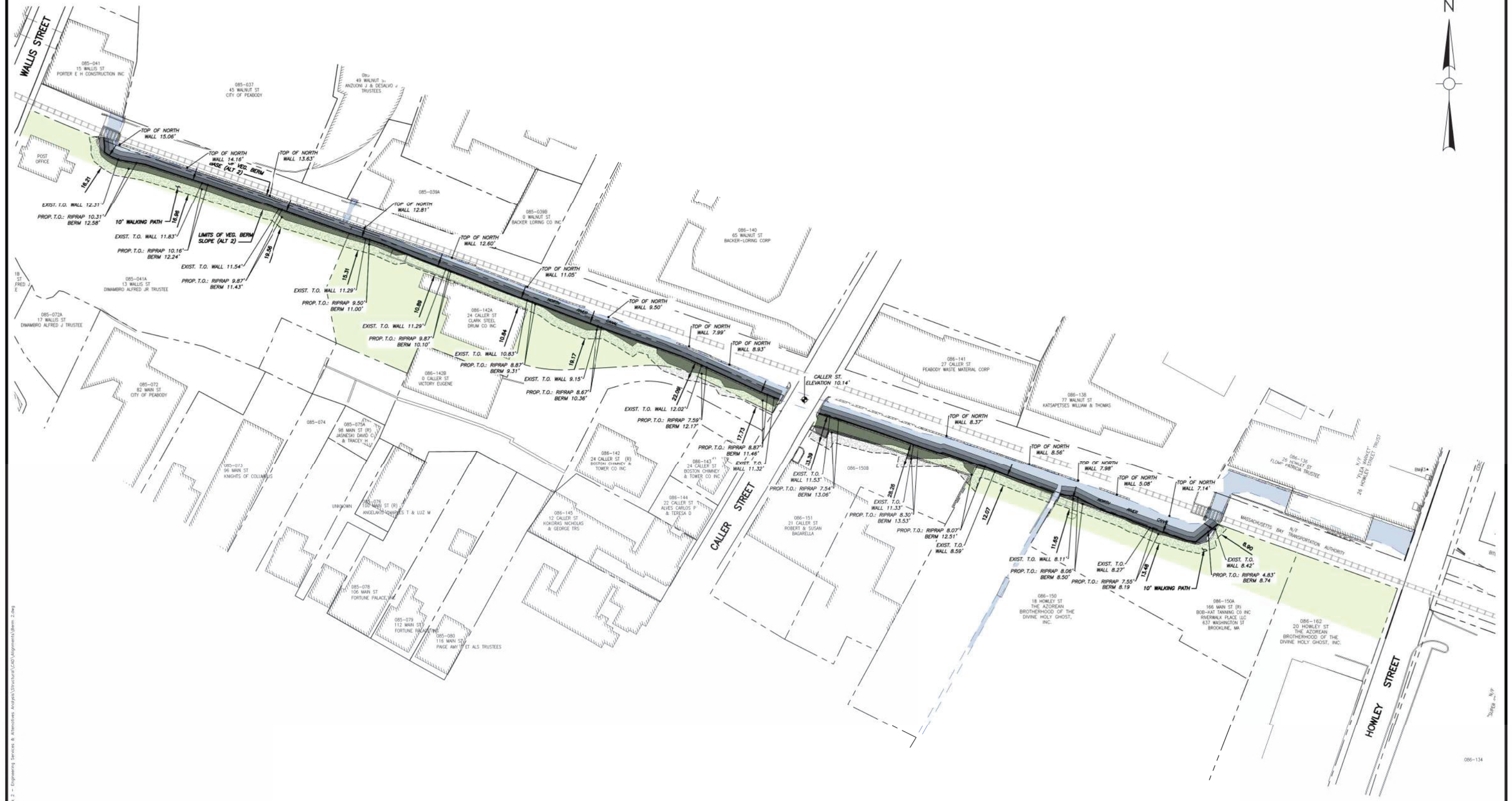


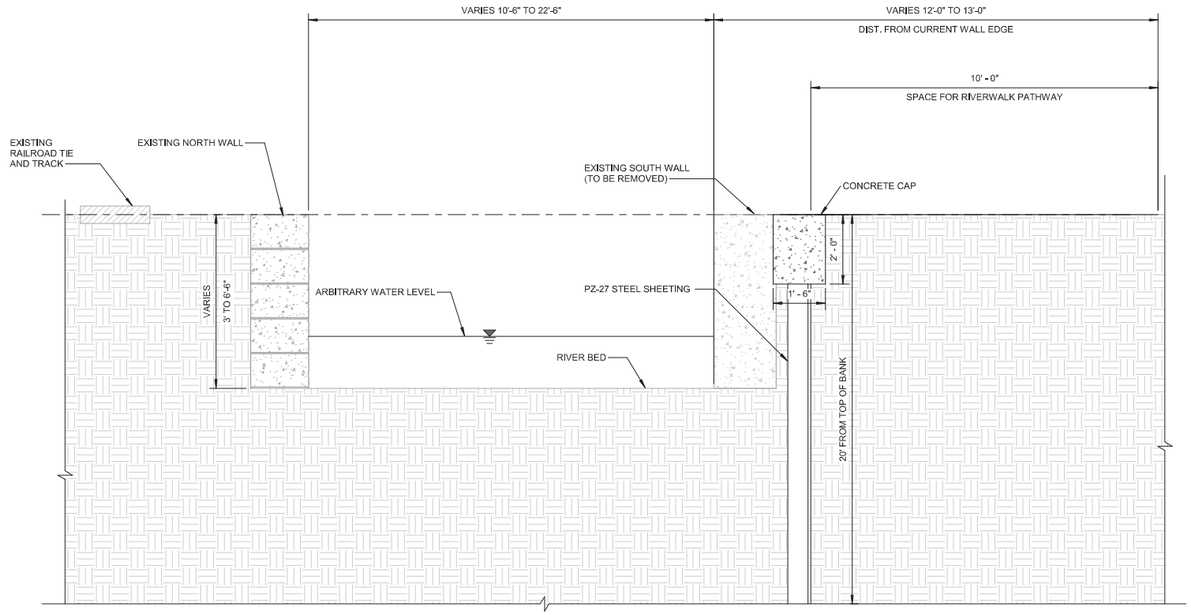
FIGURE H–6
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE OPTION 2

JANUARY, 2019

Weston & Sampson

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1 SHEET PILE DETAIL

FIGURE H–7
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE C –
SHEET PILE WALL
JANUARY, 2019

Weston & Sampson

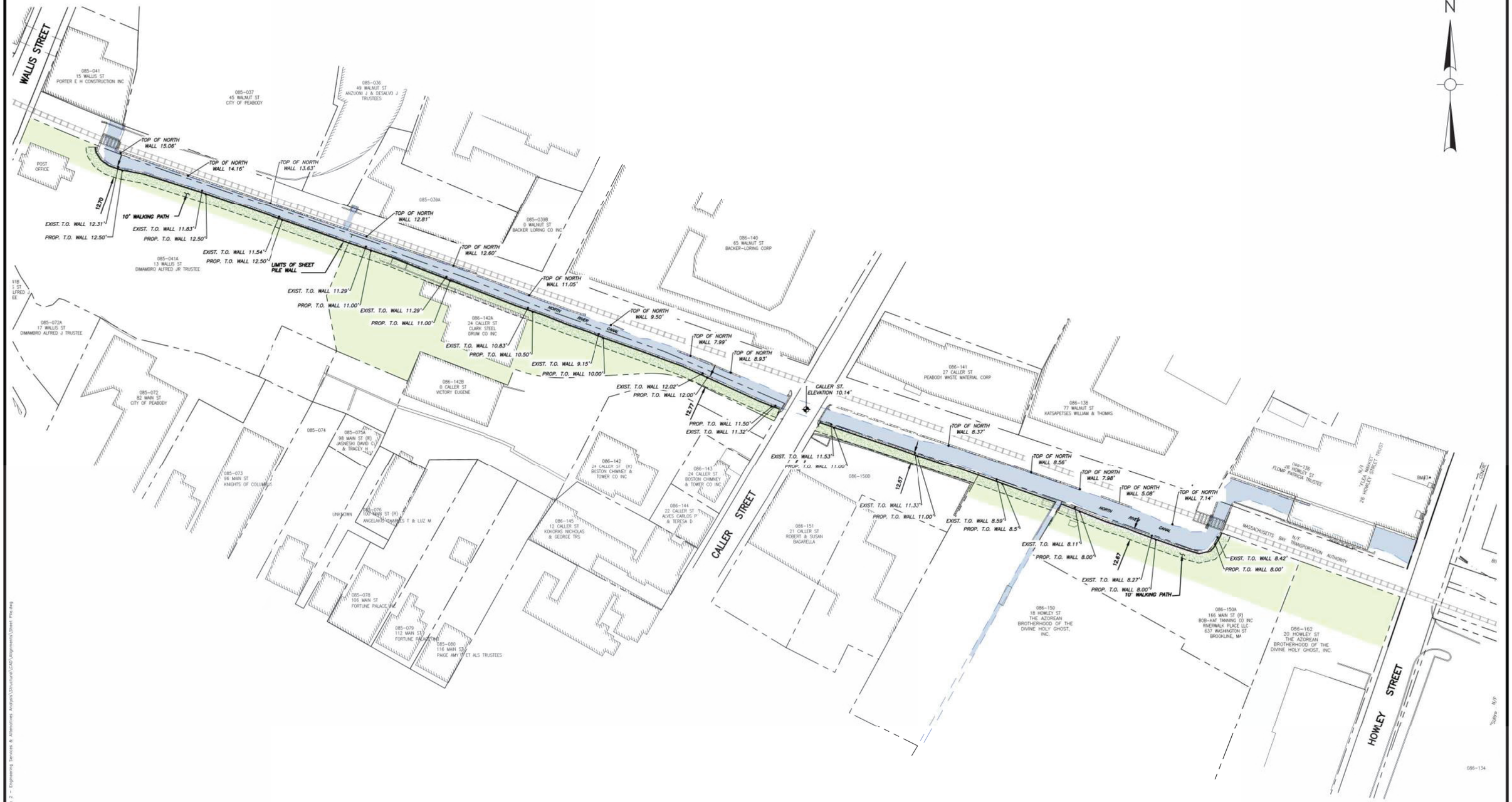
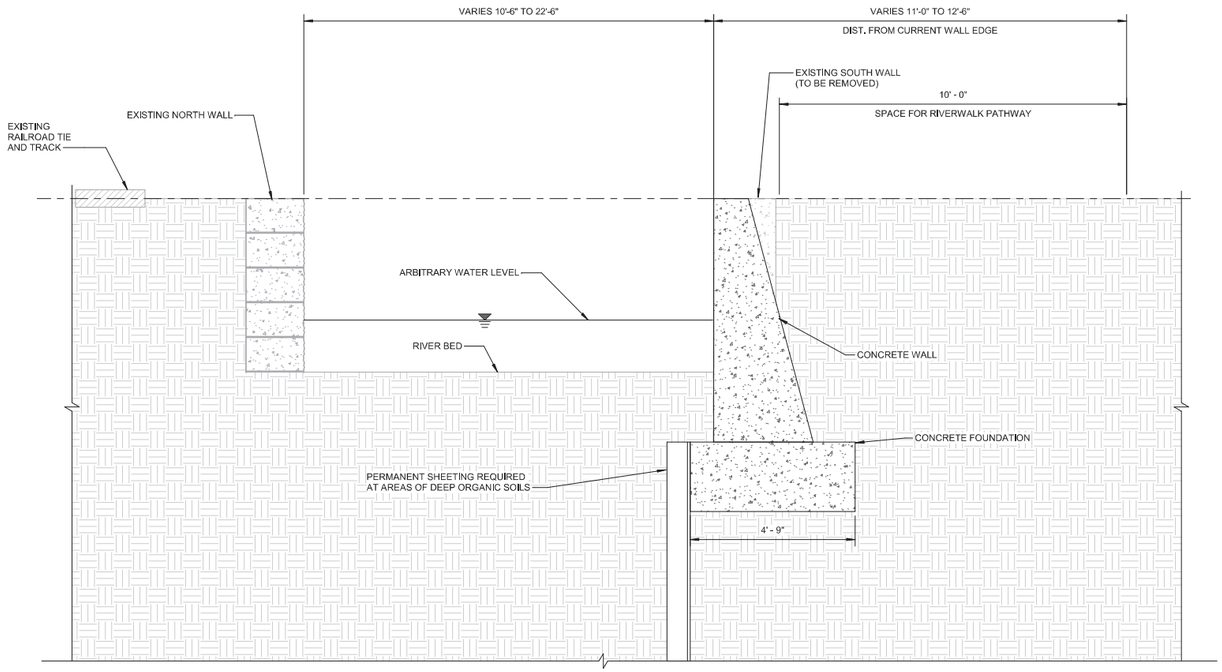


FIGURE H-8
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE C –
SHEET PILE WALL
JANUARY, 2019

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1 CANTILEVER CONCRETE RETAINING WALL

FIGURE H–9
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE D –
CANTILEVER CONCRETE RETAINING WALL
JANUARY, 2019

Weston & Sampson

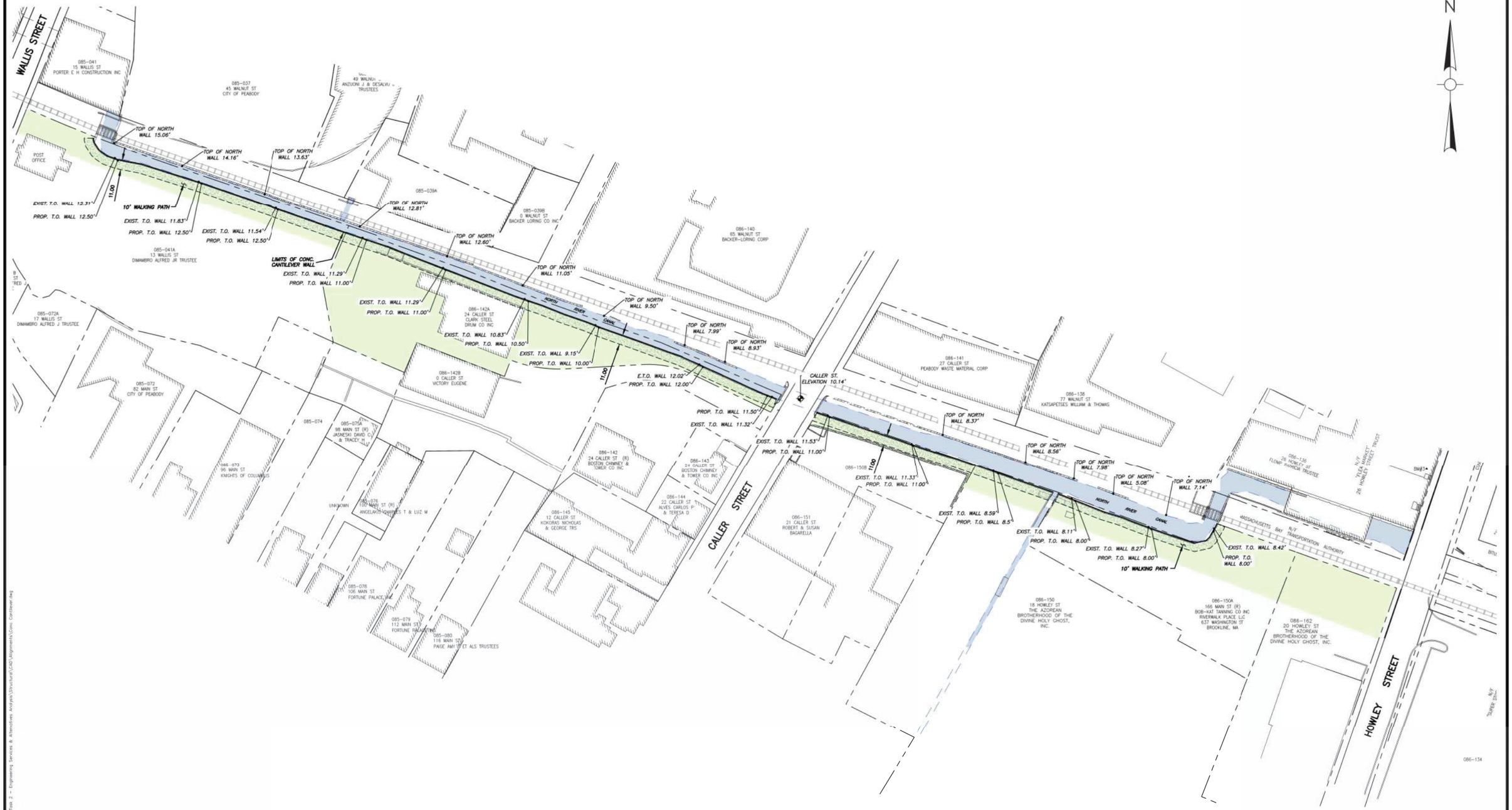
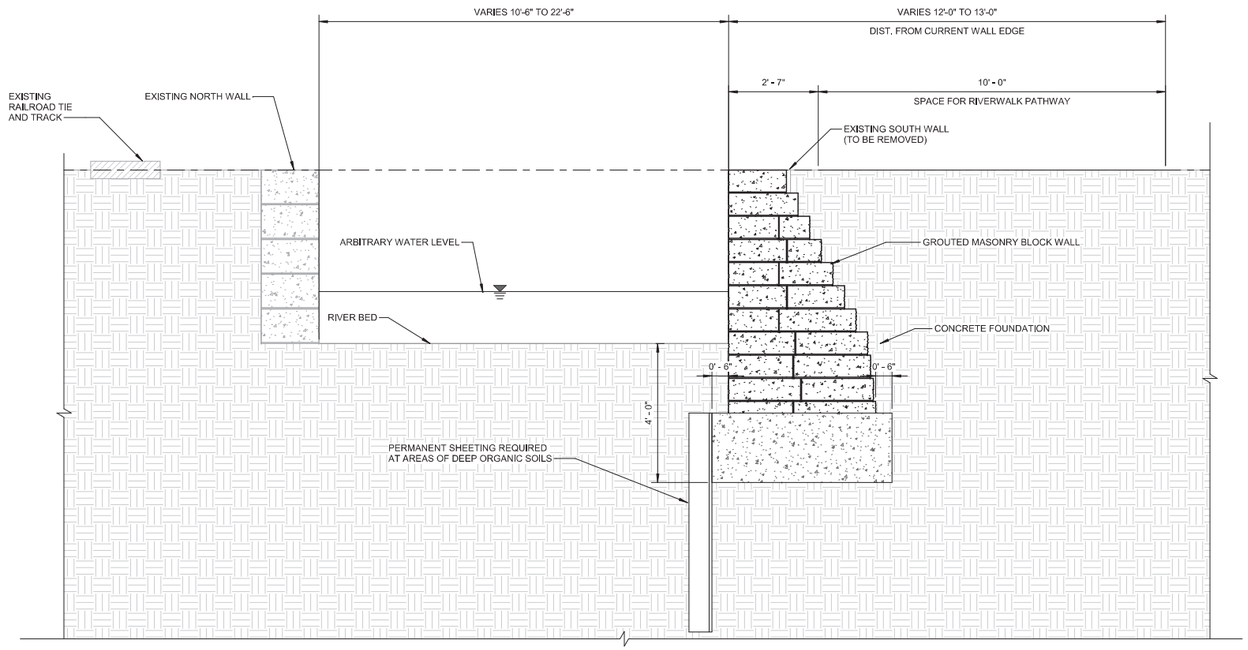


FIGURE H–10
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE D –
CANTILEVER CONCRETE RETAINING WALL
JANUARY, 2019

Weston & Sampson



1 STONE MASONRY WALL

FIGURE H–11
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE E –
STONE MASONRY WALL

JANUARY, 2019

Weston & Sampson

N

WALLIS STREET

085–041
15 WALLIS ST
PORTER E H CONSTRUCTION INC

085–037
45 WALNUT ST
CITY OF PEABODY

085–036
49 WALNUT ST
ANZUONI J & DESALVO J TRUSTEES

POST OFFICE

085–039A

085–039B
0 WALNUT ST
BACKER LORING CO INC

086–140
65 WALNUT ST
BACKER–LORING CORP

085–041A
13 WALLIS ST
DIMAMBRO ALFRED JR TRUSTEE

041B
LIS ST
ALFRED J
STEE

085–072A
17 WALLIS ST
DIMAMBRO ALFRED J TRUSTEE

085–072
82 MAIN ST
CITY OF PEABODY

086–142A
24 CALLER ST
CLARK STEEL DRUM CO INC

086–142B
0 CALLER ST
VICTORY EUGENE

086–141
27 CALLER ST
PEABODY WASTE MATERIAL CORP

086–138
77 WALNUT ST
KATSAPETSES WILLIAM & THOMAS

085–074

085–075A
98 MAIN ST (R)
JASNESKI DAVID C/
& TYRCLY R

086–142
24 CALLER ST (R)
BOSTON CHIMNEY &
TOWER CO INC

086–143
24 CALLER ST
BOSTON CHIMNEY
& TOWER CO INC

086–144
22 CALLER ST
ALVES CARLOS P
& TERESA D

086–136
26 HOWLEY ST
FLOMP PATRICIA TRUSTEE

N/F
LLCA MARKET
26 HOWLEY STREET TRUST

085–073
96 MAIN ST
KNIGHTS OF COLUMBUS

UNKNOWN

085–076
102 MAIN ST (R)
ANGELAKIS DIMITRIOS T & LUZ M

086–145
12 CALLER ST
KOKORAS NICHOLAS
& GEORGE TRS

086–150B

086–151
21 CALLER ST
ROBERT & SUSAN
BAGARELLA

085–078
106 MAIN ST
FORTUNE PALACE INC

085–079
112 MAIN ST
FORTUNE PALACE INC

085–080
116 MAIN ST
PAIGE AMY TR ET ALS TRUSTEES

086–150
18 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST,
INC.

086–150A
166 MAIN ST (R)
BOB–KAT TANNING CO INC
RIVERWALK PLACE LLC
637 WASHINGTON ST
BROOKLINE, MA

086–162
20 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST, INC.

086–134

CALLER STREET

HOWLEY STREET

NORTH RIVER CANAL

MASSACHUSETTS Bay N/F TRANSPORTATION AUTHORITY

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.16'
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.60'
TOP OF NORTH WALL 11.05'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

11.67'

EXIST. T.O. WALL 12.31'
PROP. T.O. WALL 12.50'
10' WALKING PATH
EXIST. T.O. WALL 11.83'
PROP. T.O. WALL 12.50'
EXIST. T.O. WALL 11.54'
PROP. T.O. WALL 12.50'
LIMITS OF BLOCK WALL (ALT 1)
EXIST. T.O. WALL 11.29'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 11.29'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 10.83'
PROP. T.O. WALL 10.50'
EXIST. T.O. WALL 9.15'
PROP. T.O. WALL 10.00'
EXIST. T.O. WALL 12.02'
PROP. T.O. WALL 12.00'
PROP. T.O. WALL 11.50'
EXIST. T.O. WALL 11.32'
EXIST. T.O. WALL 11.53'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 11.33'
PROP. T.O. WALL 11.00'
EXIST. T.O. WALL 8.59'
PROP. T.O. WALL 8.5'
EXIST. T.O. WALL 8.11'
PROP. T.O. WALL 8.00'
EXIST. T.O. WALL 8.27'
PROP. T.O. WALL 8.00'
10' WALKING PATH
EXIST. T.O. WALL 8.42'
PROP. T.O. WALL 8.00'

CALLER ST. ELEVATION 10.14'

FIGURE H–12
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE E –
STONE MASONRY WALL

JANUARY, 2019

Weston & Sampson℠

\\wse03.local\WSE\Projects\MA\Peabody MA MVP Action Grant 2018\Task 2 – Engineering Services & Alternatives Analysis\Structural\CAD\Alignments\Masonry Block 1.dwg

APPENDIX K

Summary of Potential Permits

A **Notice of Intent** (NOI) is required by Massachusetts Department of Environmental Protection (MassDEP) as part of the Massachusetts Wetlands Protection Act (310 CMR 10.00). The Act protects wetland resources, including bank, land under water, 100-year flood zone, and riverfront area, from being impacted from activities such as the removal, dredging, filling or alteration of said resources. A Notice of Intent requires the following:

- Forms and notifications for Wetland Regulations and Wetland Bylaw
- Project narrative
- Support documentation for the project including the potential for the following
  - Hydrology & Hydraulics (H&H) Study
  - Alternative Analysis
  - Habitat Evaluation
- Locus and Environmental Maps
- Permitting Plans
- Notification of abutters in accordance with NOI filing requirements
- Stormwater Report
- Wetlands Replication Plan, if necessary
- Wetlands Monitoring Plan, if necessary

A Massachusetts Department of Environmental Protection (MassDEP) **401 Water Quality Certification** (WQC) is required under the Massachusetts Clean Water Act for activities in wetlands and waters (314 CMR 9.00) for work that will result in a "discharge of dredged or fill material, dredging, and dredged disposal activities in waters of the United States within the Commonwealth" (314 CMR 9.01). The jurisdictional area includes wetlands and tributaries to the above-mentioned waters. A WQC requires the following:

- Forms and notifications for WQC Review
- Project narrative
- Support documentation for the project including the potential for the following
  - H&H Study
  - Sediment Sampling Plan
  - Sediment Quality Results
- Locus and Environmental Maps
- Permitting Plans
- Notification of abutters
- Wetlands Replication Plan, if necessary
- Wetlands Monitoring Plan, if necessary
- Sediment Sampling Plan
- Sediment Quality Results

Flowed tidelands, filled tidelands, great ponds and non-tidal rivers and streams are protected under the **Chapter 91** Waterways regulations (310 CMR 9.00). Any activity occurring in, on, over or under one of the above-mentioned resource areas are subject to a Chapter 91 review. Thus, the work within the North River Canal will necessitate a Chapter 91 submission.

- Forms and notifications for CH91 Review
- Project narrative, justification for proposed project
- Support documentation for the project
- Locus and Environmental Maps
- Permitting Plans (potentially a License Plan)
- Notification of abutters and placement of legal advertisement,

A Massachusetts Environmental Policy Act (MEPA) Environmental Notification Form (ENF) is required for this project. Per 301 CMR 11.00, "MEPA review is an informal administrative process that is intended to involve any interested agency or person as well as the proponent and each participating agency." The MEPA process review may be triggered based on numerous thresholds that may be triggered, including those that alter land, endangered species, wetlands, waterways, tidelands, source water, wastewater, transportation, energy, air, solid and hazardous waste, historical and archaeological resources, and areas of critical environmental concern. An ENF will require the following:

- Application form(s) and address all relevant elements
- Project Narrative providing history and justification of project
- Identification of resources and methods for mitigation and restoration as well as minimization of impacts
- Project plans illustrating project limits and resource areas
- Submission of ENF with distribution as required
- Provide public advertising as required
- Attend and assist in presentation of project at public site meeting
- Incorporation of agency and client comments from site meeting
- Provide responses to ENF comments developed during public review process

The New England District of the Army Corps of Engineers (the Corps) issues general and individual permits (IP) for the construction of any structures in, over or under any navigable waterway of the United States. Other work under the Corps jurisdiction includes dredging or filling and any other work that may affect the course, location, condition or capacity of said waters. In Massachusetts, there are 23 different general permits with unique thresholds that will trigger a Corps submission. Per General Permit 7, a Corps Individual Permit (Corps IP) is required for bank stabilization project greater than 500 lf in total length. Because each alternative result in an estimated 1,335 lf of bank restoration, a Corps IP is required. An IP will require the following:

- Forms and notifications for Corps Review
- Project narrative
- Locus and Environmental Maps
- Permitting Plans
- Notification of abutters
- Submission based on IP filing
- Support documentation could include the following:
    - H&H Study
    - Alternative Analysis
    - Habitat Evaluation
    - Sediment Sampling Plan
    - Sediment Quality Results

APPENDIX L

Summary Table of Permitting Variables

Summary of Permitting Variables

	Alternatives							
	Rip Rap 1	Rip Rap 2	Veg. Berm 1	Veg. Berm 2	Sheet Pile Wall Option 1	Sheet Pile Wall Option 2	Cantilever Retaining Wall	Masonry Block Wall
Resource Area Impacts (approximate areas)								
Bank (lf)	1,335	1,335	1,335	1,335	1,335	1,335	1,335	1,335
Land Under Water[1] - Area (ft^2)	6,700	12,300	6,000	10,600	Temp. Const.	Temp. Const.	Temp. Const.	Temp. Const.
Land Under Water[1] - Fill Volume (ft^3)	0	Unknown Fill	0	Unknown Fill	0	0	0	0
Land Under Water[1] - Dredge Volume (ft^3)	24,800	43,500	21,400	41,400	17,200	17,200	14,700	15,900
100 yr Flood Zone - (volume (ft^3)) (approximate)	24,000	0	26,700	0	10,700	37,000	0	0
Riverfront Area - (Area (ft^2)) (approximate)	26,000	21,000	28,500	21,800	17,200	20,000	14,800	15,900
Rating Index[2]	3	1	4	2	5	5	7	6
Possible Permits	NOI	NOI	NOI	NOI	NOI	NOI	NOI	NOI
	401 WQC	401 WQC	401 WQC	401 WQC	401 WQC	401 WQC	401 WQC	401 WQC
	Ch 91	Ch 91	Ch 91	Ch 91				
	ENF	ENF	ENF	ENF	ENF	ENF	ENF	ENF
	ACOE IP	ACOE IP	ACOE IP	ACOE IP	ACOE IP	ACOE IP	ACOE IP	ACOE IP
		Add'l Studies		Add'l Studies	Add'l Studies	Add'l Studies	Add'l Studies	Add'l Studies
Rating Index[2]	5	1	5	1	6	6	6	6
Possible Costs	$25,000 - $50,000	$35,000 - $65,000	$25,000 - $50,000	$35,000 - $65,000	$25,000 - $50,000	$25,000 - $50,000	$25,000 - $50,000	$25,000 - $50,000
Rating Index[2]	3	1	3	1	3	3	3	3
Favorability Rating								
Rating Index[2]	6	1	7	2	3	3	3	3
Possible Permit Schedule	up to 15 months	up to 15 months	up to 15 months	up to 15 months	up to 7 months	up to 7 months	up to 7 months	up to 7 months
Rating Index[2]	3	1	3	1	4	4	4	4
Total Rating Score[2]	4	1	4.4	1.4	4.2	4.2	4.6	4.4

1. Potential for additional construction-related impacts
2. A lower score indicates a less prefered alternative

APPENDIX M

Potential Permitting

Table 1: Project Specific Environmental Agency Review Timeline: Peabody MVP - North River Canal - South Wall Project
(for rip rap and vegetative berm options)

ID No.	Task / Review	Duration
	MEPA APPROVAL	
1	Submit ENF	1 Day
2	Environmental Monitor	15 days
3	Comment Period	20 days
4	Review of ENF	30 days
5	Secretary's Certificate	1 Day
	Army Corp Individual Permit	
1	Submit Pre-Construction Notification	1 Day
2	Public Notice	15 days
3	Public Comment	30 days
4	Agency Review	60-90 days
5	Issuance of Permit	1 day
	Joint 401WQC/Chapter 91 License (BC)	
1	Submit Application	1 Day
2	Administrative Review	30 days
3	Public Notice	30 Days
4	Technical Review	96 Days
5	Issuance of License	1 day
	Joint 401WQC/Chapter 91 License (WC)	
1	Submit Application	1 Day
2	Administrative Review	30 days
3	Administrative Review Deficiencies	60 days
4	Administrative Review 2	30 days
5	Public Notice	30 Days
6	Technical Review	96 Days
7	Technical Review Deficiencies	60 days
8	Technical Review 2	96 days
9	Issuance of License	1 day
	LOCAL CONSERVATION COMMISSION	
1	Submit Notice of Intent	1 Day
2	1st Public Hearing	15 Days
3	2nd Public hearing	15 Days
4	Issuance of Order of Conditions	15 Days

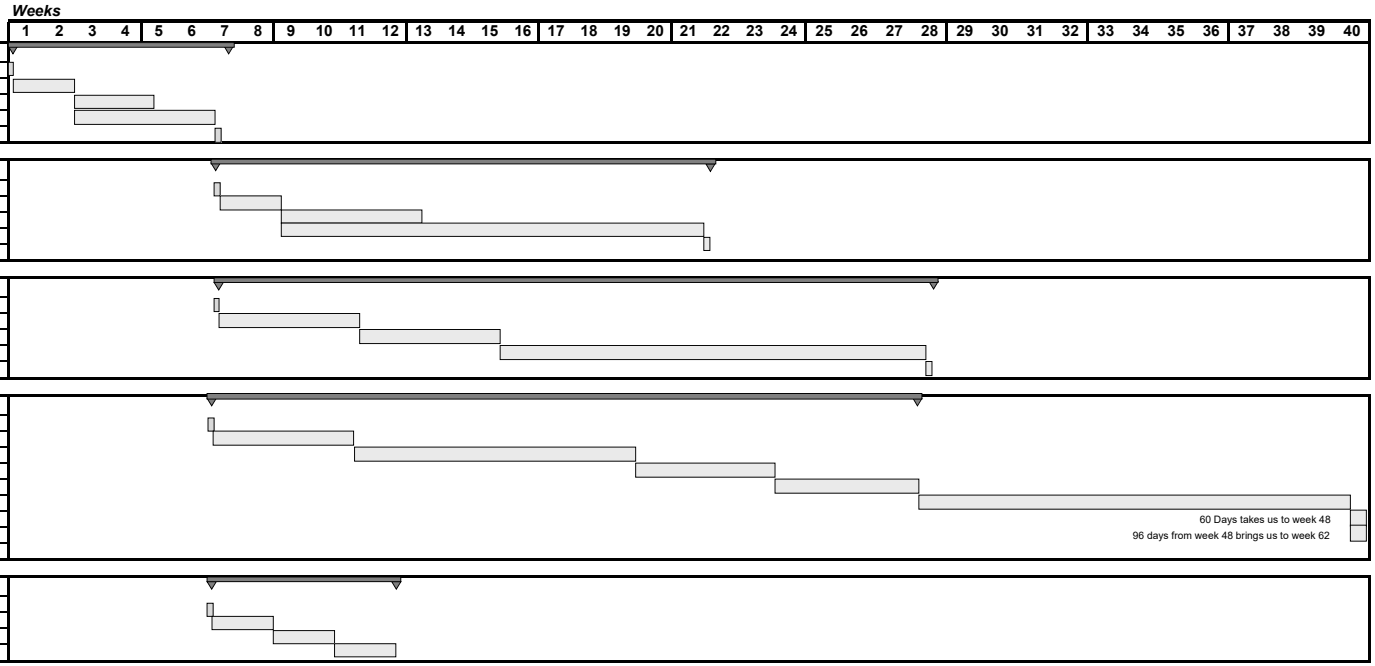
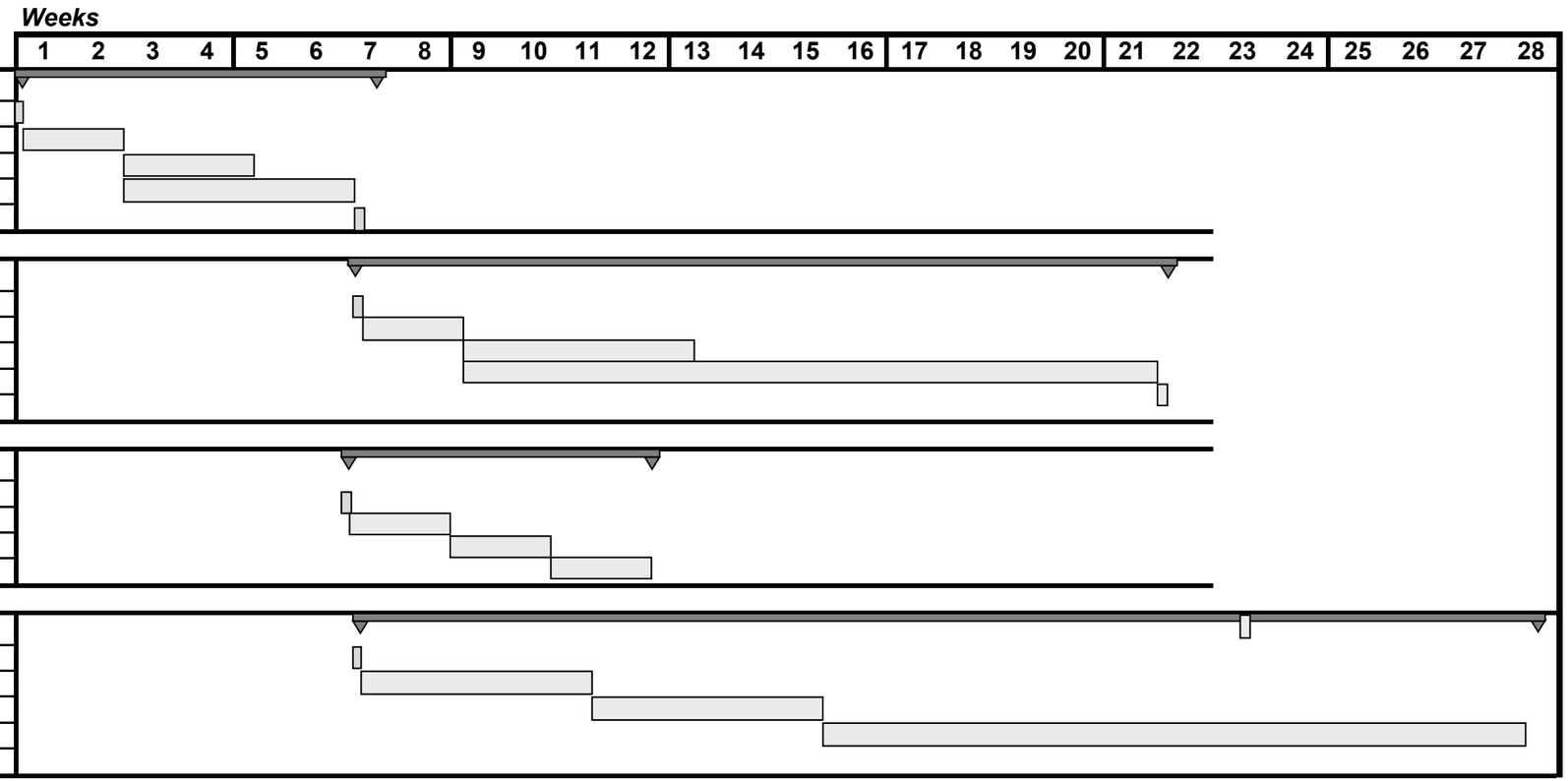


Table 2: Project Specific Environmental Agency Review Timeline: Peabody MVP - North River Canal - South Wall Project (for sheet pile wall, cantilever retaining wall, and masonry block wall options)

ID No.	Task / Review	Duration
	MEPA APPROVAL	
1	Submit ENF	1 Day
2	Environmental Monitor	15 days
3	Comment Period	20 days
4	Review of ENF	30 days
5	Secretary's Certificate	1 Day
	Army Corp Individual Permit	
1	Submit Pre-Construction Notification	1 Day
2	Public Notice	15 days
3	Public Comment	30 days
4	Agency Review	60-90 days
5	Issuance of Permit	1 day
	LOCAL CONSERVATION COMMISSION	
1	Submit Notice of Intent	1 Day
2	1st Public Hearing	15 Days
3	2nd Public hearing	15 Days
4	Issuance of Order of Conditions	15 Days
	401WQC	
1	Submit Application	1 Day
2	Administrative Review	30 days
3	Public Notice	30 Days
4	Technical Review	96 Days
5	Issuance of License	1 day



APPENDIX C

Resilience Evaluation Report

Weston & Sampson

westonandsampson.com

5 Centennial Drive
Peabody, MA 01960 (HQ)
tel: 978.532.1900

REPORT

March 2019

CITY OF
Peabody
MASSACHUSETTS

Municipal Vulnerability Preparedness Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park – Resilience Evaluation



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\\wse03.local\WSE\Projects\MA\Peabody MA\MVP Action Grant 2018\Task 1 - Resilience Evaluation\Report\Compensatory Storage Report\Compensatory Storage Report FINAL 2019.02.28.docx

EXECUTIVE SUMMARY

To address the City's priority action of addressing flooding along the North River Canal and to enable the City to address climate change and continue its efforts to increase resilience against flooding in the watershed, Weston & Sampson conducted an evaluation of the floodplain along the proposed 1,600-foot long park adjacent to the canal. The evaluation assessed the suitability and potential benefit of incorporating additional flood storage capacity in both the rehabilitation alternatives for the southern canal wall as well as on nearby public and private properties. This evaluation considered both existing and future potential climate conditions. In general, increasing flood storage has the potential to reduce peak flood levels, thereby decreasing potential damage downstream and, to a lesser degree, upstream of the storage site. Based on our evaluation, we have identified the following conclusions:

- Under existing climate conditions and under expected mid-century conditions, flooding in the North River Canal will largely be a function of runoff generated upstream – riverine flooding. However, by the end of the 21st century, tidal flooding due to sea level rise is expected to equal or exceed riverine flooding in the project area. Ultimately, the creation of additional flood storage may provide a modest benefit to the properties and infrastructure in the study area in the short- and medium-term, but those benefits are significantly reduced over the long-term.
- The creation of additional flood storage in and/or near the North River Canal is only effective in areas of riverine flooding. Projects that create compensatory storage and projects that floodproof flood prone properties will have a greater and longer lasting benefit the further upstream they are.
- The relative benefit of compensatory storage created by the eight alternatives for rehabilitating the North River Canal's southern wall should be considered in the cost-benefit analysis and alternative selection process.
- There may be value in conducting a detailed assessment of potential site-specific compensatory storage and flood control designs, including geotechnical, contamination/remediation, hydrologic and hydraulic, city planning, and cost-benefit analyses among others.
- Given the significant total riverine flood volumes in the early- and mid-century periods and the relatively modest compensatory storage that could be created by the southern retaining wall alternatives and the individual site projects explored above, it would be worth evaluating the cost-benefit of floodproofing individual buildings rather than eliminating flooding on a parcel scale. This type of floodproofing would also allow individual property owners to take on some responsibility for flooding impacts on their property.
- In light of the anticipated significant increase in tidal flooding in the study area by the end of the century, as opposed to riverine flooding, it may be worth evaluating "retreat" alternatives in more detail. On a related note, it may be worth evaluating the potential benefit of a tide gate to limit tidal flooding under future climate conditions.

1.0 INTRODUCTION

The City of Peabody has suffered from recurring flooding since the 1950's with most significant flooding occurring downtown in Peabody Square in the vicinity of Foster Street and Walnut Street. Post-World War II development as well as the North River Canal's poor condition and limited ability to handle storm flows in downtown Peabody are major contributors to the flooding problem in Peabody Square (City of Peabody, 2002). With significant floods occurring in 1954, 1968, 1979, 1987, and 1996, the City's Hazard Mitigation Plan has identified flooding as the City's top natural hazard mitigation priority (MAPC, 2016). Under climate change, flooding events have become more frequent, with several events occurring within the past fifteen years, including the Mother's Day Storm of 2006 which incapacitated the downtown area for more than a week. More recently, in March 2010, October 2011, and December 2014, downtown flooding occurred from short duration and high intensity rain events. Flooding events in Peabody regularly put a strain on area businesses and on Fire and Police Department staff who must respond to emergencies.

End-of-century climate change projections indicate that the annual precipitation will increase by as much as 7 inches and there will be up to four additional 1-inch storms each year (NECSC, 2018). In the highly urbanized Peabody Square, this increased precipitation will exacerbate stormwater runoff and result in increased peak streamflows in the North River Canal, leaving the City even more vulnerable to riverine flooding.

Climate change projections indicate that, by 2100, mean sea level rise in Boston Harbor since 2000 is unlikely to exceed (83% probability) 4.0 feet although it could be as high as 10.2 feet (NECSC). This is in addition to the documented increase in relative sea level rise of more than 11 inches (2.83 millimeters or 0.11 inches annually) that occurred in Boston Harbor between 1921 and 2018 (NOAA gage #8443970).

The 11.5-square-mile North River watershed drains land primarily east of Route 1, flowing downstream through Salem until it reaches Salem Sound of the North Coastal Basin. Closer to Salem, the North River Canal is tidally influenced. However, sea level rise is expected to cause the zone of tidal influence to migrate upstream in the North River Canal. Peabody Square, which is already prone to significant flooding during storm events, could experience an even higher likelihood of extreme flooding under scenarios involving both high tides and extreme precipitation.

Participants at the City of Peabody's April 11, 2018 Municipal Vulnerability Preparedness (MVP) Workshop identified seven "highest priority" actions. At the top of their list was:

> *"Evaluate and assess alternatives for managing commonly flooded areas and flood-impacted public safety concerns located throughout the City, including along the North River Canal, within the Lawrence Brook Watershed, in the downtown area, and along various brook channels (Horsley Witten Group, 2018)."*

To address the City's priority action of addressing flooding along the North River Canal and to enable the City to address climate change and continue its efforts to increase resilience against flooding in the watershed, Weston & Sampson conducted an evaluation of the floodplain along the proposed 1,600-foot long park adjacent to the canal, identified in Figure 1. The evaluation assessed the suitability of incorporating additional flood storage capacity under existing and future potential climate conditions.

Increasing flood storage has the potential to reduce peak flood levels, thereby decreasing potential damage downstream and, to a lesser degree, upstream of the storage site. This evaluation consists of three sub-tasks: 1) identify a suitable range of design events under existing and potential future climate scenarios, 2) identify flood levels throughout the study area associated with each of the selected design events, and 3) conduct a GIS-based analysis of potential opportunities for flood storage.

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2.0 CLIMATE SCENARIO SELECTION

Weston & Sampson collaborated with both the City of Peabody and the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), the funding agency, to identify a suitable range of design events that considered both existing and potential future climate scenarios. Selection of suitable design events considered multiple sources of flooding, including rainfall-driven runoff from the North River watershed, tidal influences and sea level rise (SLR), and storm surge. The selection process also included significant research into regional and local evaluations of the potential impact of climate change on a variety of meteorological and hydrological processes. A detailed discussion of the selection process is described in a Weston & Sampson memo, "MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park 2018 Resiliency Evaluation – Climate Scenario Selection," dated January 10, 2019. That memo is included in Appendix A. Ultimately, six climate scenarios were selected for incorporation into the compensatory storage analysis.

- Scenario 1A: Existing Conditions, 50-year flood
- Scenario 1B: Existing Conditions, 100-year flood
- Scenario 2: 2050 Moderate Climate Change for precipitation and SLR, 50-year flood
- Scenario 3: 2050 High Climate Change for precipitation and SLR, 100-year flood
- Scenario 4: 2100 Moderate Climate Change for precipitation and SLR, 50-year flood
- Scenario 5: 2100 High Climate Change for precipitation and SLR, 100-year flood

These six scenarios offer a broad range of possible outcomes under climate change and will enable a more robust analysis of resiliency alternatives. Scenarios 1A and 1B, which represent existing conditions during the 50- and 100-year flood events, respectively, provide a baseline for comparison of the future scenarios. They also represent a "best-case scenario," during which any flood storage measures will have the maximum impact. As climate change advances through the remainder of the 21st century and results in increased SLR and more extreme precipitation events, those benefits are expected to decrease.

The future climate scenarios (Scenarios 2 through 5) were selected to evaluate the potential future benefit of flood storage as a function of the degree to which climate change will occur. We have developed a moderate scenario and a high impact scenario. Under those scenarios, changes in rainfall and riverine discharge are consistent with a medium emissions pathway (RCP4.5) and a high emissions pathway (RCP8.5), respectively. Estimates of sea level rise are consistent with "Intermediate-High" and "High" scenarios, respectively, as defined in Table 6 of the Massachusetts Climate Change Projections (NECSC, 2018), which is reproduced in the graphic below. These moderate and high scenarios were chosen to give the City a sense for how the effectiveness of flood storage measures might change depending on the severity of future climate change impacts. The moderate scenario was paired with 50-year flooding conditions as the smaller storm was determined to offer a more achievable condition for which to develop flood mitigation designs at this site. The high scenario was paired with the 100-year flooding conditions to highlight the effectiveness of flood mitigation designs under worst-case conditions. We have also selected time horizons that represent potential climate conditions during both mid-century (2050) and end of century (2100) to give the City an idea of the effectiveness of flood storage measures over time.

Relative mean sea level (feet NAVD88)	
Scenario	Cross-walked probabilistic projections
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)
	• Extremely unlikely to exceed (95% probability) given a medium emissions pathway (RCP 4.5) • Unlikely to exceed (83% probability) given a medium emissions pathway (RCP 4.5) • About as likely as not to exceed (50% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible higher ice sheet contributions to sea level rise
Intermediate - High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)
	• Unlikely to exceed (83% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible higher ice sheet contributions to sea level rise • About as likely as not to exceed (50% probability) given a high emissions pathway (RCP 8.5) when accounting for higher possible ice sheet contributions to sea level rise
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)
	• Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5) when accounting for possible higher ice sheet contributions to sea level rise • Extremely unlikely to exceed (95% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible higher ice sheet contributions to sea level rise
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)
	• Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP8.5) when accounting for possible higher ice sheet contributions to sea level rise

This graphic is copied from Table 6 of the Massachusetts Climate Change Projections (NECSC, 2018).

3.0 FLOODING PROFILES

For each of the six design events identified above, Weston & Sampson determined flood levels throughout the 1,600-foot long study area. The methodologies varied for each event, based on the best available estimates of riverine flood levels and/or discharge magnitudes and on estimated high tide levels. The methodology and datasets used to prepare flooding profiles are described on a scenario-by-scenario basis below. Flood profiles for each scenario are provided in Appendix B.

3.1 Scenario 1A – Existing Conditions, 50-year Flood

Existing 50-year flood elevations are controlled by precipitation and the resulting runoff. Riverine flooding levels, caused by upgradient precipitation, were determined from the effective FEMA Flood Insurance Study (25009CV004B), which was updated most recently on July 16, 2014. These 50-year flood levels ranged from 16.6 ft. NAVD88 upstream of Wallis Street to El. 11.0 at Howley Street. *Note that all elevations identified in this report reference the height in feet above mean sea level on the North American Vertical Datum of 1988 (NAVD88).* Coastal flooding does not impact the study area during existing 50-year flood conditions.

3.2 Scenario 1B – Existing Conditions, 100-year Flood

Existing 100-year flood elevations are controlled primarily by precipitation and the resulting runoff. Riverine flooding levels, caused by upgradient precipitation, were determined from the effective FEMA Flood Insurance Study. These 100-year flood levels ranged from 17.4 ft. upstream of Wallis Street to El. 11.5 ft. at Howley Street. Coastal flooding does not significantly impact the study area during existing 100-year flood conditions.

3.3 Scenario 2 – 2050 conditions under a moderate climate change scenario

Precipitation under this scenario saw an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 9.4 inches (Cambridge, Part 1 Appendix, 2015), a 23.7% increase. It was assumed that this change would result in a corresponding increase in generated runoff. A 23.7% increase in riverine discharge in the project area would cause the FEMA 50-year flood flow to increase from 880 to 1,089 cubic feet per second (cfs). Based on the discharges associated with the 100-year (1,030 cfs) and 500-year (1,470 cfs) events, as reported in the FEMA Flood Insurance Study, the 50-year flood under this future climate scenario would be approximately equal to the current 153-year flood event. Weston & Sampson interpolated between the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 50-year riverine flood levels ranged from 17.6 ft. upstream of Wallis Street to El. 11.6 at Howley Street, an increase of 0.6 to 1.0 ft. over Scenario 1A.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2050 under this scenario is expected to be El. 1.7 ft NAVD88 or 1.7 feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 11.67 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding only at the very downstream end of the project area. The estimated flood profile was adjusted accordingly.

3.4 Scenario 3 – 2050 conditions under a high climate change scenario

Increases to the 100-year riverine discharge were assumed to reach 35%, the maximum predicted increase for the 2055 time horizon (BRAG, 2016). A 35% increase in riverine discharge in the project area would result in an increase in the FEMA 100-year flood flow from 1,030 to 1,391 cfs. Based on the

discharges associated with the 100- and 500-year events, as reported in the FEMA Flood Insurance Study, the 100-year flood under this future climate scenario would be approximately equal to the current 428-year flood event. Weston & Sampson interpolated between the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 100-year riverine flood levels ranged from 18.5 ft. upstream of Wallis Street to El. 12.2 at Howley Street, an increase of 0.7 to 1.1 ft. over Scenario 1B.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2050 under this scenario is expected to be El. 2.4 ft NAVD88 or 2.4 feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 12.37 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding only at the very downstream end of the project area. The estimated flood profile was adjusted accordingly.

3.5 Scenario 4 – 2100 conditions under a moderate climate change scenario

Precipitation under this scenario saw an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 10.9 inches (Cambridge, Part 1 Appendix, 2015), a 43.4% increase. It was assumed that this change would result in a corresponding increase in generated runoff. A 43.4% increase in riverine discharge in the project area would cause the FEMA 50-year flood flow to increase from 880 to 1,262 cfs. Based on the discharges associated with the 100-year (1,030 cfs) and 500-year (1,470 cfs) events, as reported in the FEMA Flood Insurance Study, the 50-year flood under this future climate scenario would be approximately equal to the current 311-year flood event. Weston & Sampson interpolated between the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 50-year riverine flood levels ranged from 18.1 ft. upstream of Wallis Street to El. 12.0 at Howley Street, an increase of 1.0 to 1.5 ft. over Scenario 1A.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2100 under this scenario is expected to be El. 5.0 ft NAVD88 or 5.0 feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 14.97 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding up to the Caller Street bridge crossing. The estimated flood profile was adjusted accordingly.

3.6 Scenario 5 – 2100 conditions under a high climate change scenario

Increases to the 100-year riverine discharge were assumed to reach 70%, the maximum predicted increase for the 2085 time horizon (BRAG, 2016). A 70% increase in riverine discharge in the project area would cause the FEMA 100-year flood flow to increase from 1,030 to 1,751 cfs. Based on the discharges associated with the 100- and 500-year events, as reported in the FEMA Flood Insurance Study, the 100-year flood under this future climate scenario would be approximately equal to the current 755-year flood event. Weston & Sampson extrapolated from the FEMA flood profiles of the 100-year and 500-year to estimate flood levels in the project area under this scenario; 100-year riverine flood levels ranged from 19.7 ft. upstream of Wallis Street to El. 13.0 at Howley Street, an increase of 1.5 to 2.3 ft. over Scenario 1B.

The extents of tidal flooding were estimated by adding the predicted change to mean sea level under this scenario to the baseline Mean Higher High Water (MHHW) elevation, El. 9.97 ft. (Metcalf & Eddy-AECOM, 2008). Mean sea level in 2100 under this scenario is expected to be El. 7.6 ft NAVD88 or 7.6

feet higher than mean sea level in 2000, resulting in a MHHW of approximately El. 17.57 ft. Based on the increased riverine flooding levels, sea level rise would be expected to increase flooding upstream as far as the railroad bridge crossing near Wallis Street. The estimated flood profile was adjusted accordingly.

4.0 FLOODING EXTENTS

It is important to note that the areas of riverine and tidal flooding presented in Table 1 were calculated only for flooding within the study area. It is true that riverine flooding in the subject area will decrease under future climate conditions. However, that is only because tidal flooding is expected to increase significantly. In fact, the total area subject to flooding of any kind is expected to increase under future climate conditions. In addition, while this evaluation focused only on our 1600-foot long study area, riverine flooding is likely to increase significantly in upstream areas.

Table 1: Summary of Area Flooded			
Scenario	Area (acres) Subject to Flooding		
	Riverine Flooding	Tidal Flooding	Total
1A	17.8	0.0	17.8
1B	19.4	0.0	19.4
2	19.6	0.4	20.0
3	22.4	0.8	23.2
4	11.2	12.4	23.6
5	2.9	25.4	28.3

*Areas calculated for inundation extents within the study area only.

The flooding anticipated under all six scenarios evaluated is expected to impact several residences and businesses in the study area. Table 2 summarizes the number of buildings impacted by both riverine and tidal flooding.

Table 2: Summary of Buildings Flooded			
Scenario	Number of Buildings Flooded		
	Riverine Flooding	Tidal Flooding	Total
1A	23	0	23
1B	25	0	25
2	28	2	28
3	32	2	32
4	17	18	32
5	6	33	39

*The total number of buildings flooded may not equal the sum of buildings subject to riverine flooding and tidal flooding as some buildings may be subject to both.

As shown in Table 2, under current climate conditions (Scenarios 1A and 1B) all buildings in the floodplain of the study area are expected to be impacted by riverine flooding, caused by stormwater runoff generated upstream. This condition remains largely true through 2050 (Scenarios 2 and 3), where only 2 buildings are affected by tidally influenced flooding. However, as tidal influences extend significantly further upstream into the study area near the end of the century (Scenarios 4 and 5), more buildings are impacted by tidewater moving up the North River Canal rather than stormwater runoff coming down from the North River and Proctor Brook watersheds. Even though the number of buildings impacted by riverine flooding is expected to decrease under late-century climate conditions (Scenarios 4 and 5), the total number of buildings impacted is still expected to increase. In addition, while not evaluated in this report, increased riverine flooding and association impacts would be expected upstream of the study area under future climate conditions.

It is also important to note that the increased tidal flooding extents identified for late-century climate conditions (Scenarios 4 and 5) in particular may also cause a backwater effect further upstream both within the study area and beyond. And even though the predicted riverine flood level exceeds the predicted MHHW, the presence of the tidal backwater reduces the discharge capacity of the North River Canal, resulting in worse flooding than what is represented in Tables 1 and 2 and elsewhere in this report.

5.0 FLOODING IMPACTS

To further evaluate the potential impacts to flooded buildings, Weston & Sampson considered the estimated depth of flooding at each building. By subtracting the gridded dataset of flood levels in the project area for each scenario by the best available ground elevation data (LiDAR), we developed a gridded GIS dataset of the depth of flooding throughout the 1,600-foot long project area for each scenario, as shown in Figures 2A through 2F.

We estimated the potential impacts to buildings flooded under each scenario by considering how many buildings are flooded to maximum depths of less than 2 feet, between 2 and 5 feet, and more than 5 feet. The maximum flooding depth for each building was estimated by subtracting the maximum predicted flood elevation by the lowest ground elevation (LiDAR) within each building's footprint, or partial footprint for those buildings straddling the line between riverine and tidal flooding. These comparisons are summarized in Table 3.

Table 3: Summary of Building Flooding Depths						
Scenario	Number of Buildings Flooded					
	Depth of Riverine Flooding (ft.)			Depth of Tidal Flooding (ft.)		
	<= 2	2 – 5	>=5	<= 2	2 – 5	>=5
1A	9	12	2	0	0	0
1B	8	15	2	0	0	0
2	10	15	3	1	0	1
3	13	16	3	0	1	1
4	5	11	1	7	8	3
5	3	2	1	5	9	19

*The total number of buildings flooded may not equal the sum of buildings subject to riverine flooding and tidal flooding as some buildings may be subject to both.

As Table 3 indicates, a significant portion of affected buildings experience less than 2 feet of flooding under all scenarios. Those buildings subject to shallow riverine flooding conditions are most likely to benefit from compensatory storage, floodproofing, or other flood resiliency projects. However, with the exception of Scenario 5, the majority of buildings subject to riverine flooding experience a maximum of 2-5 feet of flooding. The projects needed to eliminate or reduce flooding damage to those structures would likely be more significant in scope and costlier. The most challenging situations, those involving buildings subject to more than 5 feet of riverine flooding, are projected to occur less frequently, representing 8-17% of impacted buildings depending on the scenario.

Table 3 also indicates the fact that the impacts of tidally-influenced flooding are projected to be relatively uncommon through the middle of the century. However, of those 18 and 33 buildings likely to be impacted by tidal flooding by 2100 – Scenarios 4 and 5, respectively – the majority of those buildings

are projected to be inundated by more than 2 feet, making resilience or floodproofing projects more challenging and costlier.

As one of the goals of this project was to evaluate the potential benefit of creating compensatory storage, Weston & Sampson also evaluated the volume of flooding experienced on a parcel-by-parcel basis. A total of 58 parcels were determined to fall partially or fully within the study area; they are shown in Figure 3. The flood volume on each parcel within the study area was estimated by multiplying the area of each portion of parcel expected to be flooded by the average depth of flooding. Table 4 summarizes the estimated flood volume by parcel for each of the six scenarios.

In total, Scenarios 1A, 1B, 2, 3, 4, and 5 are associated with 23.3, 30.8, 32.5, 45.2, 19.9, and 4.7 acre-feet of riverine flooding, respectively. It is telling to note that riverine flooding volumes in the study area peak under mid-century conditions (Scenarios 2 and 3), before sharply declining late century (Scenarios 4 and 5) as tidal flooding takes on a far more significant role. This observation, combined with the large total volume of riverine flooding in the early- and mid-century scenarios, suggests that creating compensatory storage and then developing flood control structures to eliminate flooding in the study area may be difficult. Alternative flood mitigation measures such as floodproofing individual buildings or retreat may be required instead. It is also important to note that the depth of flooding at buildings and the volume of flooding on parcels upstream of the study area are expected to increase under future climate conditions.

Table 4: Summary of Parcel Flooding Volumes						
Parcel ID	Estimated Flooding Volume (acre-feet) by Scenario					
Total	1A	1B	2	3	4	5
085-008	23.312	30.762	32.473	45.212	19.911	4.655
085-008A	0.021	0.041	0.046	0.098	0.073	T
085-008B	0.333	0.416	0.433	0.549	0.502	T
085-009	0.076	0.117	0.126	0.198	0.169	T
085-010	0.025	0.052	0.058	0.102	0.085	T
085-011	0.059	0.106	0.124	0.279	0.213	T
085-011	0.175	0.271	0.304	0.520	0.425	0.090
085-016	0.175	0.271	0.304	0.520	0.425	0.090
085-026	0.000	0.004	0.005	0.013	0.009	0.017
085-028	0.036	0.071	0.081	0.124	0.105	0.148
085-032	0.102	0.153	0.166	0.257	0.225	T
085-033	0.131	0.172	0.182	0.245	0.220	T
085-034	0.062	0.115	0.129	0.207	0.175	T
085-035	0.119	0.170	0.180	0.252	0.221	T

Table 4 cont.: Summary of Parcel Flooding Volumes						
Parcel ID	Estimated Flooding Volume (acre-feet) by Scenario					
Total	1A	1B	2	3	4	5
085-036	0.494	0.603	0.625	0.780	0.716	T
085-037	1.490	1.787	1.853	2.281	2.115	T
085-038	3.612	4.122	4.261	5.061	4.761	T
085-038	0.351	0.500	0.566	0.848	0.716	0.392
085-039X	0.351	0.500	0.566	0.848	0.716	0.392
085-041	1.493	2.006	2.119	2.851	2.548	T
085-041	0.464	0.546	0.593	0.786	0.692	0.290
085-041A	0.464	0.546	0.593	0.786	0.692	0.290
085-042	0.242	0.402	0.464	0.983	0.730	T
085-043	NF	0.008	0.016	0.494	0.258	0.989
085-044	0.358	0.587	0.652	0.939	0.809	1.138
085-045	0.093	0.127	0.136	0.175	0.157	0.198
085-050A	0.100	0.139	0.149	0.197	0.175	0.228
085-060	0.028	0.045	0.050	0.070	0.061	0.080
085-060B	NF	NF	NF	0.008	0.000	0.026
085-065	0.000	0.024	0.038	0.140	0.086	0.213
085-066	NF	NF	NF	NF	NF	0.001
085-067	NF	NF	NF	0.002	NF	0.033
085-068	NF	NF	NF	NF	NF	0.010
085-068	NF	NF	NF	0.000	NF	0.016
085-072	NF	NF	NF	0.000	NF	0.016
085-280	NF	NF	NF	NF	NF	T
085-700-701	0.000	0.003	0.003	0.016	0.010	T
086-001	NF	NF	NF	NF	NF	T
086-002	0.041	0.071	0.078	0.140	0.112	T
086-020X	NF	NF	NF	0.001	0.000	5
086-136	NF	NF	NF	0.000	NF	T
086-137	2.024	2.413	2.091	2.066	T	T
086-138	0.031	0.052	0.058	0.100	T	T

Table 4 cont.: Summary of Parcel Flooding Volumes						
Parcel ID	Estimated Flooding Volume (acre-feet) by Scenario					
Total	1A	1B	2	3	4	5
086-140X	0.095	0.154	0.170	0.322	T	T
086-141	3.416	4.485	5.003	7.241	0.354	T
086-142	0.392	0.609	0.675	0.989	T	T
086-142A	0.056	0.122	0.164	0.401	T	T
086-142B	0.994	1.355	1.463	2.037	1.260	T
086-143	0.075	0.204	0.275	0.641	0.096	T
086-144	NF	0.000	0.002	0.037	T	T
086-150	NF	NF	NF	NF	NF	T
086-150A	3.844	5.147	5.458	7.350	T	T
086-150B	1.040	1.405	1.483	1.996	T	T
086-151X	NF	NF	NF	0.000	T	T
086-155	0.067	0.115	0.134	0.340	T	T
086-160	0.000	0.000	0.000	0.001	T	T
086-162	0.016	0.030	0.033	0.052	T	T
086-600-647	0.350	0.613	0.448	0.568	T	T
086-002	0.016	0.083	0.113	0.300	T	T

NF – Not Flooded. T – Tidal flooding only; volume not calculated.

6.0 FLOOD MITIGATION

As described in detail above, the anticipated impacts of flooding under the six evaluated scenarios are significant. Riverine flooding in the project area is caused by upstream stormwater runoff exacerbated by insufficient channel capacity (Metcalf & Eddy-AECOM, 2008). Mitigating these impacts can be accomplished through a variety of approaches, some of which are discussed in the following sub-sections.

6.1 Channel Improvements

Channel improvements consist of modifications that might be made to the North River Canal and/or Proctor Brook channel to increase their hydraulic capacities to discharge stormwater runoff downstream. Improvements may take the form of channel widening, modification of stream crossings, and the construction of subterranean conduits among others. These channel improvement concepts and the potential benefit to riverine flooding impacts are not the focus of this project but were studied at length by the City in 2008 (Metcalf & Eddy-AECOM, 2008). If such channel improvements were undertaken to increase the discharge capacity of the North River Canal, downstream flooding may increase so coordination with downstream communities will be necessary.

6.2 Compensatory Storage

“Compensatory storage” or “compensatory flood storage” are regulatory terms used by FEMA and by the Massachusetts Department of Environmental Protection, respectively, to describe the development of additional flood storage that is designed to offset the construction of new or improved buildings and structures within the nearby regulatory floodway. It is important to note two key caveats in evaluating the potential benefit of compensatory storage. First, the benefits are generally only felt downstream or cross-stream. It is unlikely that the benefit of additional flood storage and reduced downstream discharge would propagate upstream of a project site. And second, compensatory storage provides little to no benefit in a tidally-influenced reach as occurs in a portion of the study area under Scenarios 2, 3, 4, and 5.

Weston & Sampson has evaluated the potential benefit of creating compensatory storage specifically through its rehabilitation of the North River Canal’s southern retaining wall as well as other hypothetical projects in several adjacent parcels. As the creation of compensatory storage may be paired with the construction of flood control measures designed to protect one or more parcels from riverine flooding, Weston & Sampson has estimated the potential benefit of the various compensatory storage measures described below in terms of both the volume of storage created but also in terms of the maximum number of parcels that might be removed from the floodplain without increasing downstream flooding impacts. The maximum number of parcels that could be protected was determined for each scenario by sorting the parcels in ascending order of their total flooded volumes and adding them together one at a time, starting with the least flooded parcel, until the total volume equaled the created compensatory storage. Note that no consideration was given to the feasibility or cost of the structures or measures that would be required to protect those parcels. Nor was any consideration given to the value or current use of a parcel or portion of a parcel that could be protected.

6.2.1 *Southern Retaining Wall Alternatives*

The City of Peabody intends to repair the south side of the North River Canal. Weston & Sampson evaluated a total of eight (8) alternatives, including multiple variations of riprapped slopes, vegetative berms, and sheet pile walls, as well as a concrete cantilever retaining wall and a stone masonry wall.

- Alternative A consists of 3-foot thick layer of 8- to 24-inch rip rap placed on a slope of 1 vertical to 1.5 horizontal. This alternative requires the removal of the existing south wall. Two options are considered for the location of the bottom of the rip rap slope. Option 1 is to set the bottom of the slope at the location of the existing wall which will provide some additional flood storage. Option 2 is to set the bottom of the slope into the river, providing no additional flood storage and requiring fill within the waterway.
- Alternative B is similar to Alternative A except the rip rap slope for this alternative will stop at approximately 3.5 feet above the river bed with a vegetative berm extending to the top of the slope at a slope of 1 vertical to 3 horizontal. This alternative requires the removal of the existing south wall. Alternative B, like Alternative A, has the same two options for the location of the bottom of slope.
- Alternative C Option 1 consists of a sheet pile wall installed behind the existing wall to an approximate depth of 20 feet below the top of slope. A concrete coping would be constructed along the top of the sheet pile wall and the existing wall structure would be removed, providing a small increase in flood storage. Alternative C Option 2 consists of a sheet pile wall installed behind the existing wall, extending 2-feet above ground and 13-feet below ground. A rip rap slope or vegetated berm, much like Alternative A and B, would then extend from the top of the sheet pile to the top of bank, creating additional flood storage.
- Alternative D consists of removing the existing stone masonry wall and constructing a concrete cantilever retaining wall in the same location. The stem of the concrete wall will be approximately 14 inches wide at the top and about 30 inches wide at the base, extending down to a concrete footing 4 feet below the streambed. This alternative would provide no additional flood storage space.
- Alternative E consists of removing the existing stone masonry wall and constructing a new stone masonry wall on a concrete footing in the same location. The stem of the wall will be approximately 20 inches wide at the top and 4 feet at the base, extending down to a concrete footing 4 feet below the streambed. This alternative would provide no additional flood storage space.

Table 5A summarizes the compensatory storage associated with each of the eight alternatives as well as the potential maximum number of parcels that could be protected as a result.

Of the eight wall alternatives evaluated, six of them involved the creation of additional flood storage. The volume of that new storage ranged from 0.037 acre-feet (Alternatives A, Option 1 and Alternative B, Option 2) to 0.735 acre-feet (Alternative B, Option 1. As shown in Table 5A, the number of parcels that might be protected with the compensatory storage associated with the various wall options ranged from 3 to 19, depending on the climate scenarios. However, the number of parcels benefited does not necessarily tell the whole story as the number of parcels impacted by riverine flooding varies considerably under the various climate scenarios. The potential benefit of each wall alternative's created compensatory storage is therefore compared against the percentage of parcels that might be protected in Table 5B.

Table 5A: Southern Retaining Wall Alternatives Compensatory Storage (# Parcels)							
Wall Alternative	Compensatory Storage Created (acre-feet)	Maximum # Of Parcels Protected by Scenario					
		1A	1B	2	3	4	5
Alt A – Rip Rap Option 1	0.661	18	15	14	17	11	11
Alt A – Rip Rap Option 2	0.037	6	5	5	9	4	3
Alt B – Vegetative Berm Option 1	0.735	19	16	15	17	11	12
Alt B – Vegetative Berm Option 2	0.037	6	5	5	9	4	3
Alt C – Sheet Pile Wall Option 1	0.312	13	11	11	14	7	9
Alt C – Sheet Pile Wall Option 2	0.735	19	16	15	17	11	12
Alt D – Concrete Cantilever Wall	0.000	---	---	---	---	---	---
Alt E – Stone Masonry Wall	0.000	---	---	---	---	---	---

Table 5B: Southern Retaining Wall Alternatives Compensatory Storage (% of Parcels)							
Wall Alternative	Compensatory Storage Created (acre-feet)	Maximum # Of Parcels Protected by Scenario					
		1A	1B	2	3	4	5
Alt A – Rip Rap Option 1	0.661	41%	33%	30%	32%	31%	55%
Alt A – Rip Rap Option 2	0.037	14%	11%	11%	17%	11%	15%
Alt B – Vegetative Berm Option 1	0.735	43%	35%	33%	32%	31%	60%
Alt B – Vegetative Berm Option 2	0.037	14%	11%	11%	17%	11%	15%
Alt C – Sheet Pile Wall Option 1	0.312	30%	24%	24%	26%	20%	45%
Alt C – Sheet Pile Wall Option 2	0.735	43%	35%	33%	32%	31%	60%
Alt D – Concrete Cantilever Wall	0.000	---	---	---	---	---	---
Alt E – Stone Masonry Wall	0.000	---	---	---	---	---	---

As shown in Table 5B, an estimated 44 and 46 parcels experience riverine flooding in the study area during the 50-year and 100-year storm events, respectively, under existing climate conditions (Scenarios 1A and 1B). The number of impacted parcels that could benefit from compensatory storage is expected to increase to 46 and 53 by mid-century (Scenarios 2 and 3) before declining sharply to 35 and 20 by the end of the century. The decrease in the number of parcels subjected to riverine flooding that would benefit from compensatory storage is attributed to the anticipated rise in sea level and associated tidal flooding. Despite increased overall flooding in late century, compensatory storage will not provide a benefit in flooding conditions that are driven by the ocean.

The percentage of parcels that may be protected from riverine flooding by taking advantage of the compensatory storage created by the various wall alternatives ranges from 11% to 60% with an average of 27%. As the retaining wall runs nearly the entire length of the 1,600-foot long site, it is not unreasonable to expect that most parcels are located cross-stream or downstream of the wall and could therefore potentially take advantage of the compensatory storage created.

6.2.2 *Public Property*

In addition to additional storage that may be created by repairs, rehabilitation, and/or replacement of the existing retaining wall on the south side of the canal, Weston & Sampson evaluated the potential benefit of developing compensatory storage on two City-owned parcels near the North River Canal – the East End Peabody Veterans Memorial Park and the Mill Street Municipal Parking Lot (Figure 4).

The East End Peabody Veterans Memorial, created on the site of a former tannery, was unveiled in a dedication ceremony in May 2013. The park includes a paved circular walkway, benches, granite boulders, and an elevated wooden deck, although the site's land cover is generally grass with some trees (The Salem News, 2013). Creating additional flood storage at this site would involve excavating material, primarily in grass covered areas, and then restoring the existing public open space.

Weston & Sampson estimated the limits of the hypothetical storage area, as shown in Figure 4, based on a 25-foot setback from the property boundary and manually modifying it to avoid the more developed portions of the park like the wooden deck and stage and the impervious gathering area near the Walnut Street entrance. The area of the potential storage site is 0.53 acres, approximately 40% of the parcel. Based on LiDAR ground elevations, the average elevation of the potential storage site is El. 11.8. The FEMA Flood Insurance Study river profile of the North River indicates that the canal bottom is at approximately El. 8.5; we assumed that the potential storage site could be excavated down to El. 10.0, providing 1.5 vertical feet between the canal bottom and newly created floodplain. Based on these assumptions, a total of approximately 0.95 acre-feet of compensatory storage could be created at this site. Table 6 summarizes the potential benefit of that created storage on parcels subject to riverine flooding in the study area.

Table 6: Veterans Memorial Park Compensatory Storage

Wall Alternative	Maximum % Of Parcels Protected by Scenario					
	1A	1B	2	3	4	5
Maximum # of Parcels Benefited*	21	18	16	19	12	13
Total # of Parcels Subject to Riverine Flooding	44	46	46	53	35	20
Maximum % of Parcels Benefited*	48%	39%	35%	36%	34%	65%

*In calculating the number of parcels benefited, parcels were assumed to be protected in such a way that they remain completely dry.

The Mill Street Municipal Parking Lot is located at the corner of Wallis Street and Mill Street and contains parking spaces for approximately 55 vehicles. Creating additional flood storage at this site would require excavating a portion of the site and then repaving and otherwise returning it to its existing use. It is important to note that compensatory storage created at this site will not provide a benefit until mid-century under 100-year flood conditions and late-century under 50-year flood conditions. The reason the benefit will be delayed is that this area is not expected to flood until mid- to late-century, so the

created compensatory storage will not be accessible to the river overflows until that time, as shown in Figures 2D and 2F.

Weston & Sampson estimated the limits of the hypothetical storage area, as shown in Figure 4, based on a 25-foot setback from the property boundary. The area of the potential storage site is 0.23 acres, approximately 35% of the parcel. Based on LiDAR ground elevations, the average elevation of the potential storage site is El. 16.6. The FEMA Flood Insurance Study river profile of the North River indicates that the canal bottom is at approximately El. 9.0. While there is approximately 7.6 vertical feet between the canal bottom and the existing land surface, we assumed that the site could only be excavated down 2.5 feet in order to support re-grading the site as necessary to maintain its existing use as a parking lot. Based on these assumptions, a total of approximately 0.58 acre-feet of compensatory storage could be created at this site. Table 7 summarizes the potential benefit of that created storage on parcels subject to riverine flooding in the study area.

Table 7: Mill Street Municipal Parking Lot Compensatory Storage

Wall Alternative	Maximum % Of Parcels Protected by Scenario					
	1A	1B	2	3	4	5
Maximum # of Parcels Benefited*	17	14	14	16	10	11
Total # of Parcels Subject to Riverine Flooding	44	46	46	53	35	20
Maximum % of Parcels Benefited	39%	30%	30%	30%	29%	55%

*In calculating the number of parcels benefited, parcels were assumed to be protected in such a way that they remain completely dry.

6.2.3 *Private Lots*

In addition to the two public parcels, Weston & Sampson also evaluated the potential benefit of creating additional flood storage on the privately-owned 24 Caller Street parcel. The existing parcel usage consists of a mixture of buildings, outbuildings, on-site storage, impervious pavement, bare earth, grass and tree covers. Creating additional flood storage would likely require the removal of the storage and equipment on the western half of the parcel, behind the two primary buildings.

Weston & Sampson estimated the limits of the hypothetical storage area, as shown in Figure 4, based on a 25-foot setback from the property boundary and two existing primary buildings. The area of the potential storage site is 0.19 acres, approximately 19% of the parcel. Based on LiDAR ground elevations, the average elevation of the potential storage site is El. 13.5. The FEMA Flood Insurance Study river profile of the North River indicates that the canal bottom is at approximately El. 7.0; we assumed that the potential storage site could be excavated down to El. 8.5, providing 1.5 vertical feet between the canal bottom and newly created floodplain. Based on these assumptions, a total of approximately 0.95 acre-feet of compensatory storage could be created at this site. As the hypothetical compensatory storage created at this site is the same as the Veterans Memorial Park site above, Table 6 summarizes the potential benefit of that created storage on parcels subject to riverine flooding in the study area.

6.3 Elevate and Retreat

In addition to the general study area-wide and site-specific examples of compensatory storage described above, Weston & Sampson also considered the resilient design concepts of elevating and retreating. Both options are designed to remove public and private infrastructure from repeated impacts by flooding. In this case, the MHHW is expected to move inland, inundating more than half of the studied reach of the North River on a regular basis by the end of the 21st century.

Elevating would involve raising existing public and private buildings up on piers, allowing the buildings to remain in their current locations, but elevating them above the anticipated flood prone area. Retreating would involve the selective abandonment and removal of some buildings, coupled with the development of new public and private structures at higher elevations further from the North River Canal.

An example of where either elevation or retreat may be useful is in the northern floodplain from Caller Street to Howley Street. That block currently contains five buildings, three of which are located within approximately 50 feet of the North River Canal. Under end-of-century, 50-year flood conditions (Scenario 4), portions of four of those five buildings, totaling approximately 52% of the buildings' total ground floor square footage is expected to be inundated. Similarly, under end-of-century, 100-year flood conditions (Scenario 5), portions of all five buildings, totaling approximately 84% of their combined ground floor square footage is expected to be inundated.

Raising these buildings above the anticipated flood prone elevation may preserve their continued usefulness. Alternatively, the block could be reconstructed with existing buildings being largely abandoned and removed and new buildings being constructed at an appropriate elevation along Walnut Street, with recreation, parking or other uses consistent with frequent flooding being located in the back of those lots along the North River Canal.

7.0 CONCLUSIONS

Weston & Sampson has conducted an evaluation of the proposed 1,600-foot long park adjacent to the North River Canal to assess the suitability of incorporating additional flood storage capacity under existing and future potential climate conditions. We have evaluated the potential flooding impacts associated with six different design flood-climate change projection scenarios, and we have assessed how those flooding impacts might change a result of the construction of each of eight wall rehabilitation alternatives. We have also assessed the potential benefit of developing compensatory storage in nearby publicly- and privately-owned parcels and we have considered the potential benefit of other flood mitigation alternatives, including elevation and retreat. Based on our evaluation, we have identified the following conclusions:

- Riverine flood levels and associated impacts to property were only evaluated within the study area. Riverine flooding and associated impacts are expected to increase upstream of the study area under all future climate conditions. Those increases were not evaluated as part of this project.
- Under existing climate conditions and under expected mid-century conditions, flooding in the North River Canal will largely be a function of runoff generated upstream – riverine flooding. However, by the end of the 21st century, tidal flooding due to sea level rise is expected to equal or exceed riverine flooding in the project area. Ultimately, the creation of additional flood storage may provide a modest benefit to the properties and infrastructure in the study area in the short- and medium-term, but those benefits are significantly reduced over the long-term.
- The creation of additional flood storage in and/or near the North River Canal is only effective in areas of riverine flooding. Projects that create compensatory storage and projects that floodproof flood prone properties will have a greater and longer lasting benefit the further upstream they are.
- The relative benefit of compensatory storage created by the eight alternatives for rehabilitating the North River Canal's southern wall should be considered in the cost-benefit analysis and alternative selection process.
- There may be value in conducting a detailed assessment of potential site-specific compensatory storage and flood control designs, including geotechnical, contamination/remediation, hydrologic and hydraulic, city planning, and cost-benefit analyses among others.
- Given the significant total riverine flood volumes in the early- and mid-century periods and the relatively modest compensatory storage that could be created by the southern retaining wall alternatives and the individual site projects explored above, it would be worth evaluating the cost-benefit of floodproofing individual buildings rather than eliminating flooding on a parcel scale. This type of floodproofing would also allow individual property owners to take on some responsibility for flooding impacts on their property.
- In light of the anticipated significant increase in tidal flooding in the study area by the end of the century, as opposed to riverine flooding, it may be worth evaluating "retreat" alternatives in more detail. On a related note, it may be worth reevaluating the potential benefit of a tide gate to limit tidal flooding under future climate conditions.

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FIGURES

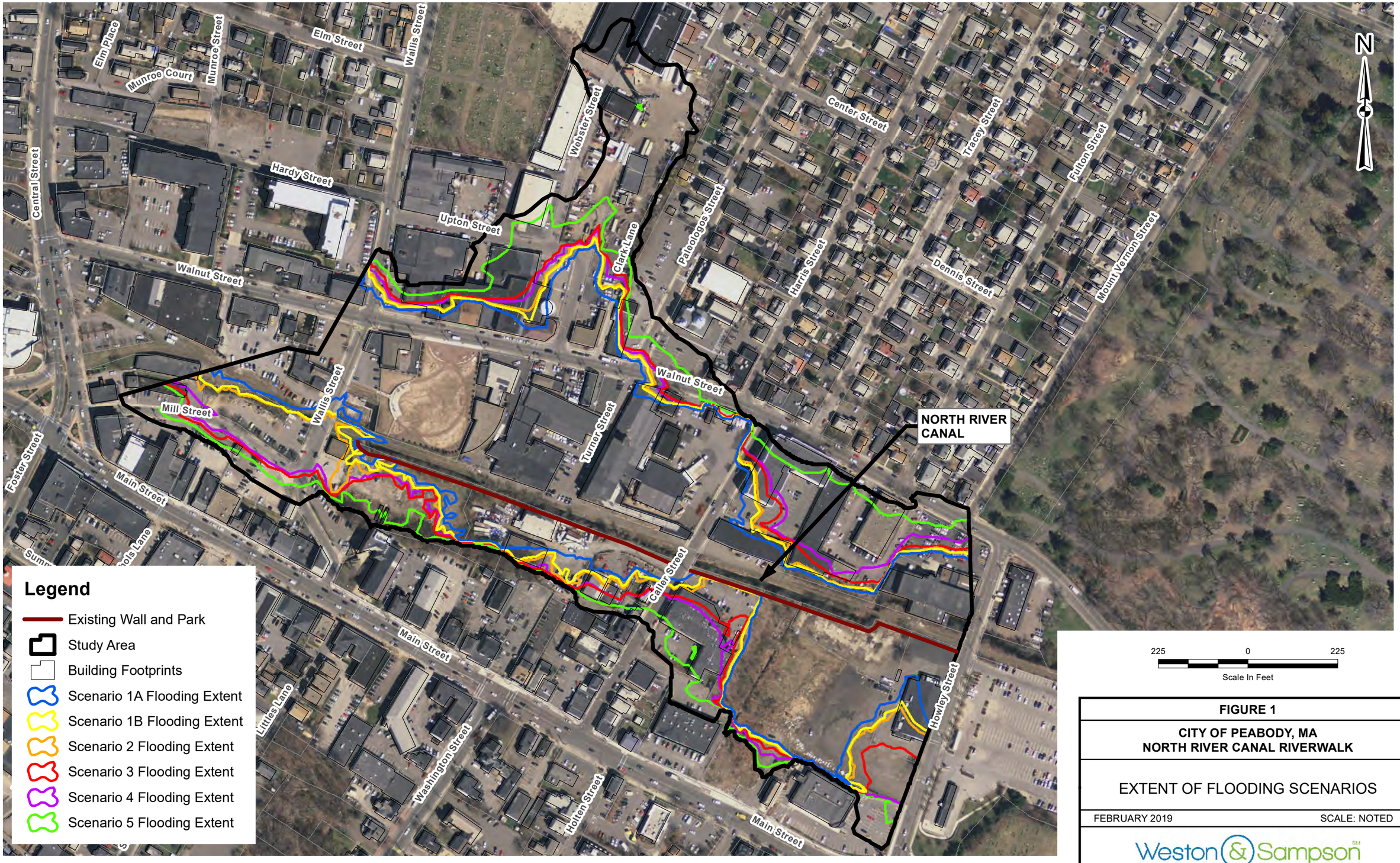


FIGURE 1

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

EXTENT OF FLOODING SCENARIOS

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Weston & Sampson

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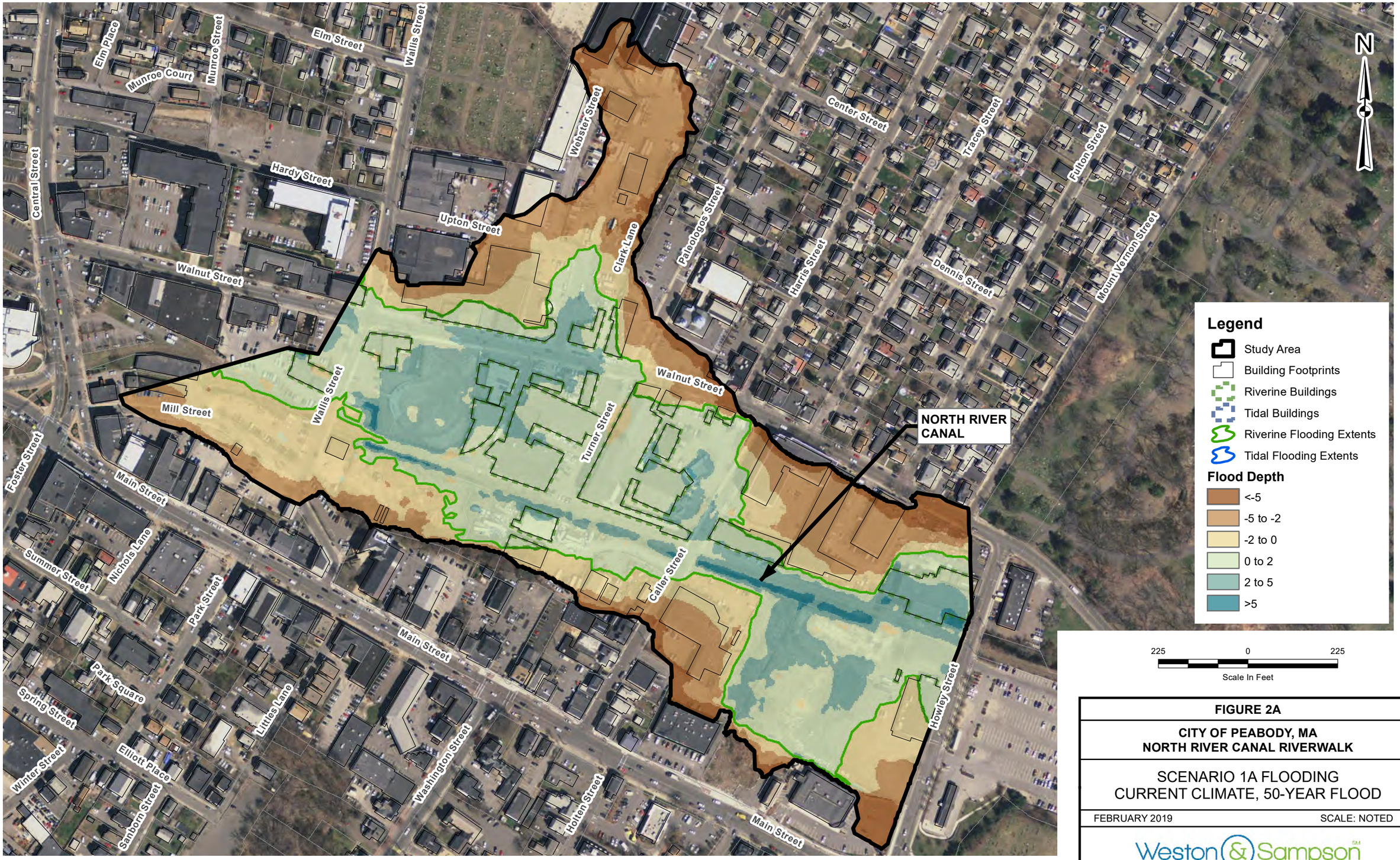


FIGURE 2A

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 1A FLOODING
CURRENT CLIMATE, 50-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson℠

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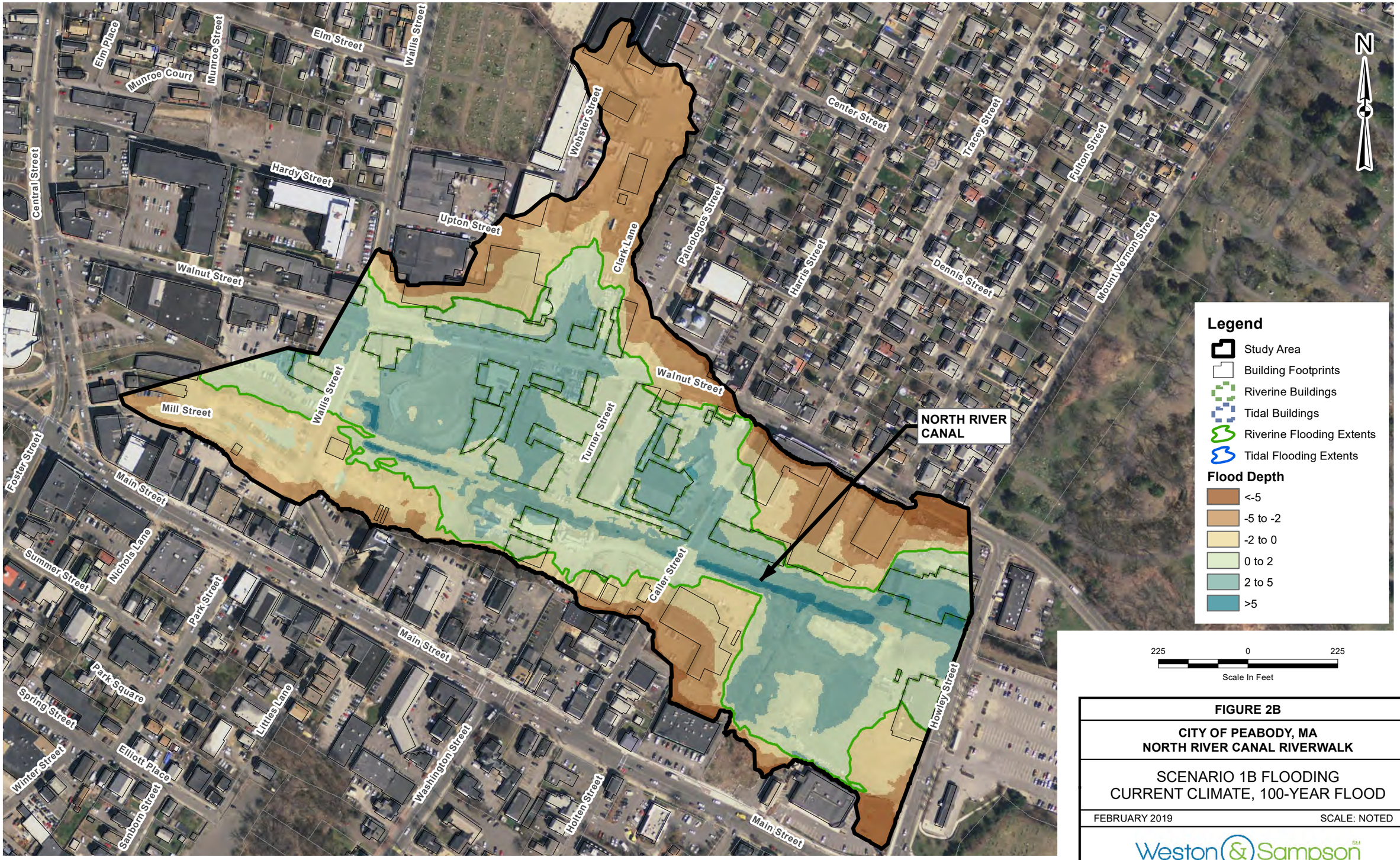


FIGURE 2B

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 1B FLOODING
CURRENT CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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FIGURE 2C

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 2 FLOODING
2050 CLIMATE, 50-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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FIGURE 2D

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 3 FLOODING
2050 CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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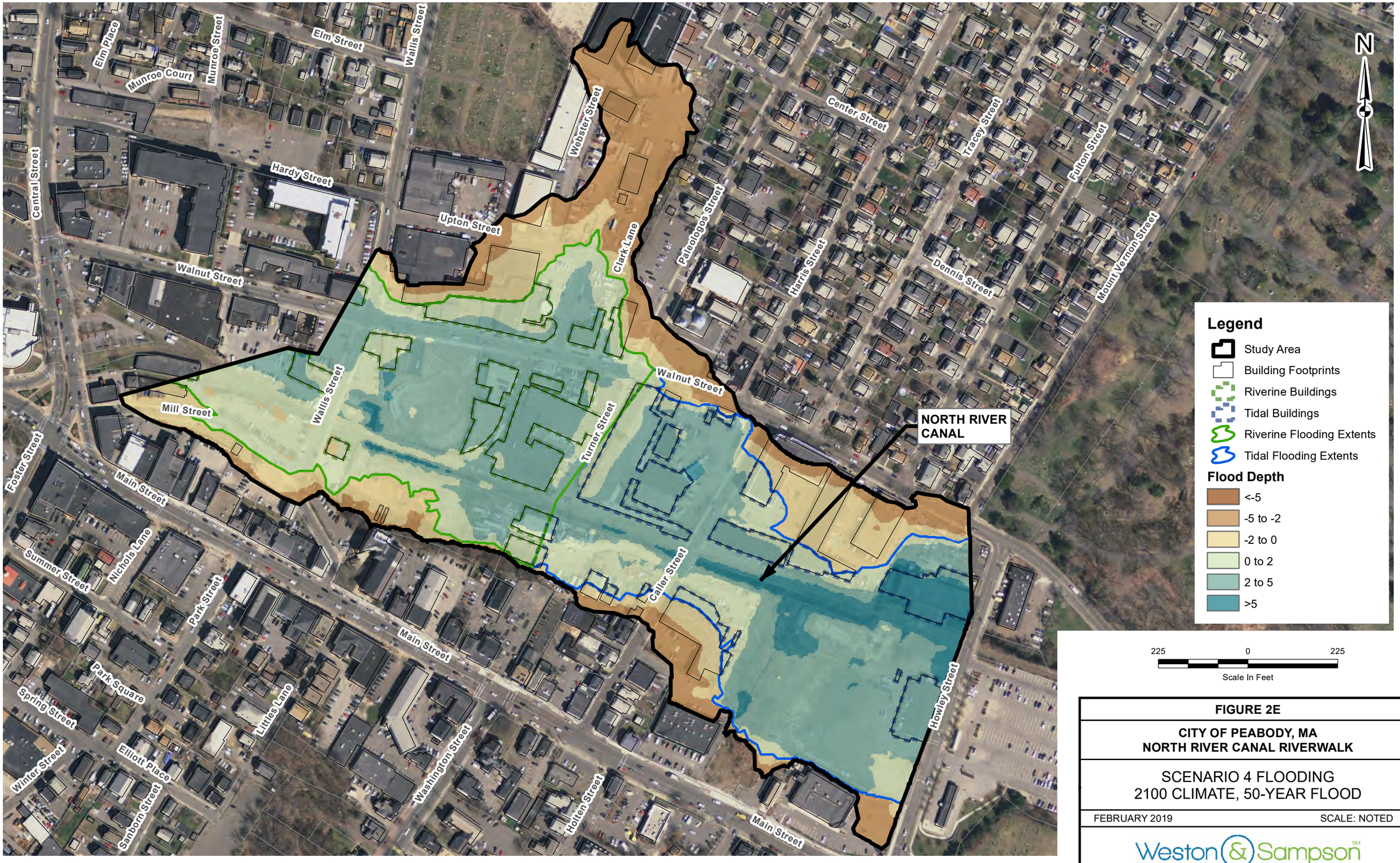


FIGURE 2E

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 4 FLOODING
2100 CLIMATE, 50-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

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FIGURE 2F

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 5 FLOODING
2100 CLIMATE, 100-YEAR FLOOD

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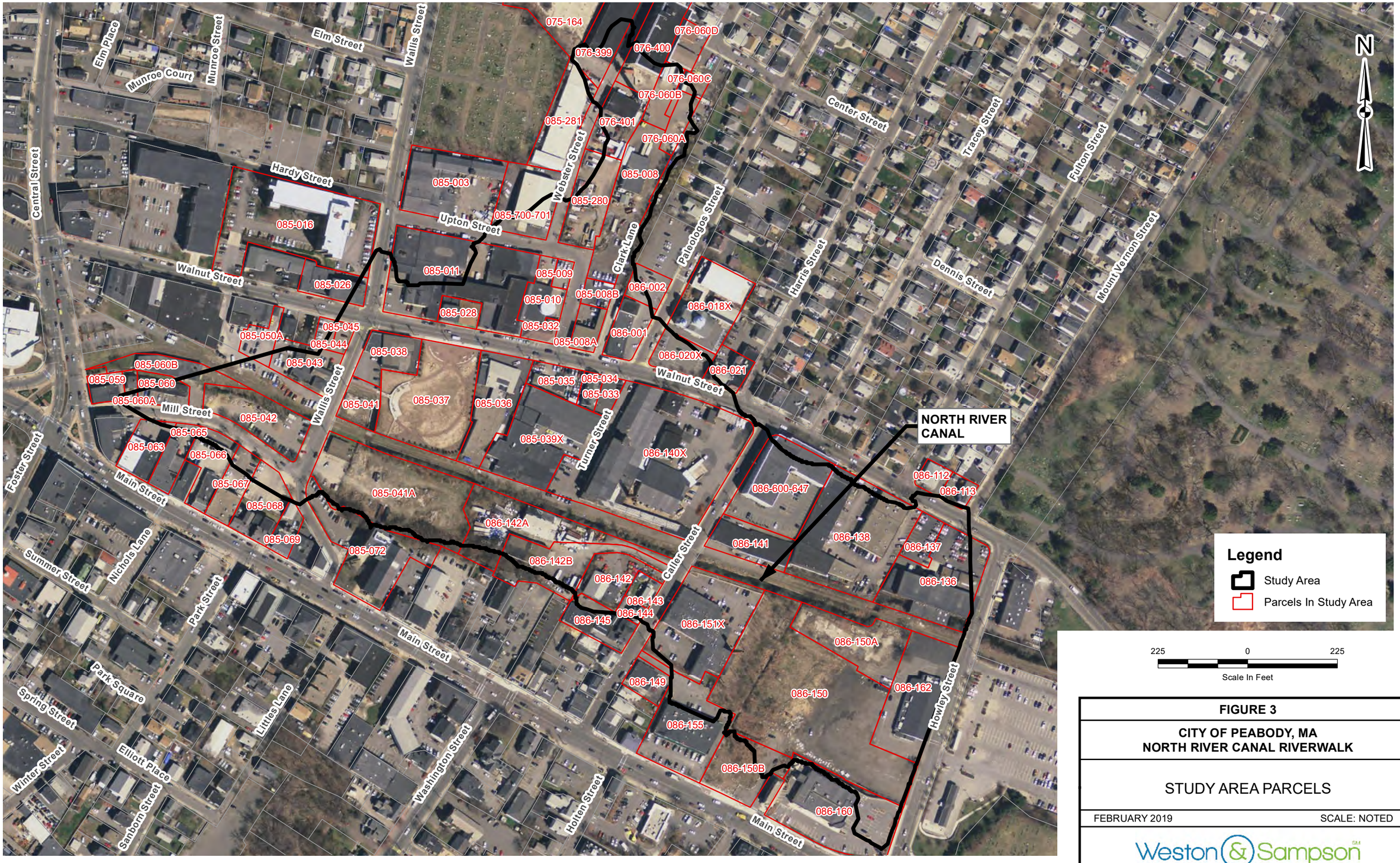


FIGURE 3

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

STUDY AREA PARCELS

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

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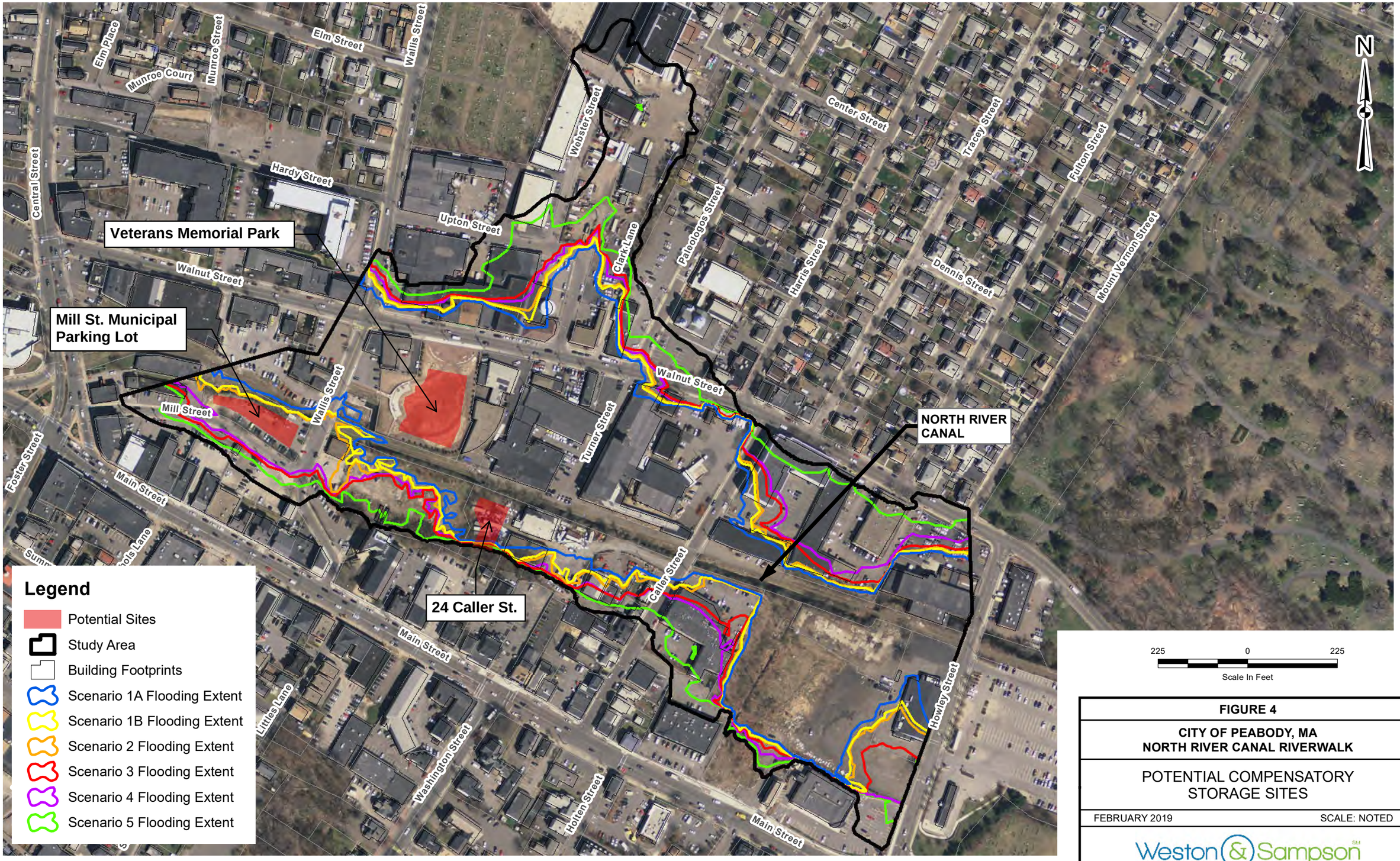


FIGURE 4

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

POTENTIAL COMPENSATORY STORAGE SITES

FEBRUARY 2019 SCALE: NOTED

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RESILIENCE EVALUATION REPORT

APPENDIX A

Climate Scenario Selection Memo

Weston & Sampson

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Tel: 978.532.1900

MEMORANDUM

TO:	Brendan Callahan, City of Peabody and Margot Mansfield, MA Executive Office of Energy & Environmental Affairs
FROM:	Andrew Walker, P.H., C.F.M., and Kathleen Baskin, P.E., Weston & Sampson Engineers
DATE:	January 25, 2019
SUBJECT:	MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park 2018 Resiliency Evaluation – Climate Scenario Selection

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Background

Task 1, the "Preliminary Resiliency Evaluation," of the MVP Action Grant: Peabody North River Canal Resilient Wall, Riverwalk and Park Project Scope of Services notes that "Weston & Sampson will work with the City of Peabody to select two future climate scenarios that represent a likely range of potential future flooding conditions." Ultimately, Weston & Sampson selected two existing conditions scenarios and four future conditions scenarios to evaluate. This memo serves to identify the selected climate scenarios and the basis for their selection.

Flooding due to precipitation and sea level rise (SLR) were considered in the selection of climate scenarios discussed in this memorandum. Flooding in the project area is largely due to high flows in the North River Canal caused by precipitation in the upgradient watersheds of Procter Brook and the North River (Metcalf & Eddy-AECOM, 2008). Precipitation events are projected to be more extreme due to climate change, which would exacerbate riverine flooding in the project area. Currently tidal influences at Mean Higher High Water (MHHW) extend approximately 230 feet upstream of Howley Street (Metcalf & Eddy-AECOM, 2008). SLR is expected to extend tidal influences further upstream into the project area.

Coastal storm surge, the phenomenon of rising water commonly associated with low pressure weather systems, can cause increased inland flooding. Weston & Sampson considered incorporation of results of hydrodynamic modeling from the Woods Hole Group to provide more information on coastal impacts within the project area including risk-based site-specific mapping of SLR, coastal storm surge heights, and overland flow pathways. There is an existing hydrodynamic model with SLR within the project area (known as the Boston Harbor Flood Risk Model (BH-FRM)) that was completed in 2015, as well as a new study being prepared by the Woods Hole Group for the Massachusetts Department of Transportation (MassDOT) for the entire Massachusetts coastline that will supersede the BH-FRM. Based on conversations with the Woods Hole Group, coastal storm surge is unlikely to have a significant impact on this project area. Regardless, updated

projections of coastal surge under future climate scenarios are not expected to be available for this project area until April 2019 at the earliest; incorporation of these model projections would result in a schedule that would not provide sufficient time to complete the current project within the timeframe allowed by the grant funding. Therefore, the influence of coastal storm surge could not be incorporated into the scenarios selected in Task 1.

Scenario Selection

Based on discussions with representatives from the City of Peabody and the project funder, the Massachusetts Executive Office of Energy & Environmental Affairs (MA EOEEA), during the project kickoff meeting on October 3, 2018; feedback from the client, funder, and project team members during calls on November 7 and 13, 2018; and on our initial review of recent studies regarding projected regional climate change impacts, Weston & Sampson has identified a total of six climate scenarios:

- Scenario 1A: Existing Conditions, 50-year flood
- Scenario 1B: Existing Conditions, 100-year flood
- Scenario 2: 2050 "Low-Intermediate" Climate Change for precipitation and SLR, 50-year flood
- Scenario 3: 2050 "High" Climate Change for precipitation and SLR, 100-year flood
- Scenario 4: 2100 "Low-Intermediate" Climate Change for precipitation and SLR, 50-year flood
- Scenario 5: 2100 "High" Climate Change for precipitation and SLR, 100-year flood

While Weston & Sampson is recommending more than two climate change scenarios, which was originally proposed, the six scenarios selected present a broad range of possible outcomes under climate change and will enable a more robust analysis of resiliency alternatives. Scenarios 1A/1B, which represent existing conditions during the 50- and 100-year flood events, respectively, will provide a baseline for comparison of the future scenarios. They will also represent a "best-case scenario," during which any flood storage measures will have the maximum impact. As climate change advances through the remainder of the 21st century and results in increased SLR and more extreme precipitation events, those benefits are expected to decrease.

The future climate scenarios (Scenarios 2 through 5) were selected to evaluate the potential future benefit of flood storage as a function of the degree to which climate change will occur. In general, predicted impacts of climate change are presented as a range of likely values based on various combinations of potential future greenhouse gas emissions, energy use, population growth, air pollutants, land use, and other societal trends. We have selected a "low-intermediate" scenario known as RCP4.5 and a "high" impact scenario known as RCP8.5. They were chosen to give the City a sense for how the effectiveness of flood storage measures might change depending on the severity of future climate change impacts. The "low-intermediate" scenario was paired with 50-year flooding conditions as the smaller storm was determined to offer a more achievable condition for which to develop flood mitigation designs at this site. The "high" scenario was paired with the 100-year flooding conditions to highlight the effectiveness of flood mitigation designs under worst-case conditions.

We have selected time horizons that represent potential climate conditions both mid-century (2050) and end of century (2100) to give the City an idea of effectiveness of flood storage measures over time. These time

horizons also take advantage of published climate change predictions of relative SLR and riverine flood discharge as reported in regional climate studies. The studies reviewed in support of this project are summarized and described in Appendix A. The climate projections (precipitation and SLR) for the selected climate scenarios are based on the following sources and described in detail in the following section.

- FEMA Flood Insurance Study (25009CV004B)
- NOAA tide gage data for Boston and Beverly Harbors
- City of Cambridge Climate Change Vulnerability Assessment, Part 1 Appendix: Climate Projections & Scenario Development (Cambridge, 2015)
- Climate Change and Sea Level Rise Projections for Boston - The Boston Research Advisory Group Report (BRAG, 2016)
- Northeast Climate Science Center (NECSC), Massachusetts Climate Change Projections (NECSC, 2018)

Scenario 1A – Existing Conditions, 50-year Flood

Existing 50-year flood elevations are controlled by precipitation and the resulting runoff. Riverine flooding levels, caused by upgradient precipitation, will be determined from the effective FEMA Flood Insurance Study (25009CV004B), which was updated most recently on July 16, 2014. These 50-year flood levels range from 16.5 ft. NAVD88 at Wallis Street to El. 12.5 ft. at the railroad crossing upstream of Howley Street and El. 11.0 at Howley Street. Coastal flooding is not expected to impact the study area during 50-year flood conditions.

Scenario 1B – Existing Conditions, 100-year Flood

Existing 100-year flood elevations are controlled primarily by precipitation and the resulting runoff as well as by some tidal influences in the downstream end of the project area, specifically, up to approximately 230 feet above of Howley Street. Riverine flooding levels, caused by upgradient precipitation, will be determined from the effective FEMA Flood Insurance Study (25009CV004B), which was updated most recently on July 16, 2014. These 100-year flood levels range from 17.5 ft. NAVD88 at Wallis Street to El. 14.5 ft. at the railroad crossing upstream of Howley Street and El. 11.5 at Howley Street. Coastal flooding levels are assumed equal to MHHW, which was estimated from NOAA tide gage data for Boston and Beverly Harbors to be 4.76 above mean sea level, corresponding to approximately El. 9.97 ft. NAVD88 (Metcalf & Eddy-AECOM, 2008).

Scenario 2 - Mid-century (2050) conditions under a “low-intermediate” climate change scenario (RCP4.5)

Precipitation under this scenario will see an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 9.4 inches for the 2050s time-horizon (Cambridge, Part 1 Appendix, 2015). The resulting increase in expected riverine flows will be estimated. One methodology may be to apply the unit hydrograph method to the rainfall-runoff parameters identified in the Peabody Square study (M&E and AECOM, 2008). This increase in river discharge will be converted to a flood level by interpolating/extrapolating from flooding profiles contained in the FEMA Flood Insurance Study of the project area. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 1.7 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 11.67 ft.

Scenario 3 - Mid-century (2050) conditions under a “high” climate change scenario (RCP8.5)

Increases to the 100-year riverine discharge are assumed to reach 35%, the maximum predicted increase for the 2055 time horizon (BRAG, 2016). This increase in river discharge will be converted to a flood level by interpolating/extrapolating from flooding profiles contained in the FEMA Flood Insurance Study of the project area. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 2.4 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 12.37 ft.

Scenario 4 - Late-century (2100) conditions under a “low-intermediate” climate change scenario (RCP4.5)

Precipitation under this scenario will see an increase in the 24-hour, 50-year design rainfall depth from 7.6 to approximately 10.9 inches for the 2070 time horizon (Cambridge, Part 1 Appendix, 2015). The same methodology to evaluate increases in riverine flows for Scenario 2 is likely to be used for this scenario. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 5.0 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 14.97 ft.

Scenario 5 – Late-century (2100) conditions under a “high” climate change scenario (RCP8.5)

Increases to the 100-year riverine discharge are assumed to reach 70%, the maximum predicted increase for the 2085 time horizon (BRAG, 2016). The same methodology to evaluate increase in riverine discharge for Scenario 3 will be used for this scenario. The extents of tidal flooding will be evaluated by adding the predicted change to mean sea level, 7.6 feet (NECSC, 2018), to the baseline MHHW elevation, resulting in a future MHHW of approximately El. 17.57 ft.

List of References

Bosma, Kirk; Ellen Douglas; Paul Kirshen; Katherine McArthur; Steven Miller; and Chris Watson; 2015. MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery, June 2015.

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Massachusetts Office of Coastal Zone Management (CZM), 2013. Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, December 2013.

Metcalf & Eddy-AECOM, 2008. Preliminary Design of Flood Mitigation Facilities for Peabody Square Area, April 2008.

National Oceanic and Atmospheric Administration, 2012. NOAA Technical Report OAR CPO-1: Global Sea Level Rise Scenarios for the United States National Climate Assessment, December 2012.

Northeast Climate Science Center (NECSC), 2018. Massachusetts Climate Change Projections, March 2018.

Appendix A

Review of Relevant Reports and Data Sets

Table 1 – Summary of Recent Regional Climate Studies Reviewed

Date	Author	Title	Available Data
2016	BRAG	Climate Change and Sea Level Rise Projections for Boston	SLR for RCP4.5 and RCP8.5 in 2050, 2100 100-year flood probability for RCP4.5 and RCP8.5 in 2050, 2100 Change in 100-year river discharge for 2055, 2085
2015	City of Cambridge	Climate Change Vulnerability Assessment, Part 1 Appendix: Climate Projections & Scenario Development	24-hour design rainfall depths for 2000 and for RCP4.5, and RCP8.5 in 2030s, 2070s Relative SLR for RCP8.5 in 2050, 2100
2018	Northeast Climate Science Center	Massachusetts Climate Change Projections	# of Days with significant precipitation for RCP8.5 in 2050, 2100 SLR for "Intermediate-High" and "High" scenarios in 2050 and 2100
2018	Bosma	Email communication to Kathleen Baskin of W&S	SLR for RCP8.5 in 2050, 2100
2015	Bosma et al.	MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery	Superseded by Bosma, 2018
2017	City of Cambridge	Climate Change Vulnerability Assessment, Part 2	N/A
2017	City of Cambridge	Climate Change Vulnerability Assessment, Part 2 – Sea Level Rise and Storm Surge	SLR for 2030, 2070 River discharge for 2070
2015	City of Cambridge	Climate Change Vulnerability Assessment, Part 1	SLR for 2030, 2070
2013	MA Office of Coastal Zone Management	Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning	SLR for RCP4.5 and RCP8.5 in 2050, 2100
2012	National Oceanic and Atmospheric Administration	NOAA Technical Report OAR CPO-1: Global Sea Level Rise Scenarios for the United States National Climate Assessment	N/A

Note:

- *Sources highlighted in gray and available data in red text were used to identify riverine and coastal flooding elevations in (Scenarios 2-5).*
- *"N/A" indicates source had no future climate projections relevant to this project.*

Boston Research Advisory Group (BRAG), 2016. Climate Change and Sea Level Rise Projections for Boston - The Boston Research Advisory Group Report, prepared for Climate Ready Boston, June 1, 2016.

Initial impression: very valuable, includes change in percent likelihood of the current 100-year coastal storm event as well as the riverine 2-year and 100-year flood events

Review Bosma et al., 2015 for river discharge values

- Climate scenarios RCP 2.6, RCP 4.5, and RCP 8.5
- "The amount and rate of RSLR in Boston during the first half of the 21st century is nearly independent of emissions. The most likely estimates of RSLR from 2000 to 2050 (associated with exceedance probabilities of 83%, 50%, and 17%) are 19, 32 and 45 cm (7.5, 13 and 18 inches, respectively), thus a 2050 range of 19 cm to 45 cm (7.5 to 18 in) can be considered, but higher RSLR approaching 75 cm (30 in) is possible."
- "After ~2050 the scenarios diverge sharply, with substantially more RSLR under the higher emissions pathways. Under the highest emissions pathway (RCP8.5), the most likely estimates of RSLR from 2000 to 2100 in Boston are 97, 149 and 226 cm (3.2, 4.9 and 7.4 ft). Under the moderate-emissions RCP4.5 pathway, RSLR estimates from 2000 to 2100 are 74, 111 and 156 cm (2.4, 3.6 and 5.1 ft). Thus a 2100 range of 74 cm to 226 cm (2.5 to 7.4 ft) can be considered."
- "The maximum physically plausible sea-level rise from 2000 to 2100 at Boston was estimated to range from 1.9 m and 3.2 m (6.2 and 10.5 ft) in this analysis. This is substantially more than the maximum RSLR of 2.08 m (6.83 ft) from 2003 to 2100 under the highest emissions scenario reported in a recent study," Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning by CZM (2013).

Table 1-1. *RSL projections for Boston, MA (in ft, relative to 2000) categorized by exceedance probabilities.*

			LIKELY RANGE					MAXIMUM
	0.99	0.95	0.833	0.5	0.167	0.05	0.01	0.001
RCP8.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.1	1.5	1.8	2.1	2.4
2070	0.6	1.0	1.5	2.2	3.1	3.7	4.3	4.8
2100	1.6	2.4	3.2	4.9	7.4	8.6	9.5	10.5
2200	18.9	19.9	21.4	26.1	32.8	34.1	35.3	36.9
RCP4.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.0	1.4	1.7	2.0	2.3
2070	0.4	0.9	1.3	1.9	2.6	3.1	3.6	4.1
2100	0.9	1.7	2.4	3.6	5.1	6.1	7.0	8.0
2200	5.5	6.2	7.2	10.9	16.5	18.0	19.3	20.9
RCP2.6								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.6	1.0	1.4	1.7	2.0	2.3
2070	0.3	0.7	1.1	1.7	2.3	2.7	3.1	3.6
2100	0.4	1.2	1.8	2.8	3.8	4.6	5.3	6.2
2200	3.6	4.4	5.2	6.4	7.7	8.8	9.9	11.8

- "…results suggest that incorporating fixed median SLR estimates for 2100, rather than accounting for the full distribution, halves the height of the expected 1% annual probability flood and underestimates it by over 1 m."

Table 2-1 *Current and future annual probability of today's (circa 2000) 100-year flood for 2030s, 2050s, and 2100 under two concentration pathways (RCP4.5 and RCP8.5). Values in parentheses represent the 10-90 percentile range. Flood heights (in ft NAVD88) for a 1% probability flood for 2030s, 2050s, and 2100 under two concentration pathways (RCP4.5 and RCP8.5). Values in parentheses represent the 10-90 percentile range.*

Extreme Event	Current (2000)	2030		2050		2100	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
Future annual probability of today's 100-year flood	1%	2.5% (1.5-4.0)	2.8% (1.4-4.5)	8.7% (2.4-17)	14% (2.9-29)	75/yr (22%-daily)	230/yr (5/yr-daily)
Flood heights for 1% flood (ft NAVD88)	9.2	9.8 (9.5-10.1)	9.8 (9.5-10.1)	10.5 (9.8-10.8)	10.5 (9.8-10.8)	13.8 (10.8-14.1)	17.4 (12.1-17.4)

- Discussion of storm events cites CCVA and BWSC scenarios B2 (medium) and A1Fi (precautionary)
- River flooding values based on a synthesis of Hodgkins and Dudley (2013), Demaria et al. (2015), BWSC (2015), and Bosma et al. (2015)

Table 3-3: *Best available estimates for changes in river floods (as percent) in Boston associated with anticipated climate changes. The basis for these estimates are discussed in Appendix A.*

Flood Type	2055	2085
Small floods (e.g., 2-year recurrence interval)	0 to 20%	20% to 50%
Design floods (e.g., 100-year)	-10% to 35%	15% to 70%
Flood frequency (floods/year)	increases	increases

City of Cambridge, 2015. Climate Change Vulnerability Assessment (CCVA), Climate Projections & Scenario Development, November 2015.

Initial impression: very useful design rainfall depth information

- CCVA used three time horizons: present day, 2030 and 2070
- 100-year storm in 1971-2000 equivalent to 25-year storm in 2055-2084 and the 25-year storm becomes the 10-year storm
- High emissions scenario RCP 8.5; low emissions scenario RCP 4.5
- Provides 10-, 25-, and 100-year design rainfall depths for baseline, 2030, and 2070 horizons

Precipitation Changes	Baseline	2030s (2015-2044)		2070s (2055-2084)	
	1971-2000	Lower	Higher	Lower	Higher
Annual Precipitation (in.)	45	48	48	51.5	54
Summer Precipitation (in.)	9.5	9.8	9.8	10.1	10.3
Winter Precipitation (in.)	11.4	12.6	12.7	14.1	15.4
# days per year > 2 in. rain in 24 hrs (days)	2	3	3	3	3
Max. 5-day precipitation per year (in.)	6	6.5	6.6	7	7.2
24-hr design storms					
10yr	4.9	5.6		6.4	
25 yr	6.2	7.3		8.2	
100 yr	8.9	10.2		11.7	
48-hr design storms					
10yr	5.5	6.4		7.2	
25 yr	7	8.6		9.8	
100 yr	10	13.2		15.7	

Table 3: Precipitation projections [12]

- Provides RSLR estimates for “highest” and “intermediate-high” climate scenarios at decadal intervals

Scenarios	2020	2030	2040	2050	2060	2070	2080	2090	2100
Global SLR (from 2013-2020) "Highest" (feet)	0.21	0.61	1.10	1.70	2.40	3.21	4.11	5.12	6.23
Global SLR (from 2013-2020) "Intermediate-High" (feet)	0.14	0.38	0.68	1.04	1.46	1.93	2.48	3.05	3.69
Land subsidence (feet) @ 0.04 in./yr.	0.02	0.06	0.09	0.12	0.15	0.19	0.22	0.25	0.29
Total Relative SLR - "Highest" (feet)	0.24	0.66	1.19	1.82	2.56	3.39	4.33	5.37	6.52
Total Relative SLR – "Intermediate-High" (feet)	0.16	0.44	0.77	1.16	1.61	2.12	2.68	3.30	3.98

Table 4: "Highest" and "Intermediate-High" scenario projections for relative SLR in Boston (2013-2100) [19,20]

Northeast Climate Science Center (NECSC), 2018. Massachusetts Climate Change Projections, March 2018.

Initial impression: sea level rise predictions are useful to this project

- Based on 28 climate scenarios from 14 downscaled regional climate models; ranges are presented for 10th to 90th percentile simulated results
- Peabody straddles the Ipswich and North Coastal Basins, but the project site is in the North Coastal Basin
- Predictions of Days with Precipitation Over 1", Days Over 2", and Days Over 4", reported seasonally and annually, for mid-century and end of century

NORTH COASTAL BASIN

North Coastal Basin		Observed Baseline 1971-2000 (Days)	Mid-Century: Projected Change in 2030s (Days)	Mid-Century: Projected Change in 2050s (Days)	End of Century: Projected Change in 2070s (Days)	End of Century: Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	8	+<1[77] to +2	+<1[77] to +3	+1 to +3	+1 to +4
	Winter	2	+<1[77] to +1	+<1[77] to +1	+<1[77] to +2	+<1[77] to +2
	Spring	2	+0 to +1	+0 to +1	+<1[77] to +1	+<1[77] to +1
	Summer	2	+0 to +1	+0 to +1	+0 to +1	+0 to +1
	Fall	2	-0.29 to +1	+0 to +1	+0 to +1	+0 to +1
Days with Precipitation Over 2"	Annual	1	+<1[77] to +1	+0 to +1	+<1[77] to +1	+<1[77] to +1
	Winter	<1[77]	+0 to +<1[77]	+<1[77] to +<1[77]	+0 to +<1[77v]	+<1[77] to +<1[77]
	Spring	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Summer	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Fall	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
Days with Precipitation Over 4"	Annual	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Winter	0	+0 to +0	+0 to +0	+0 to +<1[77]	+0 to +<1[77]
	Spring	0	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Summer	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]
	Fall	<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]	+0 to +<1[77]

[77] Over the observed period, there were some years with at least 1 day with seasonal precipitation over a certain threshold while in all the other years that threshold wasn't crossed seasonally at all.

- Predictions of total precipitation reported seasonally and annually, for mid-century and end of century
- Does not present predictions of precipitation based on frequency and duration (i.e. the projected 100-year, 24-hour event)
- Provides sea level rise estimates for both 2050 and 2100 for multiple climate change scenarios

Table 7, Figure 1: Relative (or local) mean sea level projections for the Boston, MA tide station based on four National Climate Assessment global scenarios with associated probabilistic model outputs from the Northeast Climate Science Center. Each of the scenarios—Intermediate, Intermediate-High, High, and Extreme—is cross-walked with two to three probabilistic model outputs. Modeling considered two future concentrations of greenhouse gas emissions (referred to as representative concentration pathways [RCP]) and two methods of accounting for Antarctic ice sheet contributions to sea level rise. A 19-year reference time period for sea level (tidal epoch) centered on the year 2000 was used to minimize biases caused by tidal, seasonal, and inter-annual climate variability. Sea level projections for the Boston tide station are referenced to the North American Vertical Datum of 1988 (NAVD88).

Relative mean sea level (feet NAVD88) for Boston, MA					
Scenario	**Probabilistic projections**	**2030**	**2050**	**2070**	**2100**
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)	0.7	1.4	2.3	4.0
Intermediate- High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)	0.8	1.7	2.9	5.0
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)	1.2	2.4	4.2	7.6
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)	1.4	3.1	5.4	10.2

Massachusetts Sea Level Rise Projections, 2018 (Bosma, 2018) (Email correspondence)

Initial impression: useful to this project

- Future sea-level projections for Boston Harbor are based on a methodology which provides complete probability distributions for different greenhouse gas concentration trajectories (representative concentration pathways, or RCPs)[1].
- Analysis (DeConto and Kopp, 2017)[5] consisted of a probabilistic assessment of future relative sea level rise under two future atmospheric greenhouse gas concentration scenarios, medium (RCP4.5) and high (RCP8.5)[6].
- Assessment included two model approaches for projecting Antarctic ice sheet based on: expert elicitation (Kopp, 2014[1]) and new, process-based numerical ice sheet model simulations (Deconto and Pollard, 2016[7]; Kopp, 2017[8]).
- These projections can be used for detailed, site specific hydrodynamic modeling[12] to map storm surge impacts and influences of localized processes along the coast.
- On their own, these projections provide insight to overall trends in rising sea levels along the Massachusetts coastline.

The following values are presented as an elevation of the mean sea level in feet NAVD88 for the RCP8.5 climate scenario.

2030 = 1.2 feet NAVD88

2050 = 2.4 feet NAVD88

2070 = 4.2 feet NAVD88

2100 = 7.6 feet NAVD88

These projections are considered the standard by the Massachusetts Office of Coastal Zone Management, and are being used by the Massachusetts Department of Transportation (MassDOT) in its statewide modeling of sea level rise and can be applied in Peabody.

Note that these values represent the elevation of mean sea level and can be used to estimate the change in mean sea level from the baseline year, 2000. For instance, mean sea level in 2050 is expected to be El. 2.4 ft. NAVD88 or 2.4 feet higher than existing conditions. However, that increase may not be linear across the entire tide cycle; high tide and low tide in 2050 may be more or less than 2.4 feet above baseline conditions. Despite this cautionary note, Weston & Sampson will assume that changes in MHHW conditions are the same as changes in mean sea level, to take advantage of these most up-to-date estimates of sea level rise for the project region.

Massachusetts Sea Level Rise Projections, 2018 (Bosma, 2018) (continued)

List of References

[1] Kopp, R. E., R. M. Horton, C. M. Little, J. X. Mitrovica, M. Oppenheimer, D. J. Rasmussen,B. H. Strauss, and C. Tebaldi (2014), Probabilistic 21st and 22nd century sea level projections at a global network of tide gauge sites, Earth's Future, 2, 383–406.

[5] DeConto, R. M. and R.E. Kopp. (2017). Massachusetts Sea Level Assessment and Projections. Technical memorandum.

[6] Van Vuuren, D. P., Edmonds, J., Kainuma, M., Riahi, K., Thomson, A., Hibbard, K., Lamarque, J.-F. (2011), The representative concentration pathways: an overview. *Climatic Change*, 109, 5-31.

[7] DeConto, R. M., and Pollard, D. (2016). Contribution of Antarctica to past and future sea-level rise. Nature, 531(7596), 591–597.

[8] Kopp, R. E., DeConto, R. M., Bader, D. A., Hay, C. C., Horton, R. M., Kulp, S., Oppenheimer, M., Pollard, D., and Strauss, B. H. (2017). Evolving Understanding of Antarctic Ice-Sheet Physics and Ambiguity in Probabilistic Sea-Level Projections, Earth's Future, 5.

[9] A tidal datum epoch is a 19-year astronomical cycle over which tidal height observations are taken and reduced to obtain mean values in order to establish the various datums (e.g., mean higher high water, etc.) (NOAA Tides and Currents).

[10] Sweet, W.V., R. Horton, R.E. Kopp, A.N. LeGrande, and A. Romanou, 2017: Sea level rise. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 333-363.

[11] Sweet, W.V., R.E. Kopp, C.P. Weaver, J. Obeysekera, R.M. Horton, E.R. Thieler, and C. Zervas, 2017: Global and Regional Sea Level Rise Scenarios for the United States. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services.

[12] e.g., Bosma, K., E. Douglas, P. Kirshen, K. McArthur, S. Miller, S., and C. Watson (2015), Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery. MassDOT, Boston MA.

City of Cambridge, 2017. Climate Change Vulnerability Assessment, Part 2. February 2017.

Initial impression: not useful to this project

- Does not state sea level rise estimates or changes in precipitation
- References the Boston Harbor Flood Risk Model as presented in MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery, (Bosma et al, 2015).

City of Cambridge, 2017. Climate Change Vulnerability Assessment, Part 2 – Sea Level Rise and Storm Surge, February 2017.

Initial impression: Sea level rise (SLR) estimates are from a "highest" SLR scenario but may be useful to our project; review Bosma et al., 2015 for river discharge methodology

- Boston Harbor Flood Risk Model (BH-FRM) is comprised of the Advanced Circulation Model (ADCIRC) and the Simulating Waves Nearshore Model (SWAN)
- Model was developed by Woods Hole Group for a MassDOT-funded project (Bosma et al, 2015)
- Risk-based model using Monte Carlo simulations
- SLR scenarios for 2030 and 2070 based on the "Highest" SLR scenario as published in the NOAA Technical Report OAR CPO-1: Global Sea Level Rise Scenarios for the United States National Climate Assessment, December 2012 (NOAA, 2012)
- Mean sea level rise of 0.66 feet by 2030 and 3.39 feet by 2070
- Storm climatology up to 2050 based on present climate; storm climatology after 2050 based on 21st century projections by Dr. Kerry Emmanuel of Massachusetts Institute of Technology
- Use ICM-2D model to evaluate impact of tidal backwatering and river flooding on the City's drainage system
- River discharge associated with a 24-hour 100-year event under 2070 climate conditions as explained in: Bosma et al, 2015.

City of Cambridge, 2015. Climate Change Vulnerability Assessment, Part 1. November 2015.

Initial impression: relatively little information useful to this project

- Up to 8 inches of SLR by 2030 and up to 3.4 feet by 2070
- Precipitation event information references 2014 NCA
- Between 1958 and 2012, 1% rainfall events occurred 71% more frequently
- 100-year storm in 1971-2000 equivalent to 25-year storm in 2055-2084
- Riverine flood modeling methodology unclear

Massachusetts Office of Coastal Zone Management (CZM), 2013. Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning, December 2013.

Initial impression: very useful estimates of RSLR for Boston; could compare to more recent estimates

- Local historical sea level trends
- Global sea level rise predictions associated with four climate change scenarios: highest, intermediate-high, intermediate-low, and lowest
- Recommendation: use multiple climate scenarios and time horizons, consider land subsidence impact on sea level rise (RSLR)
- "the estimated vertical land movement values for the NOAA Boston long-term tide gauge station of -0.84 mm/yr (Zervas et al., 2013)"
- Provides estimates of Boston RSLR for seven time horizons and four climate scenarios

Table 3. Relative sea level rise estimates for Boston, MA. Global scenarios were adjusted to account for local vertical land movement with 2003 as the beginning year of analysis.

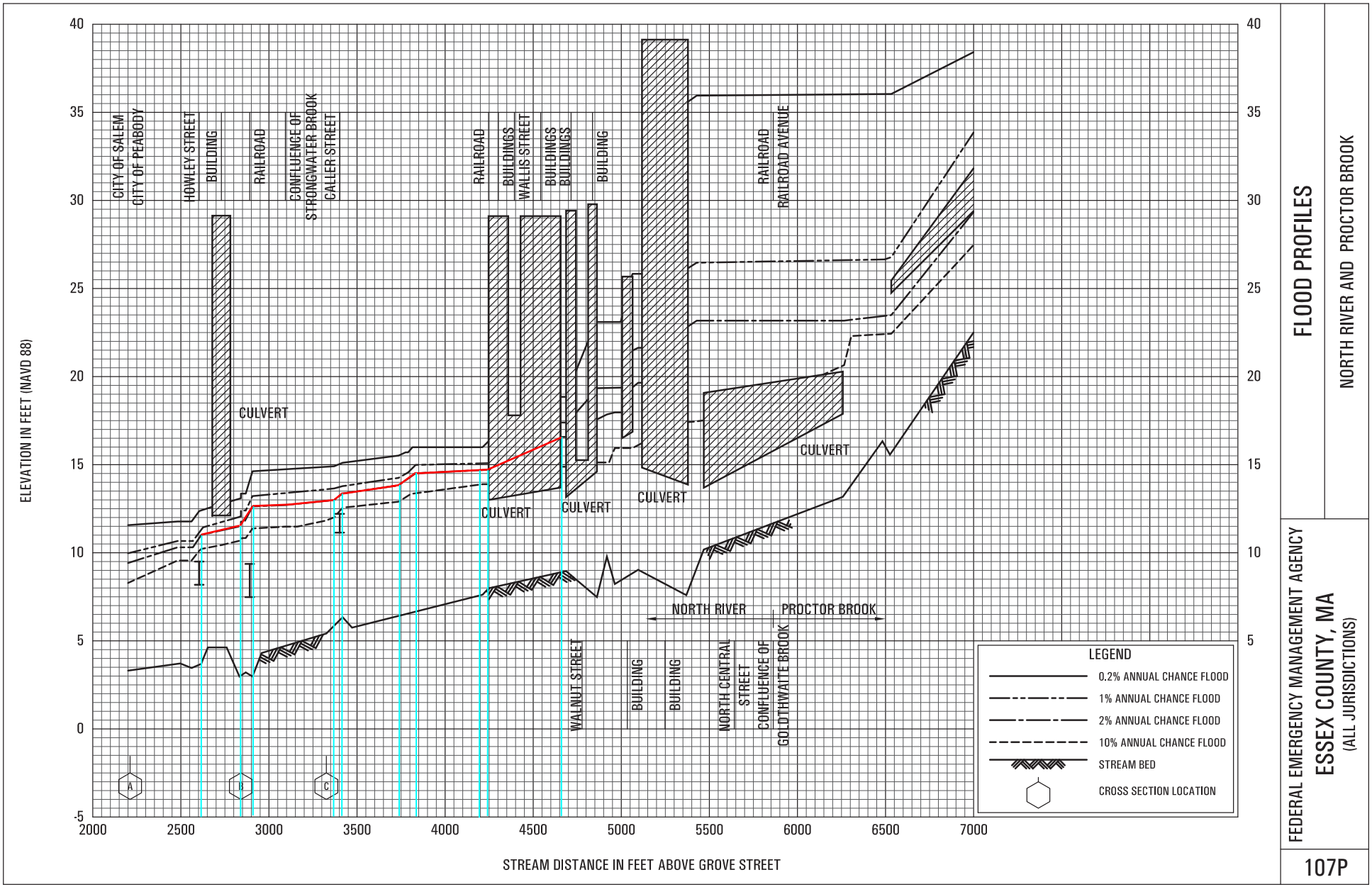
Scenario	2025		2038		2050		2063		2075		2088		2100	
	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
Highest	0.49	0.15	1.08	0.33	1.81	0.55	2.80	0.85	3.92	1.19	5.33	1.63	6.83	2.08
Intermediate High	0.36	0.11	0.73	0.22	1.19	0.36	1.80	0.55	2.47	0.75	3.32	1.01	4.20	1.28
Intermediate Low	0.24	0.07	0.43	0.13	0.65	0.20	0.92	0.28	1.21	0.37	1.55	0.47	1.91	0.58
Lowest (Historic Trend)	0.18	0.06	0.29	0.09	0.39	0.12	0.50	0.15	0.60	0.18	0.71	0.22	0.81	0.25
Range	0.31	0.09	0.79	0.24	1.42	0.43	2.30	0.70	3.32	1.01	4.62	1.41	6.02	1.83

RESILIENCE EVALUATION REPORT

APPENDIX B

River Profiles

Scenario 1A



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

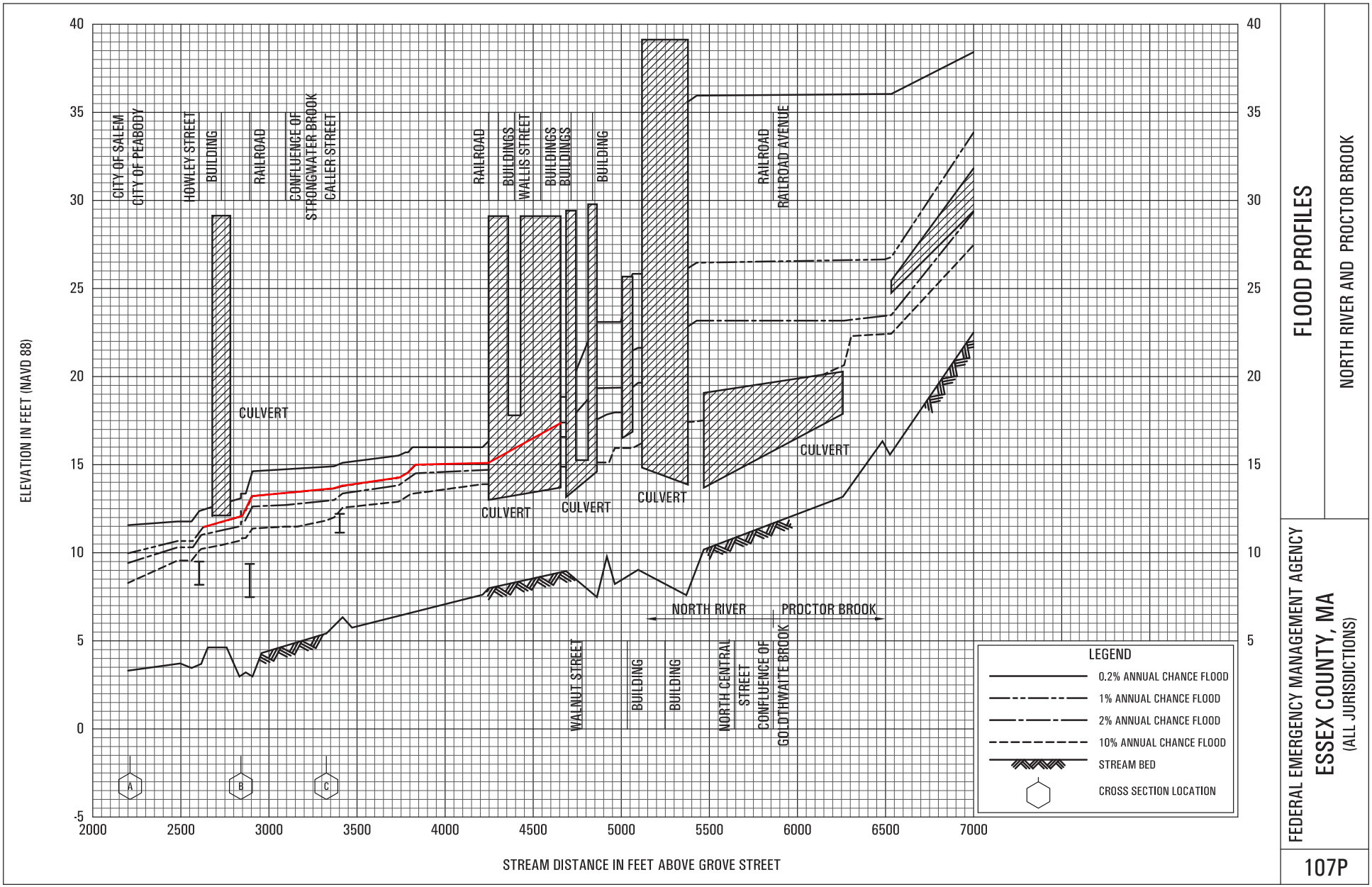
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

(ALL JURISDICTIONS)

107P

Scenario 1B



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

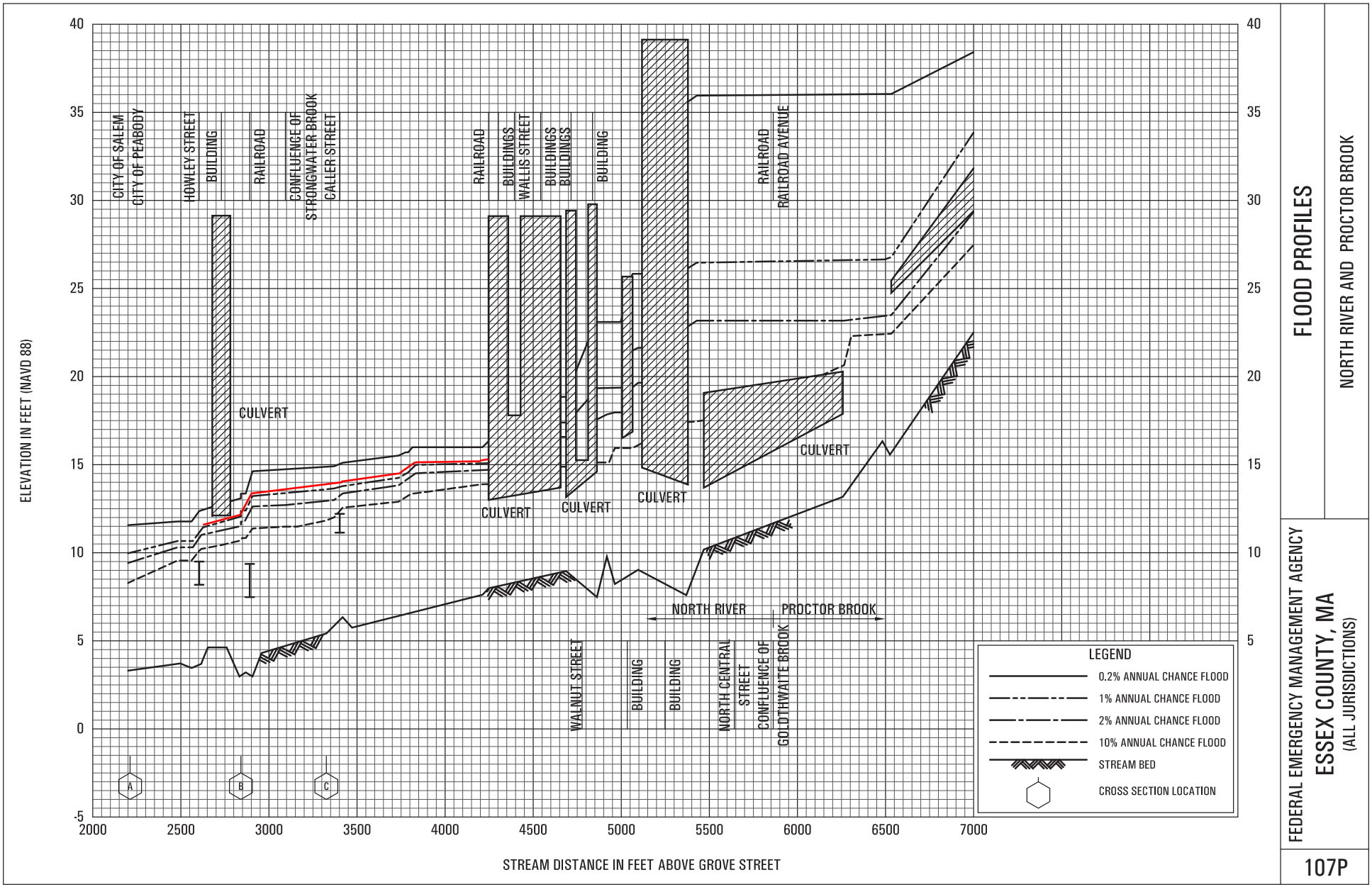
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

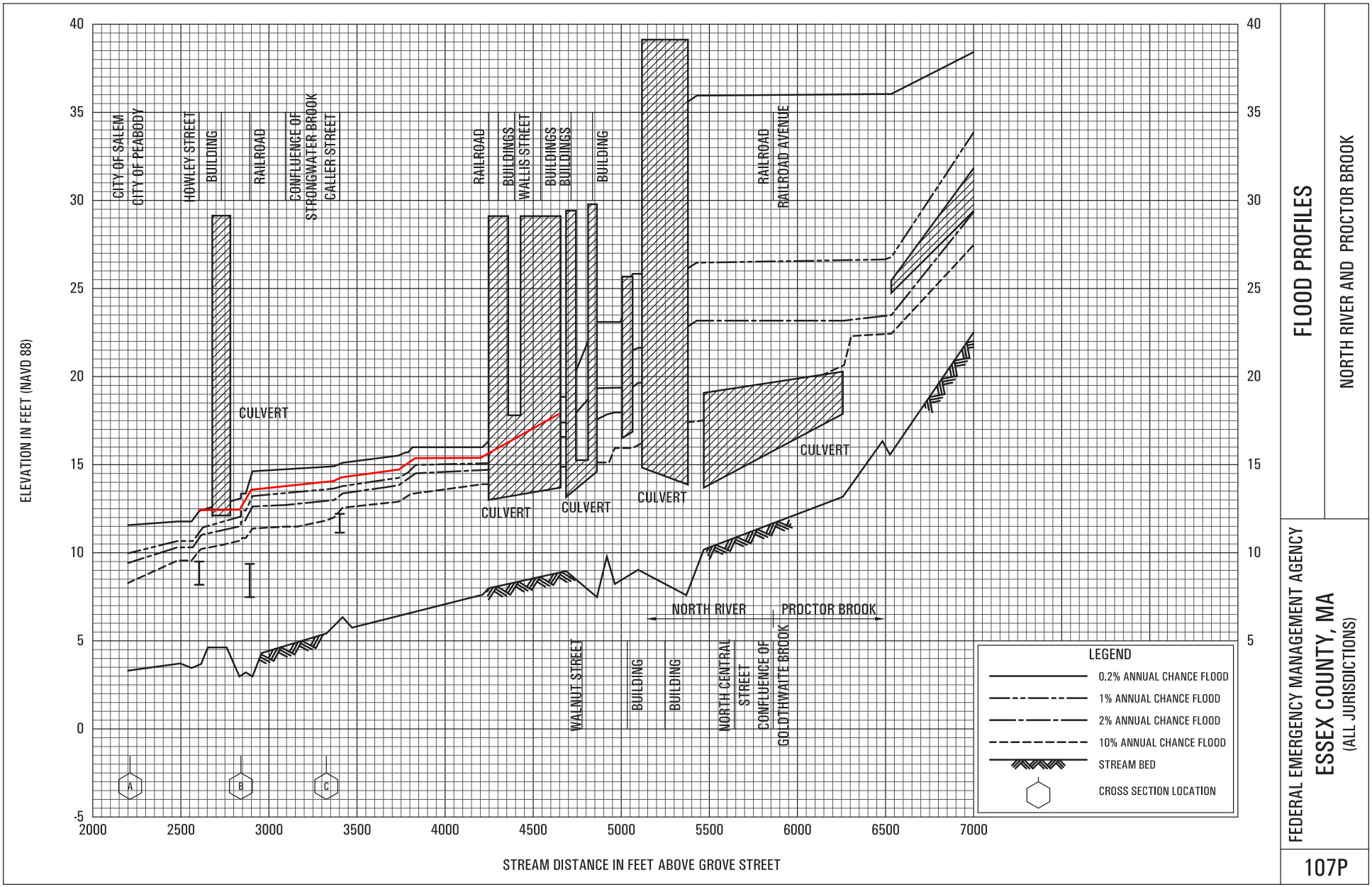
(ALL JURISDICTIONS)

107P

Scenario 2


ELEVATION IN FEET (NAVD 88)
STREAM DISTANCE IN FEET ABOVE GROVE STREET
CITY OF SALEM
CITY OF PEABODY
HOWLEY STREET
BUILDING
RAILROAD
CONFLUENCE OF STRONGWATER BROOK
CALLER STREET
RAILROAD
BUILDINGS
WALLIS STREET
BUILDINGS
BUILDINGS
BUILDING
RAILROAD
RAILROAD AVENUE
CULVERT
CULVERT
CULVERT
CULVERT
CULVERT
NORTH RIVER
PROCTOR BROOK
WALNUT STREET
BUILDING
BUILDING
NORTH CENTRAL STREET
CONFLUENCE OF GOLDTHWAITE BROOK
A
B
C
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION
FLOOD PROFILES
NORTH RIVER AND PROCTOR BROOK
FEDERAL EMERGENCY MANAGEMENT AGENCY
ESSEX COUNTY, MA
(ALL JURISDICTIONS)
107P

Scenario 3



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

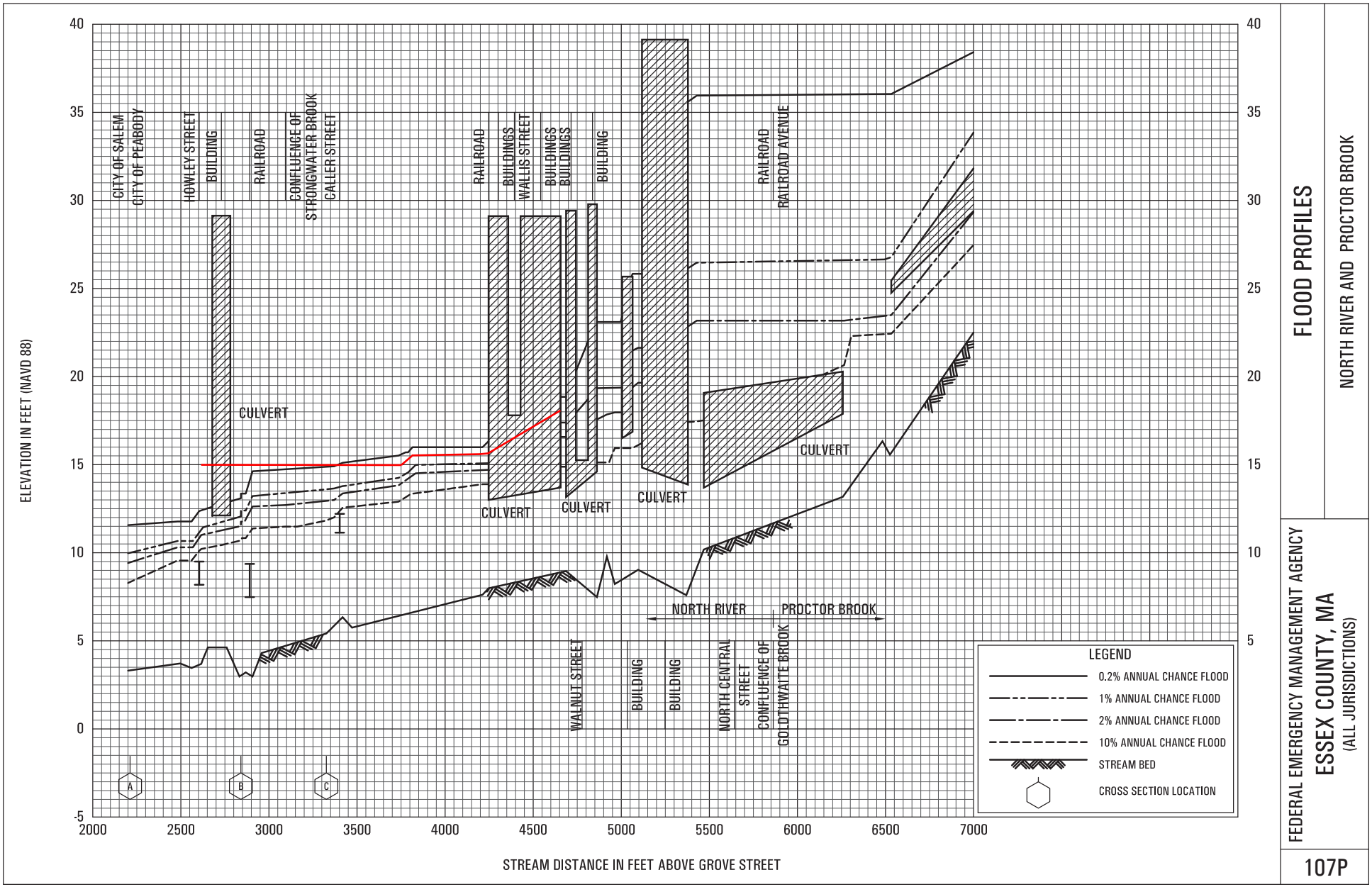
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

(ALL JURISDICTIONS)

107P

Scenario 4



FLOOD PROFILES

NORTH RIVER AND PROCTOR BROOK

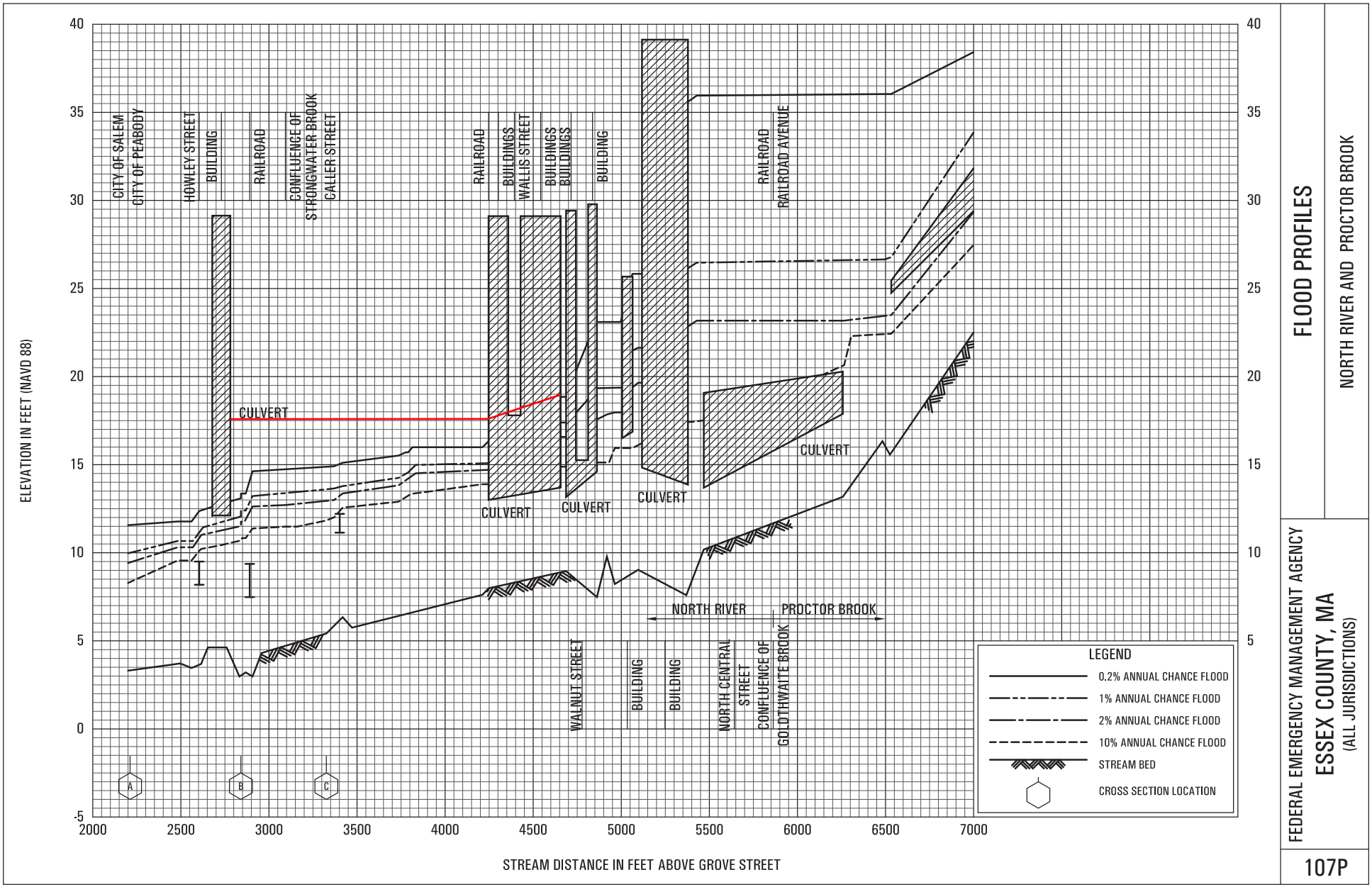
FEDERAL EMERGENCY MANAGEMENT AGENCY

ESSEX COUNTY, MA

(ALL JURISDICTIONS)

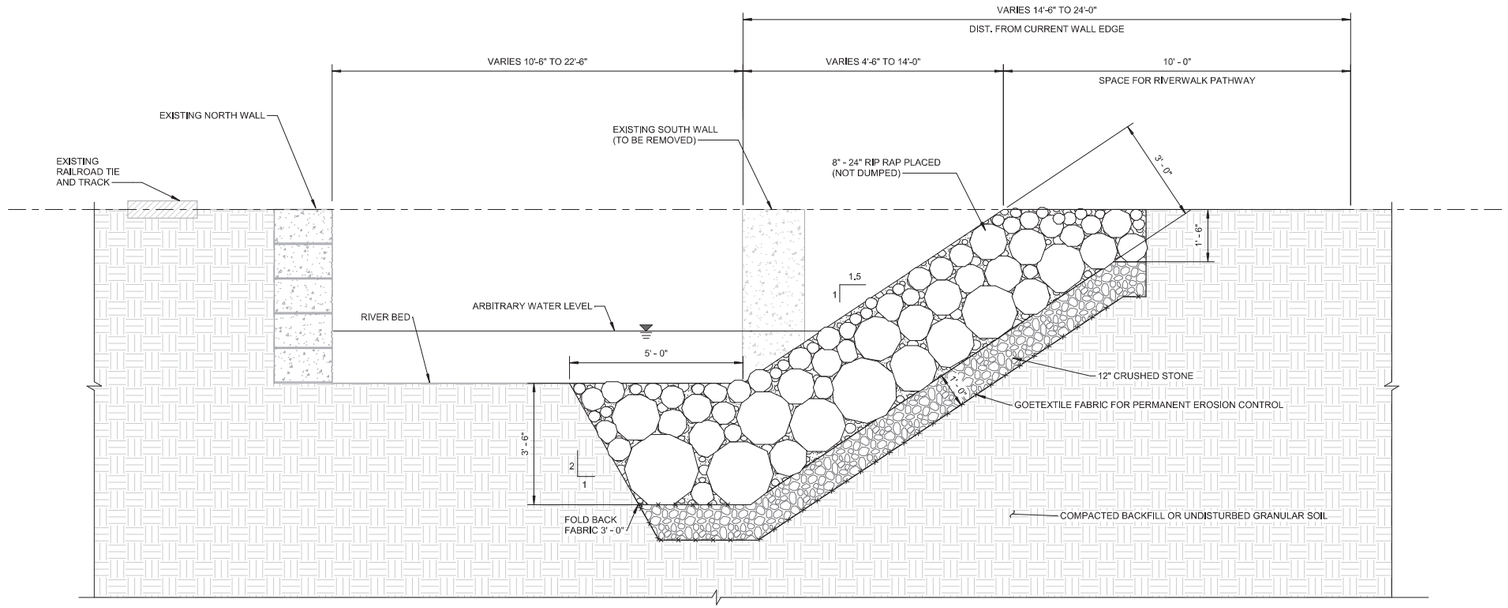
107P

Scenario 5

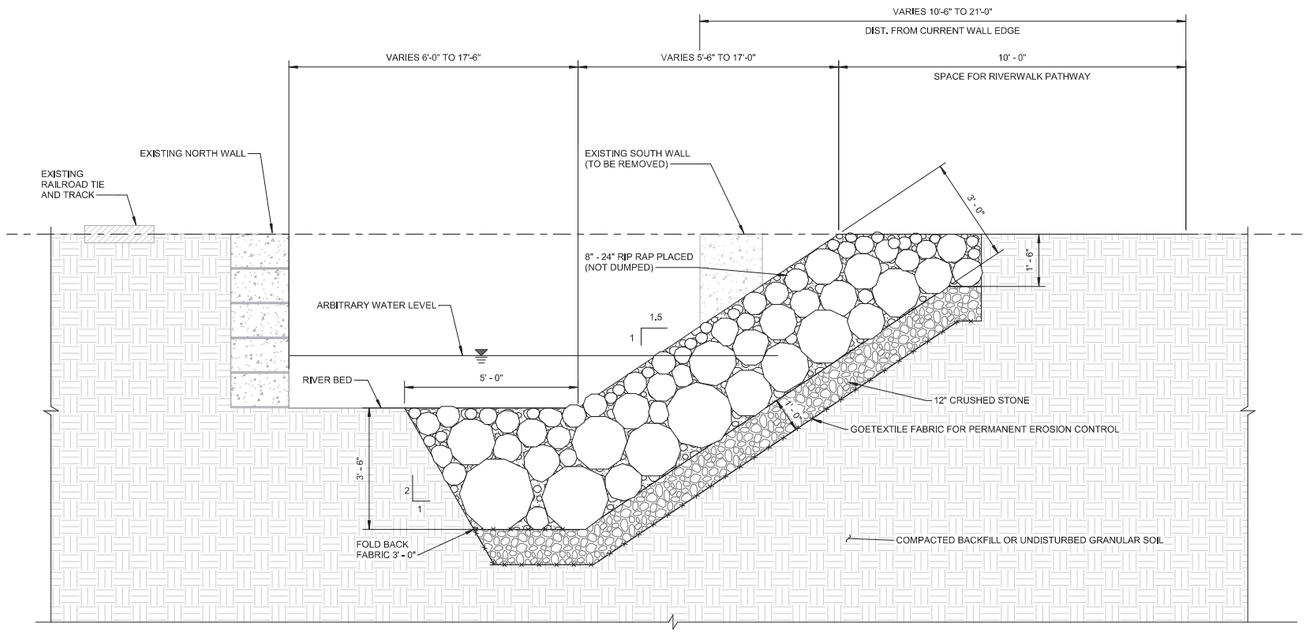

FLOOD PROFILES
NORTH RIVER AND PROCTOR BROOK
FEDERAL EMERGENCY MANAGEMENT AGENCY
ESSEX COUNTY, MA
(ALL JURISDICTIONS)
107P
ELEVATION IN FEET (NAVD 88)
STREAM DISTANCE IN FEET ABOVE GROVE STREET
CITY OF SALEM
CITY OF PEABODY
HOWLEY STREET
BUILDING
RAILROAD
CONFLUENCE OF STRONGWATER BROOK
CALLER STREET
RAILROAD
BUILDINGS
WALLIS STREET
BUILDINGS
BUILDINGS
BUILDING
RAILROAD
RAILROAD AVENUE
CULVERT
CULVERT
CULVERT
CULVERT
CULVERT
NORTH RIVER
PROCTOR BROOK
WALNUT STREET
BUILDING
BUILDING
NORTH CENTRAL STREET
CONFLUENCE OF GOLDTHWAITE BROOK
A
B
C
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION

APPENDIX C

Wall Alternatives Typical Cross-Sections



1 RIP RAP SLOPE OPTION 1



2 RIP RAP SLOPE OPTION 2

FIGURE H–1
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE A –
RIP RAP SLOPE DETAILS
JANUARY, 2019

Weston & Sampson

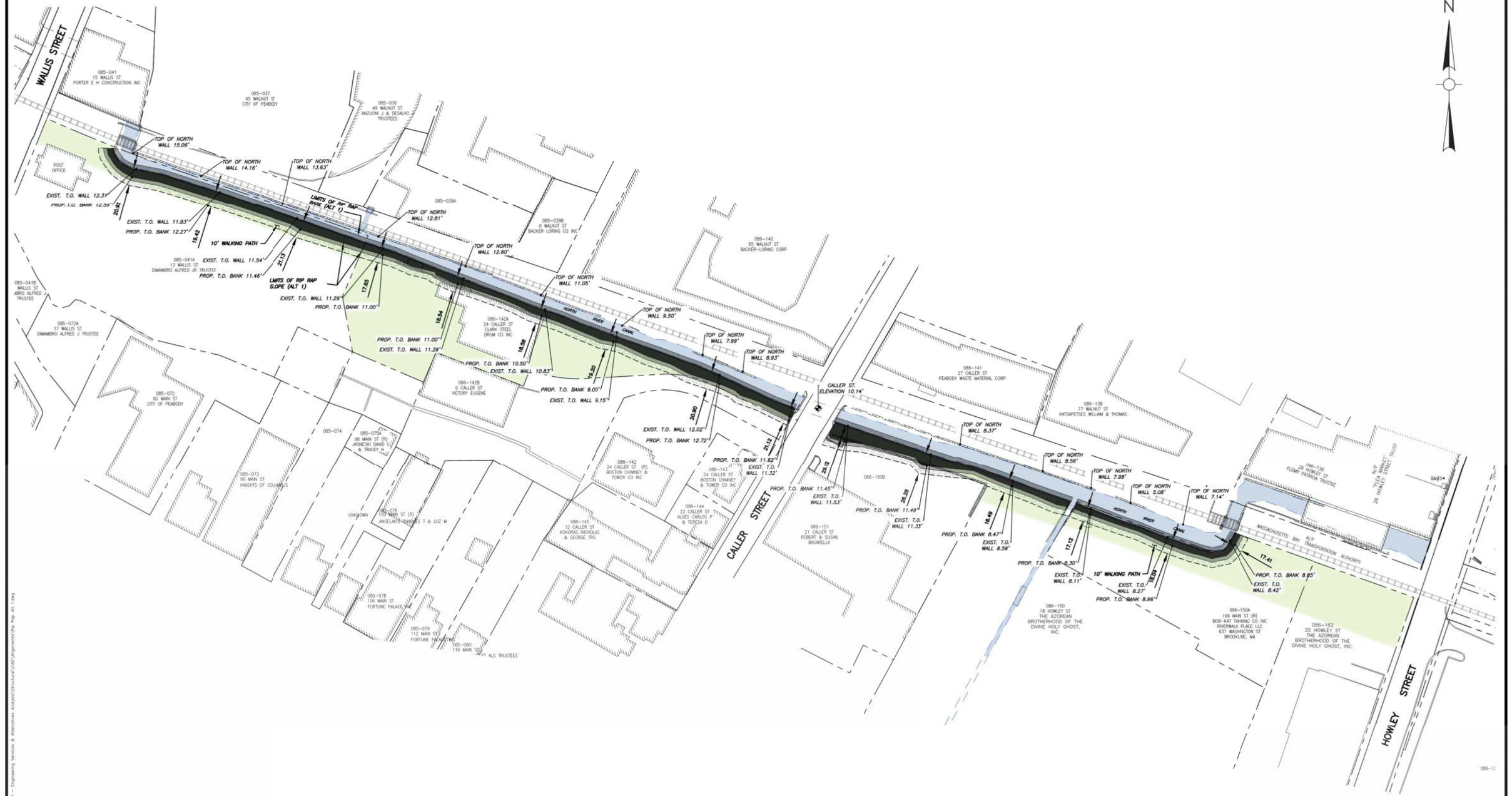


FIGURE H-2
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE A –
RIP RAP SLOPE OPTION 1

JANUARY, 2019

Weston & Sampson

\\wsbo3.local\WSE\Projects\MA\Peabody MA MVP Action Grant 2018\Task 2 - Engineering Services & Alternatives Analysis\Structural\CAD\Alignments\Alt Rip Rap Alt 1.dwg

N

WALLIS STREET

085-041
15 WALLIS ST
PORTER E H CONSTRUCTION INC

085-037
45 WALNUT ST
CITY OF PEABODY

085-036
49 WALNUT ST
ANZUONI J & DESALVO J
TRUSTEES

POST OFFICE

TOP OF NORTH WALL 15.06'
TOP OF NORTH WALL 14.16'
TOP OF NORTH WALL 13.63'
TOP OF NORTH WALL 12.81'
TOP OF NORTH WALL 12.60'
TOP OF NORTH WALL 11.05'
TOP OF NORTH WALL 9.50'
TOP OF NORTH WALL 7.99'
TOP OF NORTH WALL 8.93'
TOP OF NORTH WALL 8.37'
TOP OF NORTH WALL 8.56'
TOP OF NORTH WALL 7.98'
TOP OF NORTH WALL 5.08'
TOP OF NORTH WALL 7.14'

LIMITS OF RIP RAP BASE (ALT 2)
LIMITS OF RIP RAP SLOPE (ALT 2)

10' WALKING PATH

16.35
PROP. T.O. BANK 12.51'
EXIST. T.O. WALL 12.31'

15.65
PROP. T.O. BANK 12.14'
EXIST. T.O. WALL 11.83'

16.26
EXIST. T.O. WALL 11.54'
PROP. T.O. BANK 11.42'

14.74
PROP. T.O. BANK 11.00'
EXIST. T.O. WALL 11.29'

13.10
EXIST. T.O. WALL 11.29'
PROP. T.O. BANK 9.85'

13.83
EXIST. T.O. WALL 10.83'
PROP. T.O. BANK 9.63'

17.37
EXIST. T.O. WALL 9.15'
PROP. T.O. BANK 9.37'

20.48
PROP. T.O. BANK 12.69'
EXIST. T.O. WALL 12.02'

16.72
PROP. T.O. BANK 11.53'
EXIST. T.O. WALL 11.32'

28.55
EXIST. T.O. WALL 11.53'
PROP. T.O. BANK 13.01'

22.95
EXIST. T.O. WALL 11.33'
PROP. T.O. BANK 15.04'

12.28
EXIST. T.O. WALL 8.59'
PROP. T.O. BANK 8.54'

13.46
EXIST. T.O. WALL 8.11'
PROP. T.O. BANK 8.12'

14.09
EXIST. T.O. WALL 8.27'
PROP. T.O. BANK 8.39'

13.42
PROP. T.O. BANK 8.52'
EXIST. T.O. WALL 8.42'

085-039A

085-039B
0 WALNUT ST
BACKER LORING CO INC

086-140
65 WALNUT ST
BACKER-LORING CORP

085-041A
13 WALLIS ST
DIMAMBRO ALFRED JR TRUSTEE

085-072A
17 WALLIS ST
DIMAMBRO ALFRED J TRUSTEE

086-143A
24 CALLER ST
CLARK STEEL DRUM CO INC

086-141
27 CALLER ST
PEABODY WASTE MATERIAL CORP

086-138
77 WALNUT ST
KATSAPETSES WILLIAM & THOMAS

085-072
82 MAIN ST
CITY OF PEABODY

085-074

085-075A
98 MAIN ST (R)
JASNESKI DAVID C.
& TRACEY H

085-073
96 MAIN ST
KNIGHTS OF COLUMBUS

086-142B
0 CALLER ST
VICTORY EUGENE

086-142
24 CALLER ST (R)
BOSTON CHIMNEY &
TOWER CO INC

086-143
24 CALLER ST
BOSTON CHIMNEY
& TOWER CO INC

086-144
22 CALLER ST
ALVES CARLOS P
& TERESA D

086-145
12 CALLER ST
KOKORAS NICHOLAS
& GEORGE TRS

086-150B

086-151
21 CALLER ST
ROBERT & SUSAN
BAGARELLA

086-150
18 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST,
INC.

086-150A
166 MAIN ST (R)
BOB-KAT TANNING CO INC
RIVERWALK PLACE LLC
637 WASHINGTON ST
BROOKLINE, MA

086-156
26 HOWLEY ST
FLOMO PATRICIA TRUSTEE

N/F
TLEA MARKET
26 HOWLEY STREET TRUST

086-162
20 HOWLEY ST
THE AZOREAN
BROTHERHOOD OF THE
DIVINE HOLY GHOST, INC.

086-134

085-078
106 MAIN ST
FORTUNE PALACE INC

085-079
112 MAIN ST
FORTUNE PALACE INC

085-080
116 MAIN ST
PAGE AMY LEE ET ALS TRUSTEES

085-076
100 MAIN ST (R)
ANGELAKIS CHARLES T & LUZ M

UNKNOWN

CALLER ST.
ELEVATION 10.14'

CALLER STREET

HOWLEY STREET

NORTH RIVER CANAL

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

N/F
TRANSPORTATION AUTHORITY

CONCRETE

BM#3

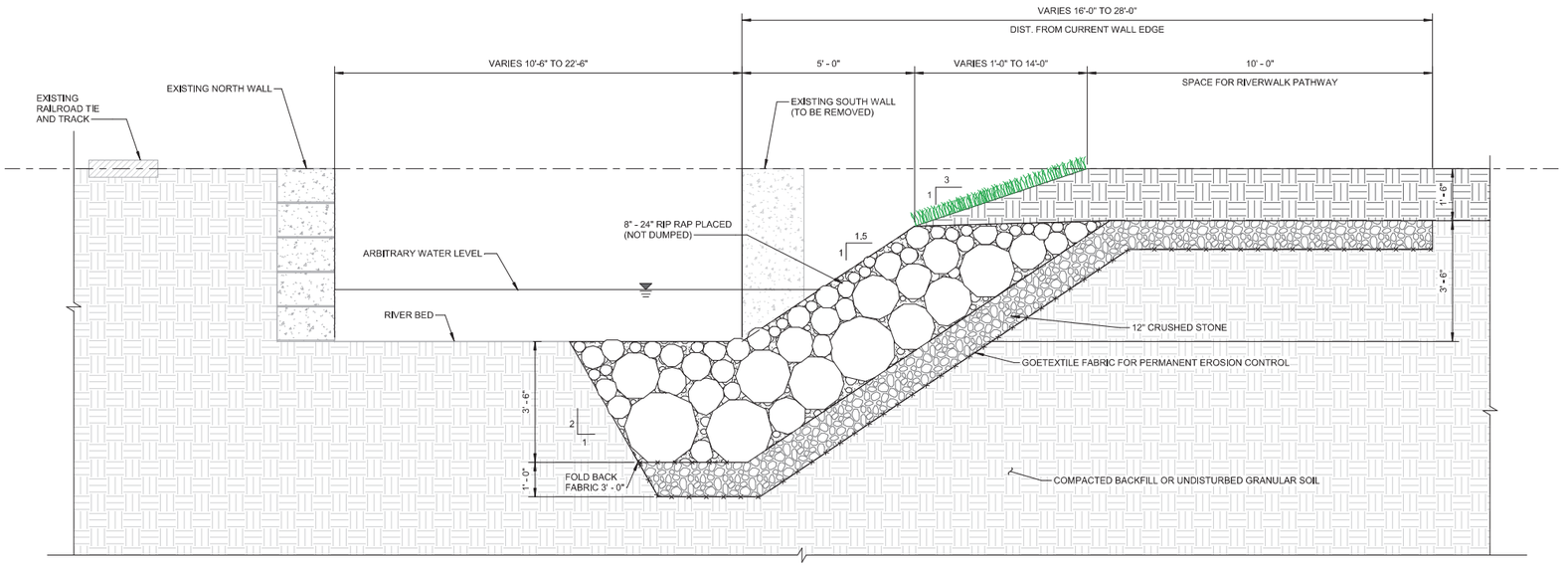
FIGURE H-3
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE A –
RIP RAP SLOPE OPTION 2

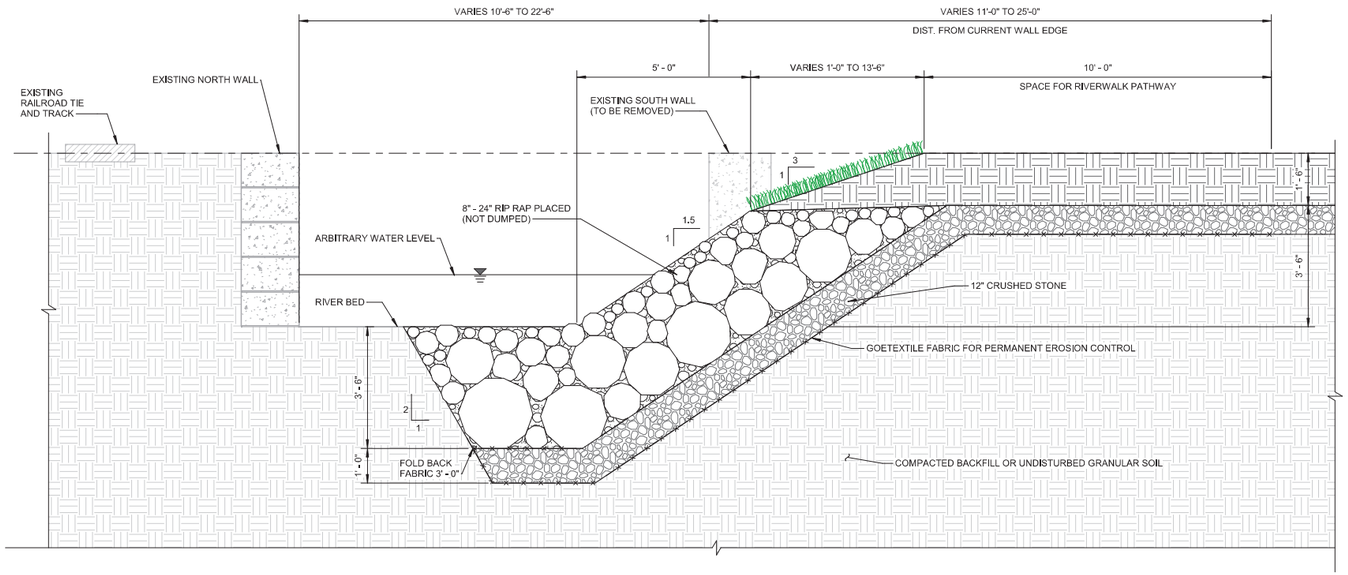
JANUARY, 2019

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\\wse03.local\WSE_Projects\MA\Peabody MA\MVP Action Grant 2018\Task 2 - Engineering Services & Alternatives Analysis\Structural\CAD\Alignments\Fig. H-3 Alt 2.dwg



1 VEGETATIVE BERM ABOVE RIP RAP SLOPE OPTION 1



2 VEGETATIVE BERM ABOVE RIP RAP SLOPE OPTION 2

FIGURE H-4
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE DETAILS
JANUARY, 2019

Weston & Sampson

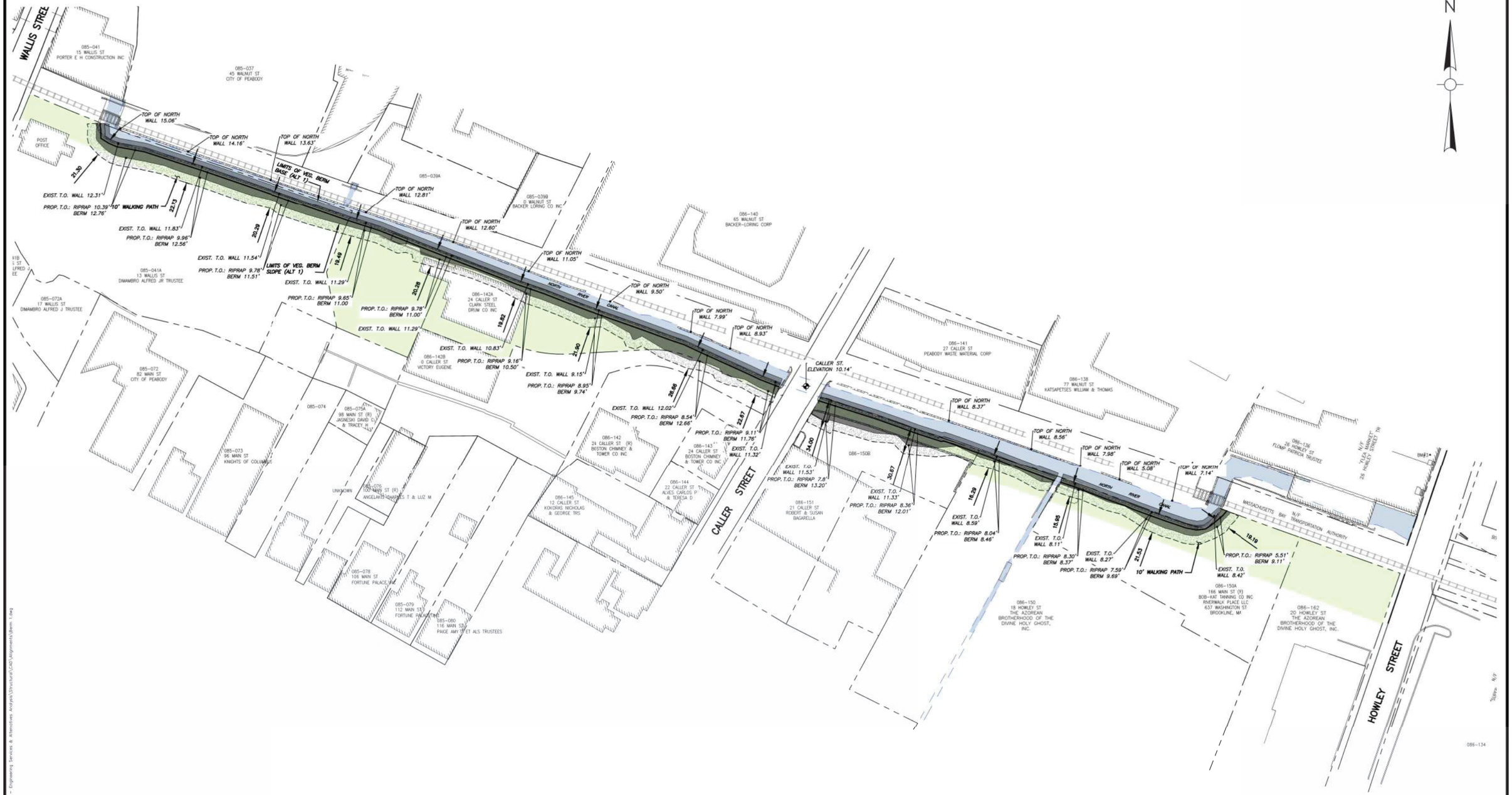


FIGURE H–5
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE OPTION 1
JANUARY, 2019

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\\wes03.ecuk.WSE\Projects\MA\Peabody MA MVP Action Grant 2018\Task 2 – Engineering Services & Alternatives Analysis\Structural\CAD\Alignments Sheet 1.dwg

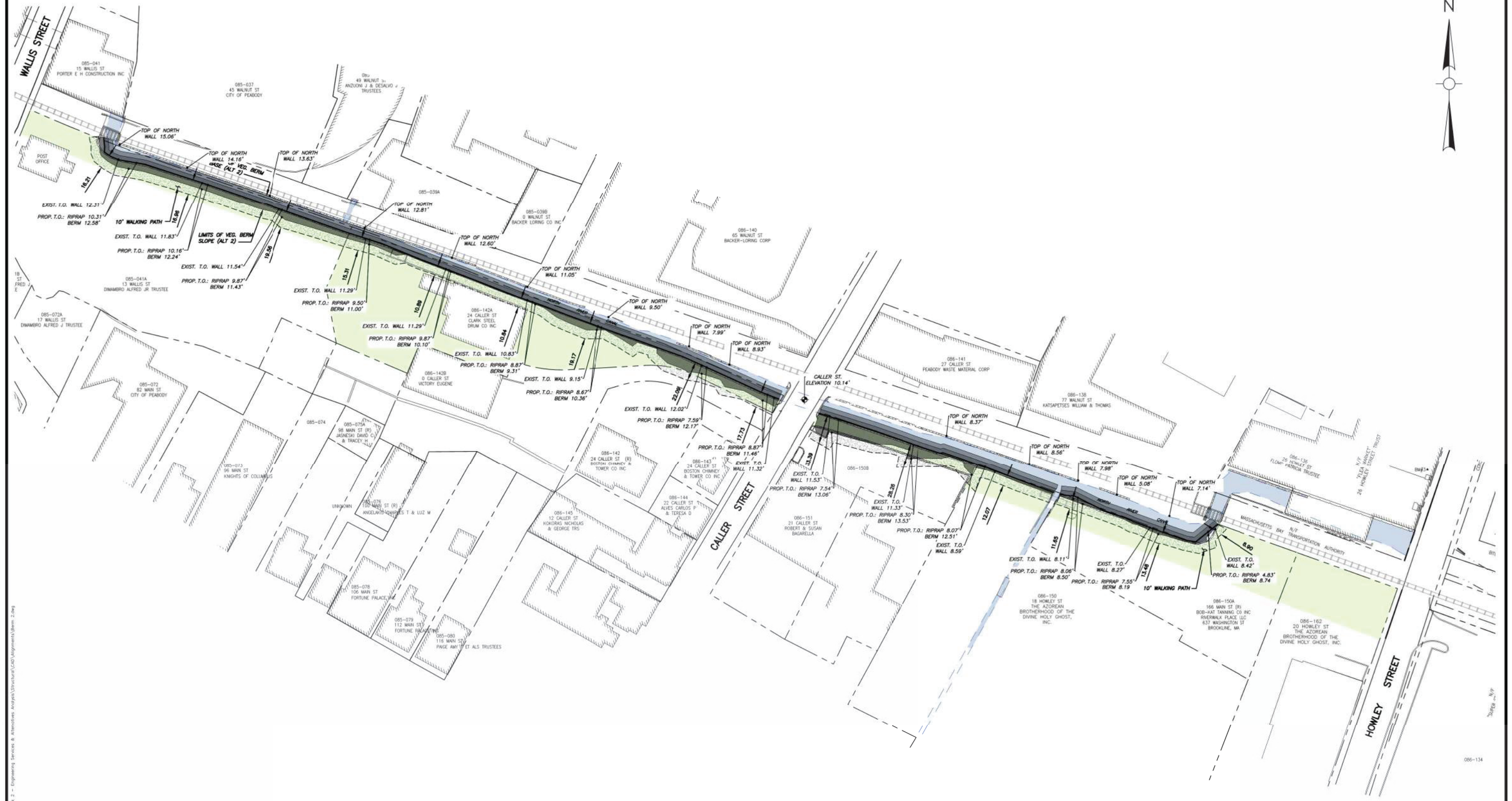


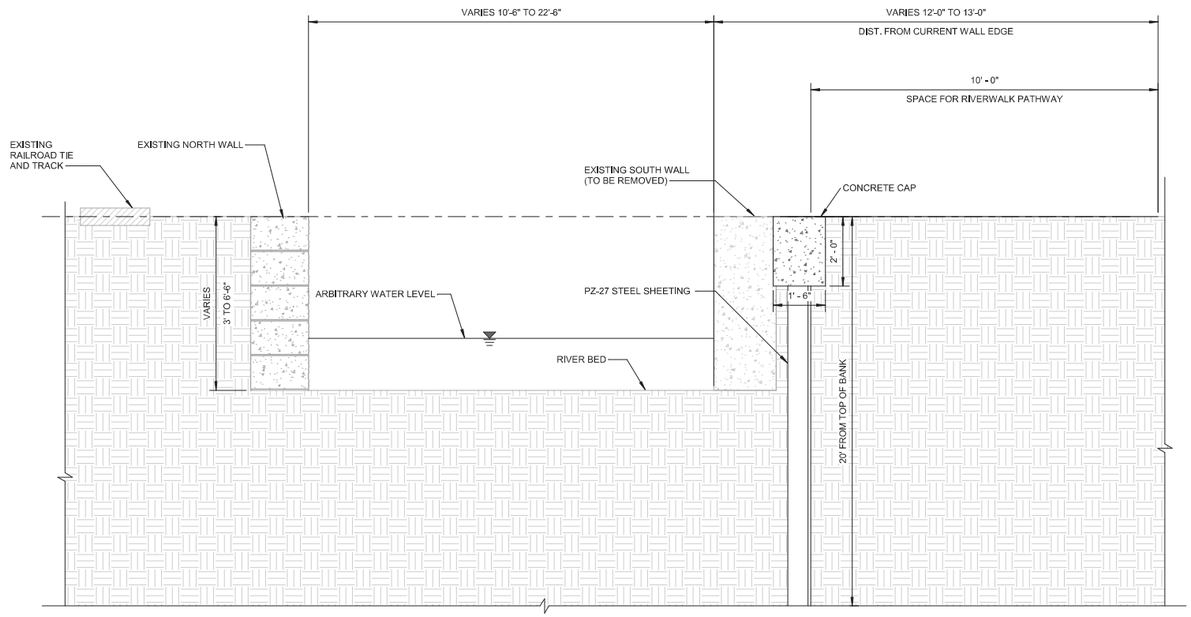
FIGURE H–6
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE B – VEGETATIVE BERM OVER RIP RAP SLOPE OPTION 2

JANUARY, 2019

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1 SHEET PILE DETAIL

FIGURE H–7
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE C –
SHEET PILE WALL
JANUARY, 2019

Weston & Sampson

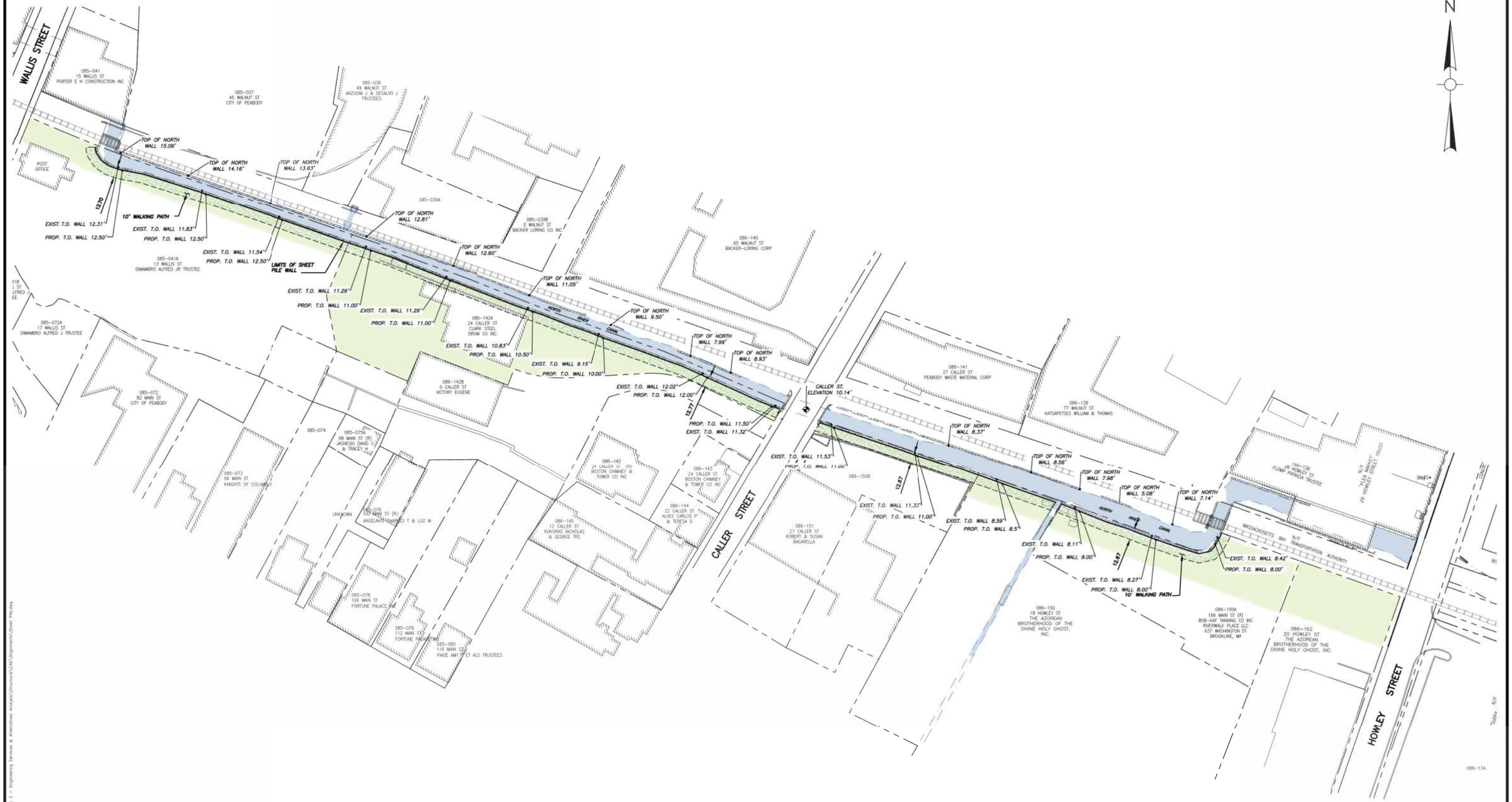
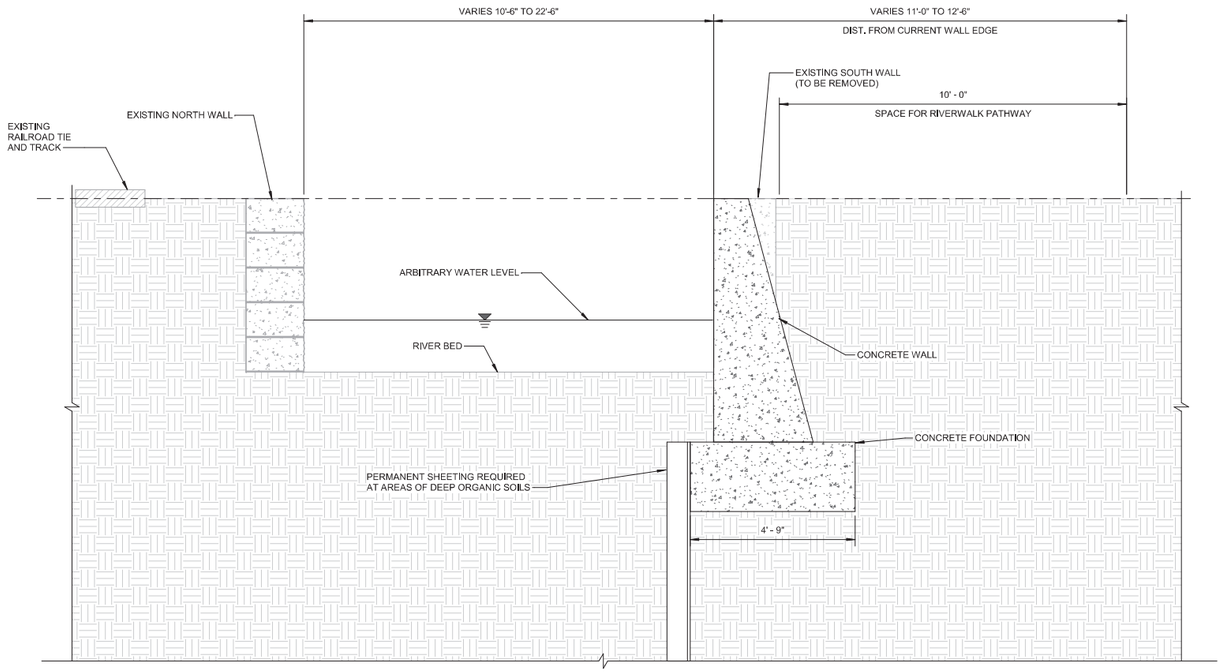


FIGURE H-8
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE C –
SHEET PILE WALL
JANUARY, 2019

Weston & Sampson℠

\\wsbo3.local\WSE\Projects\MA\Peabody MA MVP Action Grant 2018\Task 2 - Engineering Services & Alternatives Analysis\Structural\CAD\Alignments\Sheet Pile.dwg



1 CANTILEVER CONCRETE RETAINING WALL

FIGURE H–9
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE D –
CANTILEVER CONCRETE RETAINING WALL
JANUARY, 2019

Weston & Sampson

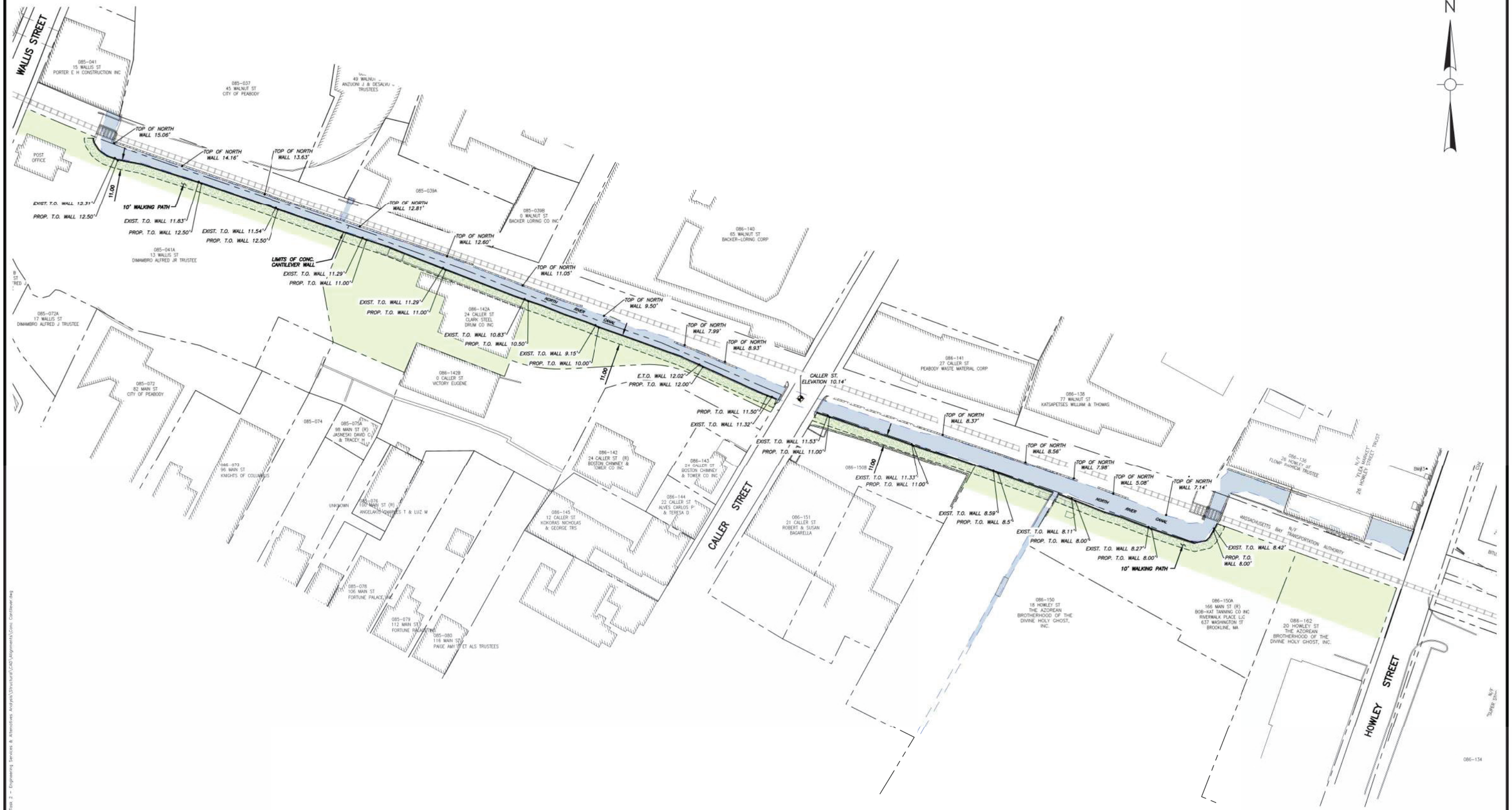
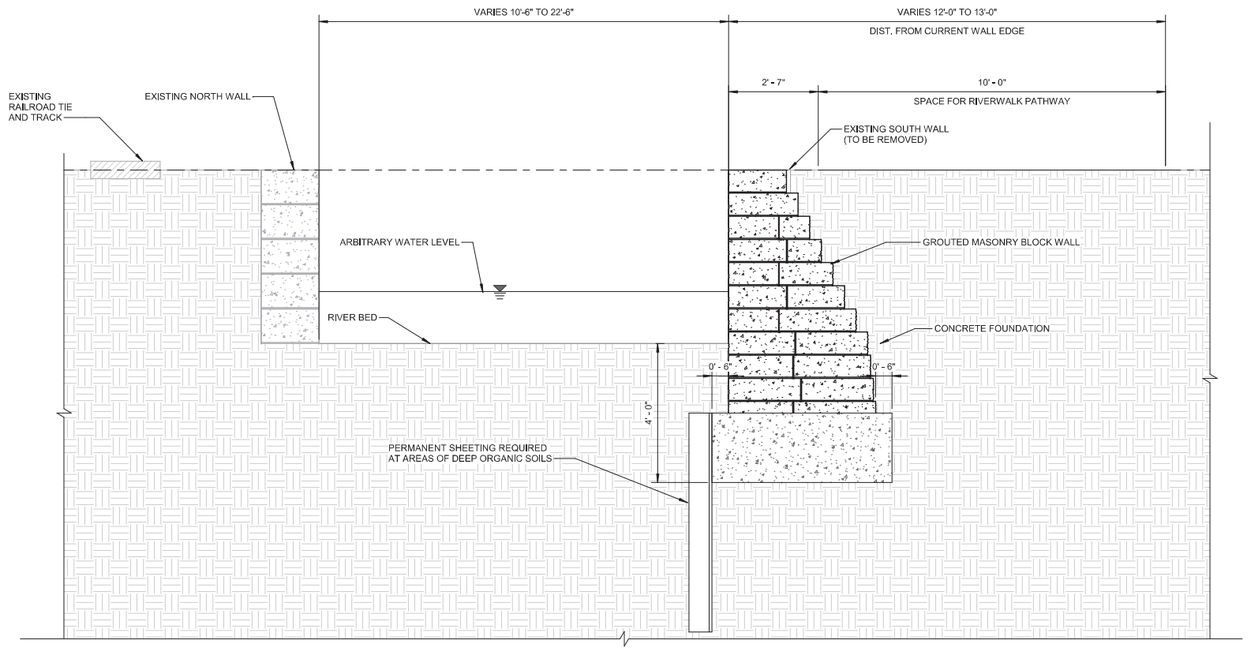


FIGURE H–10
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE D –
CANTILEVER CONCRETE RETAINING WALL
JANUARY, 2019

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1 STONE MASONRY WALL

FIGURE H–11
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT
ALTERNATIVE E –
STONE MASONRY WALL

JANUARY, 2019

Weston & Sampson

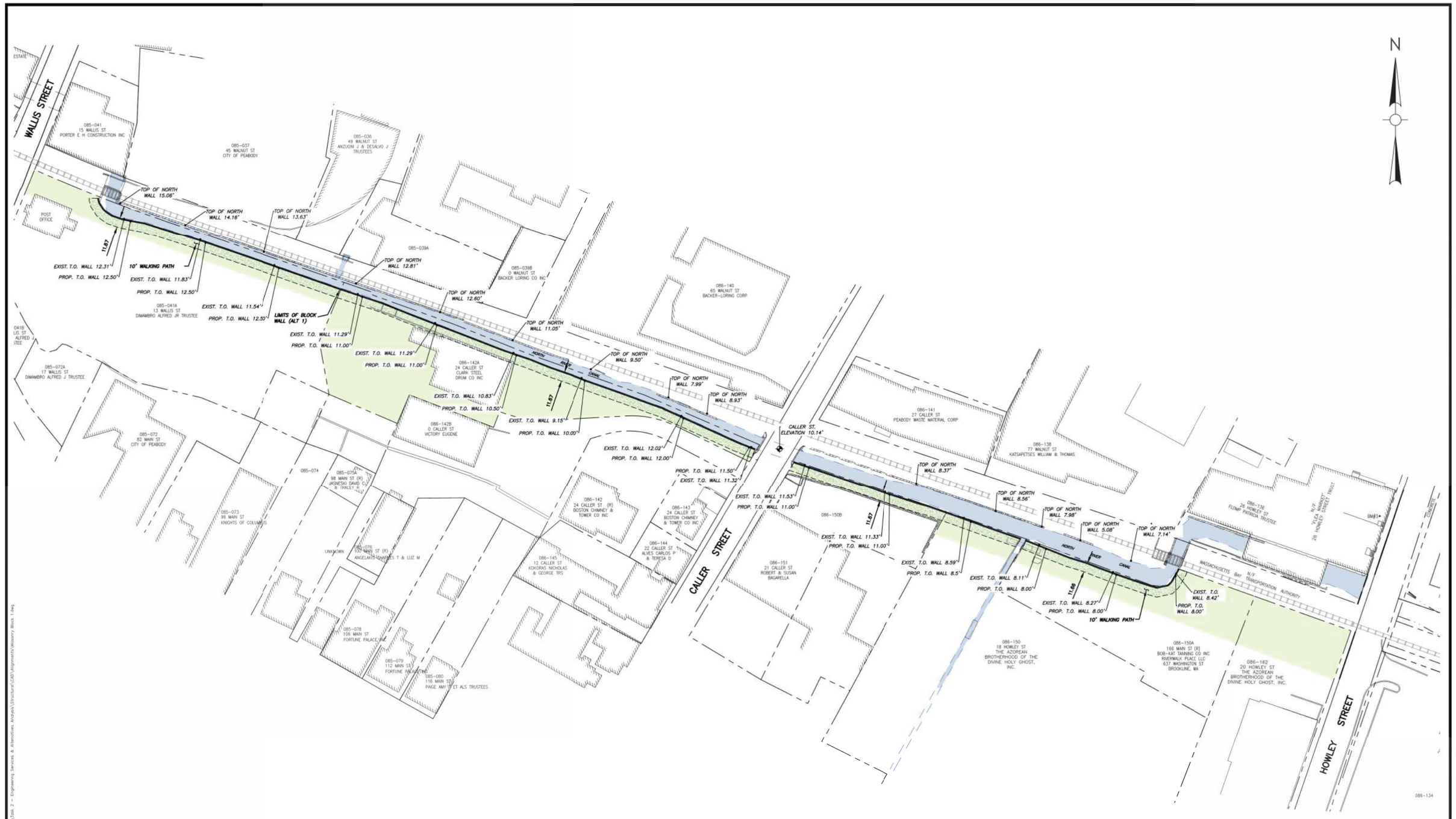


FIGURE H-12
CITY OF PEABODY, MASSACHUSETTS
MVP ACTION GRANT

ALTERNATIVE E –
STONE MASONRY WALL

JANUARY, 2019

Weston & Sampson℠

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Appendix D

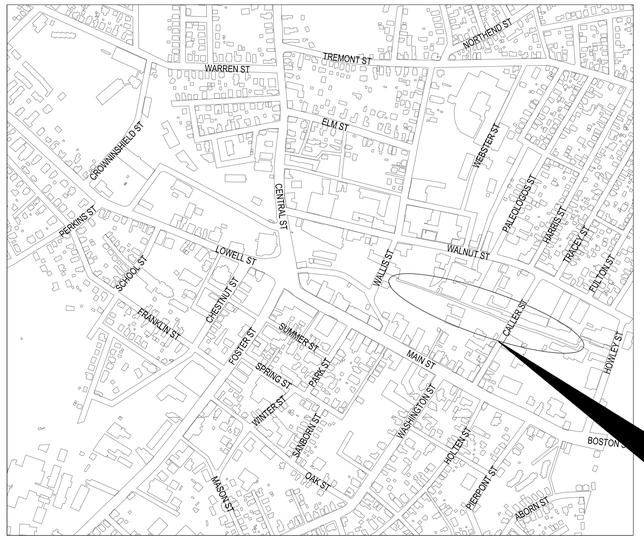
South Wall – Preliminary 25% Design Plans

CITY OF PEABODY, MA

MVP ACTION GRANT, TASK 3

24 LOWELL ST PEABODY, MA 01960

Weston & Sampson Engineers, Inc.
100 Foxborough Boulevard, Suite 250
Foxborough, MA 02035
978.532.1900 800.SAMPSON
www.westonandsampson.com



LOCUS PLAN
SCALE: 1"=500'

SHEET INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET AND INDEX
2	GENERAL NOTES & LEGEND (C001)
3	EXISTING CONDITIONS PLAN I (EX101)
4	EXISTING CONDITIONS PLAN II (EX102)
5	EXISTING CONDITIONS PLAN III (EX103)
6	PROPOSED LAYOUT PLAN I (S201)
7	PROPOSED LAYOUT PLAN II (S202)
8	PROPOSED LAYOUT PLAN III (S203)
9	WALL SECTIONS AND DETAILS I (S601)
10	WALL SECTIONS AND DETAILS II (S602)
11	PEDESTRIAN BRIDGE & TYP. WALL SECTION (S603)
12	EROSION AND SEDIMENT CONTROL DETAILS (C601)

NOT FOR CONSTRUCTION

ISSUED DATE:

05/31/2019

COA:

Know what's **below.**
Call before you dig.

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GENERAL NOTES

1. LOCATIONS OF ANY UTILITIES SHOWN ON THESE PLANS ARE APPROXIMATE ONLY. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF SUCH UTILITIES, PROTECTING ALL EXISTING UTILITIES AND REPAIRING ANY DAMAGE DONE DURING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ON-SITE COORDINATION WITH UTILITY COMPANIES AND PUBLIC AGENCIES AND FOR OBTAINING ALL REQUIRED PERMITS AND PAYING ALL REQUIRED FEES. IN ACCORDANCE WITH M.G.L. CHAPTER 82, SECTION 40, INCLUDING AMENDMENTS, CONTRACTORS SHALL NOTIFY ALL UTILITY COMPANIES AND GOVERNMENT AGENCIES IN WRITING PRIOR TO EXCAVATION.
2. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR AND THE INFORMATION FURNISHED TO THE ENGINEER FOR RESOLUTION OF THE CONFLICT.
3. THE CONTRACTOR SHALL MAKE ALL ARRANGEMENTS FOR THE ALTERATION AND ADJUSTMENT OF GAS, ELECTRIC, TELEPHONE AND ANY OTHER PRIVATE UTILITIES BY THE UTILITY OWNER AT NO ADDITIONAL COST TO THE OWNER.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR REVIEWING ALL DRAWINGS AND SPECIFICATIONS TO DETERMINE THE EXTENT OF EXCAVATION AND DEMOLITION REQUIRED TO RECEIVE SITE IMPROVEMENTS.
5. ANY DISCREPANCIES OR CONFLICTS BETWEEN THE DRAWINGS AND EXISTING CONDITIONS, EXISTING CONDITIONS TO REMAIN, TEMPORARY CONSTRUCTION, PERMANENT CONSTRUCTION AND WORK OF ADJACENT CONTRACTS SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER BEFORE PROCEEDING. ITEMS ENCOUNTERED IN AREAS OF EXCAVATION THAT ARE NOT INDICATED ON THE DRAWINGS, BUT ARE VISIBLE ON SURFACE, SHALL BE THE CONTRACTOR'S RESPONSIBILITY AND SHALL BE REMOVED AT NO ADDITIONAL COST TO THE OWNER.
6. ANY ALTERATIONS TO THESE DRAWINGS MADE IN THE FIELD DURING CONSTRUCTION SHALL BE RECORDED BY THE GENERAL CONTRACTOR ON "AS-BUILT" DRAWINGS.
7. ALL AREAS DISTURBED BY THE CONTRACTOR'S OPERATIONS OUTSIDE THE PROJECT LIMITS, SHALL BE RESTORED TO THE ORIGINAL CONDITION BY THE CONTRACTOR AT NO ADDITIONAL COST AND TO THE SATISFACTION OF THE OWNER.
8. ALL WORK SHOWN ON THE PLANS AS BOLD SHALL REPRESENT PROPOSED WORK, THE TERM "PROPOSED (PROP)" INDICATES WORK TO BE CONSTRUCTED USING NEW MATERIALS OR, WHERE APPLICABLE, RE-USING EXISTING MATERIALS IDENTIFIED AS "REMOVE AND RESET (R&R)", OR REMOVE, RELOCATE, RESET, (R,R&R).
9. ALL KNOWN EXISTING STATE, COUNTY AND TOWN LOCATION LINES AND PRIVATE PROPERTY LINES HAVE BEEN ESTABLISHED FROM AVAILABLE INFORMATION AND ARE INDICATED ON THE PLANS.
10. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT HIS EMPLOYEES, AS WELL AS PUBLIC USERS FROM INJURY DURING THE ENTIRE CONSTRUCTION PERIOD USING ALL NECESSARY SAFEGUARDS, INCLUDING BUT NOT LIMITED TO, THE ERECTION OF TEMPORARY WALKS, STRUCTURES, PROTECTIVE BARRIERS, COVERING, OR FENCES AS NEEDED.
11. THE CONTRACTOR SHALL SUPPLY THE OWNER WITH THE NAME OF THE OSHA "COMPETENT PERSON" PRIOR TO CONSTRUCTION.
12. FILLING OF EXCAVATED AREAS SHALL NOT TAKE PLACE WITHOUT THE PRESENCE OR PERMISSION OF THE OWNER.
13. EXISTING TREES TO REMAIN SHALL BE PROTECTED FROM CONSTRUCTION ACTIVITIES. NO STOCKPILING OF MATERIAL, EQUIPMENT OR VEHICULAR TRAFFIC SHALL BE ALLOWED WITHIN THE DRIP LINE OF TREES TO REMAIN. NO GUYS SHALL BE ATTACHED TO ANY TREE TO REMAIN. WHEN NECESSARY OR AS DIRECTED BY THE ENGINEER, THE CONTRACTOR SHALL ERECT TEMPORARY BARRIERS FOR THE PROTECTION OF EXISTING TREES DURING CONSTRUCTION.
14. TREES AND SHRUBS WITHIN THE LIMITS OF WORK SHALL BE REMOVED ONLY UPON THE APPROVAL OF THE ENGINEER OR AS NOTED ON THE PLANS.
15. THE CONTRACTOR SHALL CALL DIGSAFE AT 1-888-344-7233 AT LEAST 72 HOURS, SATURDAYS, AND HOLIDAYS EXCLUDED, PRIOR TO EXCAVATING AT ANY LOCATION. A COPY OF THE DIGSAFE PROJECT REFERENCE NUMBER(S) SHALL BE GIVEN TO THE OWNER PRIOR TO EXCAVATION.
16. NO FILLING SHALL OCCUR AROUND EXISTING TREES TO REMAIN WITHOUT THE APPROVAL OF THE OWNER OR OWNER REPRESENTATIVE.
17. THE CONTRACTOR SHALL REMOVE ALL SURFACE VEGETATION PRIOR TO GRADING THE SITE. STUMPS SHALL BE STOCKPILED ON SITE FOR DISPOSAL BY THE GC. TEMPORARY EROSION CONTROL MEASURES SHOWN ON THE DRAWINGS (INCLUDING SILT FENCE, STRAW WATTLES, OR SILT SOCKS) SHALL BE INSTALLED BY THE CONTRACTOR UNLESS OTHERWISE NOTED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THESE TEMPORARY EROSION CONTROL MEASURES THROUGHOUT THE PROJECT WHICH COST SHALL BE INCIDENTAL TO THE PROJECT.
18. ALL UNSUITABLE UNCONTAMINATED EXCESS SOIL FROM CONSTRUCTION ACTIVITIES SHALL BE STOCKPILED ON SITE, AS DIRECTED BY THE TOWN, AT NO ADDITIONAL COST TO THE OWNER. REMOVAL ACTIVITIES SHALL BE IN ACCORDANCE WITH STATE AND LOCAL REGULATIONS AT NO ADDITIONAL COST TO THE OWNER. SUITABLE SOIL EXCAVATION AS PART OF THE PROJECT MUST MEET ONE OR MORE OF THE MATERIAL REQUIREMENTS SPECIFIED IN 02300-EARTHWORK. ON-SITE FILL MATERIALS, WHICH DO NOT CONFORM TO SPEC 02300, SHALL NOT BE USED BELOW ANY STRUCTURES. IF THE CONTRACTOR PROPOSES TO USE THE EXISTING FILL ON SITE BELOW PAVEMENT AREAS, HE MUST DEMONSTRATE THAT THE FILL MEETS THE REQUIREMENTS PER SECTION 02300 OF THE SPECIFICATIONS. ALL EXCAVATED FILL MATERIAL WHICH DOES NOT MEET THE REQUIREMENTS OF THE CONTRACT DOCUMENTS SHALL BE REMOVED AND DISPOSED OF OFF-SITE AT NO ADDITIONAL COST.
19. CONTRACTOR IS RESPONSIBLE FOR STAKING CONSTRUCTION BASELINES IN FIELD. NO CONSTRUCTION WILL BE PERFORMED WITHOUT THE PROPOSED BASELINES AND LAYOUTS APPROVED BY THE ENGINEER.
20. NO FILL SHALL CONTAIN HAZARDOUS MATERIALS.
21. CONTRACTOR SHALL PROVIDE TEMPORARY FENCING AROUND PERIMETER OF WORK AREA (LIMIT OF WORK). FENCE SHALL NOT IMPEDE TRAVEL WAYS.
22. ANY QUANTITIES SHOWN ON PLANS ARE FOR COMPARATIVE BIDDING PURPOSES ONLY. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VISIT THE PROJECT SITE TO VERIFY ALL QUANTITIES AND CONDITIONS PRIOR TO SUBMITTING BID.
23. ALL EXISTING DRAINAGE FACILITIES TO REMAIN SHALL BE MAINTAINED FREE OF DEBRIS, SOIL, SEDIMENT, AND FOREIGN MATERIAL AND OPERATIONAL THROUGHOUT THE LIFE OF THE CONTRACT. REMOVE ALL SOIL, SEDIMENT, DEBRIS AND FOREIGN MATERIAL FROM ALL DRAINAGE STRUCTURES, INCLUDING BUT NOT LIMITED TO, DRAINAGE INLETS, MANHOLES AND CATCH BASINS WITHIN THE LIMIT OF WORK AND DRAINAGE STRUCTURES OUTSIDE THE LIMIT OF WORK THAT ARE IMPACTED BY THE WORK FOR THE ENTIRE DURATION OF CONSTRUCTION.
24. CONTRACTOR'S STAGING AREA MUST BE WITHIN THE CONTRACT LIMIT LINE AND IN AREAS APPROVED BY OWNER. ANY OTHER AREAS THAT THE CONTRACTOR MAY WISH TO USE FOR STAGING MUST BE COORDINATED WITH THE OWNER.
25. THE CONTRACTOR SHALL KEEP ALL STREETS, PARKING LOTS AND WALKS THAT ARE NOT RESTRICTED FROM PUBLIC USE DURING CONSTRUCTION BROOM CLEAN AT ALL TIMES. THE CONTRACTOR SHALL USE ACCEPTABLE METHODS AND MATERIALS TO MAINTAIN ADEQUATE DUST CONTROL THROUGHOUT CONSTRUCTION.
26. CONTRACTOR SHALL COORDINATE ALL WORK WITH THE OWNER.
27. CONTRACTOR SHALL DEWATER AS NECESSARY TO PERFORM THE PROPOSED WORK. CONTRACTOR SHALL BE AWARE OF PERCHED GROUNDWATER. (SEE SPECIFICATION SECTION 00320 SUBSURFACE DATA).
28. THE LIMIT OF WORK SHALL BE DELINEATED IN THE FIELD PRIOR TO THE START OF SITE CLEARING OR CONSTRUCTION.
29. DEEP SUMP CATCH BASINS AND STORMWATER BASIN SHALL BE CLEANED FOLLOWING CONSTRUCTION AND SHALL FOLLOW THE OPERATION AND MAINTENANCE PLAN THEREAFTER.
30. HAULING OF EARTH MATERIALS TO AND FROM THE SITE SHALL BE RESTRICTED TO THE HOURS OF 7:00 AM TO 5:00 PM MONDAY THROUGH FRIDAY.
31. ANY BOULDERS 3 CY OR SMALLER SHALL BE CONSIDERED UNDOCUMENTED FILL AND SHALL BE DISPOSED OF AT NO ADDITIONAL COST TO THE OWNER.
32. WORK ON SATURDAYS SHALL ONLY BE CONDUCTED IF PRIOR WRITTEN PERMISSION IS PROVIDED BY THE CITY.

EROSION AND SEDIMENT CONTROL NOTES

1. ALL SEDIMENT AND EROSION CONTROL DEVICES SHALL BE PUT INTO PLACE PRIOR TO BEGINNING ANY CONSTRUCTION OR DEMOLITION. REFER TO PLAN FOR APPROXIMATE LOCATION OF EROSION AND SEDIMENT CONTROL. REFER TO SPECS AND DETAILS FOR TYPE OF EROSION AND SEDIMENT CONTROL.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONTINUAL MAINTENANCE OF ALL CONTROL DEVICES THROUGHOUT THE DURATION OF THE PROJECT.
3. CONTRACTOR SHALL MEET ALL OF THE STATE OF MASSACHUSETTS D.E.P. AND THE CITY OF PEABODY WETLAND ORDINANCE REGULATIONS FOR SEDIMENT AND EROSION CONTROL.
4. EXCAVATED MATERIAL STOCKPILED ON THE SITE SHALL BE SURROUNDED BY A RING OF UNBROKEN SEDIMENT AND EROSION CONTROL FENCE. THE LIMITS OF ALL GRADING AND DISTURBANCE SHALL BE KEPT TO A MINIMUM WITHIN THE APPROVED AREA OF CONSTRUCTION. ALL AREAS OUTSIDE OF THE LIMIT OF CONTRACT SHALL REMAIN TOTALLY UNDISTURBED UNLESS OTHERWISE APPROVED BY OWNER'S REPRESENTATIVE.
5. ALL CATCH BASINS AND DRAIN GRATES WITHIN LIMIT OF CONTRACT SHALL BE PROTECTED WITH FILTER FABRIC DURING THE ENTIRE DURATION OF CONSTRUCTION.
6. EROSION CONTROL BARRIERS TO BE INSTALLED AT THE TOE OF SLOPES. SEE SITE PREPARATION PLAN, NOTES, DETAILS AND SPECIFICATIONS.
7. ANY AREA OUTSIDE THE PROJECT LIMIT THAT IS DISTURBED SHALL BE RESTORED TO ITS ORIGINAL CONDITION AT NO COST TO THE OWNER.
8. THE CONTRACTOR SHALL PROVIDE DUST CONTROL FOR CONSTRUCTION OPERATIONS AS APPROVED BY OWNER.
9. ALL POINTS OF CONSTRUCTION EGRESS OR INGRESS SHALL BE MAINTAINED TO PREVENT TRACKING OR FLOWING OF SEDIMENT ON TO PUBLIC/PRIVATE ROADS.

LAYOUT & MATERIALS NOTES

1. REFER TO EXISTING CONDITIONS PLANS FOR SURVEY INFORMATION.
2. COORDINATE ALL LAYOUT ACTIVITIES WITH THE SCOPE OF WORK CALLED FOR BY DEMOLITION, GRADING AND UTILITIES OPERATIONS ENCOMPASSED BY THIS CONTRACT. SET, PROTECT AND REPLACE REFERENCE STAKES AS NECESSARY OR AS REQUIRED BY THE OWNER'S REPRESENTATIVE.
3. ALL WORK SHALL BE PERFORMED BY CONTRACTOR UNLESS SPECIFICALLY INDICATED THAT THE WORK WILL BE PERFORMED "BY CITY".
4. TO FACILITATE LAYOUT OF PROPOSED SITE FEATURES AND FACILITIES, LAYOUT INFORMATION FOR CERTAIN FUTURE WORK, WHICH IS NOT INCLUDED WITHIN THE SCOPE OF THIS CONTRACT HAS BEEN PROVIDED ON THE LAYOUT AND MATERIALS PLAN FOR INFORMATION ONLY. THE LAYOUT OF SITE AMENITIES AND FENCES MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION. SOME ITEMS ARE "NOT IN CONTRACT" (NIC) AND SHOWN FOR REFERENCE ONLY.
5. THE LAYOUT OF SITE AMENITIES AND FENCES MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION.
6. THE LAYOUT OF ALL NEW PATHWAYS / WALKWAYS AND THE GRADING OF ALL SLOPES AND CROSS SLOPES SHALL CONFORM TO THE COMMONWEALTH OF MASSACHUSETTS RULES AND REGULATIONS FOR HANDICAP ACCESS CMR 521, AND THE AMERICANS WITH DISABILITIES ACT (ADA), TITLE 3. THE CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY OF ANY DISCREPANCIES BETWEEN ACTUAL CONDITIONS AND THOSE REQUIRED.
7. ALL LAYOUT LINES, OFFSETS, OR REFERENCES TO LOCATING OBJECTS ARE EITHER PARALLEL OR PERPENDICULAR UNLESS OTHERWISE DESIGNATED WITH ANGLE OFFSETS NOTED.
8. ALL PROPOSED SITE FEATURES SHALL BE LAID OUT AND STAKED FOR REVIEW AND APPROVAL BY THE OWNER'S REPRESENTATIVE PRIOR TO COMMENCEMENT OF INSTALLATION. ANY REQUIRED ADJUSTMENTS TO THE LAYOUT SHALL BE UNDERTAKEN AS REQUIRED, AT NO ADDITIONAL COST TO THE OWNER.
9. ALL PROPOSED PAVEMENTS SHALL MEET THE LINE AND GRADE OF EXISTING ADJACENT PAVEMENT SURFACES AND SHALL BE TREATED WITH AN RS-1 TACK COAT AT POINT OF CONNECTION. ALL PATHWAY WIDTHS SHALL BE AS NOTED ON THE LAYOUT AND MATERIALS PLAN.
10. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND GRADES ON THE GROUND AND REPORT ANY DISCREPANCIES IMMEDIATELY TO THE OWNER.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD MEASUREMENT OF ALL PROPOSED FENCES AND GATES.
12. THE DEPTH OF LOAM BORROW FOR ALL PROPOSED LAWN AREAS SHALL BE 6" MINIMUM. ALL DISTURBED AREAS SHALL BE RESTORED WITH LOAM AND SEED UNLESS OTHERWISE NOTED
13. ALL REFERENCES TO LOAM AND SEED (L&S) REFER TO HYDROMULCH SEEDED LAWN.
14. REFER TO DETAIL DRAWINGS FOR CONSTRUCTION DETAILS.

DEMOLITION & SITE PREPARATION NOTES

1. THE CONTRACTOR SHALL INCLUDE IN THE BID THE COST OF REMOVING ANY EXISTING SITE FEATURES AND APPURTENANCES NECESSARY TO ACCOMPLISH THE CONSTRUCTION OF THE PROPOSED SITE IMPROVEMENTS. THE CONTRACTOR SHALL ALSO INCLUDE IN THE BID THE COST NECESSARY TO RESTORE SUCH ITEMS IF THEY ARE SCHEDULED TO REMAIN AS PART OF THE FINAL SITE IMPROVEMENTS. REFER TO PLANS TO DETERMINE EXCAVATION, DEMOLITION AND TO DETERMINE THE LOCATION OF THE PROPOSED SITE IMPROVEMENTS.
2. THE OWNER RESERVES THE RIGHT TO REVIEW ALL MATERIALS DESIGNATED FOR REMOVAL AND TO RETAIN OWNERSHIP OF SUCH MATERIALS. IF THE OWNER RETAINS ANY MATERIAL THE CONTRACTOR SHALL ALLOW ARRANGEMENTS WITH THE OWNER TO HAVE THOSE MATERIALS REMOVED OFF SITE AT NO ADDITIONAL COST.
3. UNLESS SPECIFICALLY NOTED TO BE SAVED / STOCKPILED (R&S) OR REUSED / RELOCATED (R&R), ALL SITE FEATURES CALLED FOR REMOVAL (REM) SHALL BE REMOVED WITH THEIR FOOTINGS, ATTACHMENTS, BASE MATERIAL, ETC. TRANSPORTED FROM THE SITE TO BE DISPOSED OF IN A LAWFUL MANNER AT AN ACCEPTABLE DISPOSAL SITE AND AT NO COST TO THE OWNER.
4. ALL EXISTING SITE FEATURES TO REMAIN SHALL BE PROTECTED THROUGHOUT THE CONSTRUCTION PERIOD. ANY FEATURES DAMAGED DURING CONSTRUCTION OPERATIONS SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE AT NO ADDITIONAL COST.
5. DURING EARTHWORK OPERATIONS, CONTRACTOR SHALL TAKE CARE TO NOT DISTURB EXISTING MATERIALS TO REMAIN, OUTSIDE THE LIMITS OF EXCAVATION AND BACKFILL AND SHALL TAKE WHATEVER MEASURES NECESSARY, AT THE CONTRACTOR'S EXPENSE, TO PREVENT ANY EXCAVATED MATERIAL FROM COLLAPSING. ALL BACKFILL MATERIALS SHALL BE PLACED AND COMPACTED AS SPECIFIED TO THE SUBGRADE REQUIRED FOR THE INSTALLATION OF THE REMAINDER OF THE CONTRACT WORK.
6. IT SHALL BE THE CONTRACTOR'S OPTION, WITH CONCURRENCE OF THE OWNER, TO REUSE EXISTING GRAVEL IF IT MEETS THE REQUIREMENTS OF THE SPECIFICATIONS FOR GRAVEL BORROW.
7. ALL ITEMS CALLED FOR REMOVAL SHALL BE REMOVED TO FULL DEPTH INCLUDING ALL FOOTINGS, FOUNDATIONS, AND OTHER APPURTENANCES, EXCEPT AS SPECIFICALLY NOTED OTHERWISE.
8. 'CLEAR AND GRUB VEGETATION' SHALL INCLUDE REMOVAL OF GRASS, SHRUBS, AND UNDERBRUSH, REMOVAL OF ROOTS, ROUGH GRADING, INSTALLATION OF LOAM (IF APPLICABLE), FINE GRADING, SEEDING AND TURF ESTABLISHMENT BY THE CONTRACTOR.
9. TREES DESIGNATED FOR REMOVAL SHALL BE TAGGED BY CONTRACTOR AND APPROVED BY OWNER'S REPRESENTATIVE PRIOR TO COMMENCEMENT OF CONSTRUCTION.
10. THE STORAGE OF MATERIALS AND EQUIPMENT WILL BE PERMITTED AT LOCATIONS DESIGNATED BY OWNER OR OWNER'S REPRESENTATIVE. PROTECTION OF STORED MATERIALS AND EQUIPMENT SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
11. STRIP & STORE EXISTING TOPSOIL FOR LATER REUSE WHERE APPROPRIATE, AND AS NOTED ON PLAN, WITH APPROPRIATE EROSION AND SEDIMENT CONTROLS.
12. LOAM / TOP SOIL DESIGNATED FOR REUSE AS GENERAL FILL SHALL BE BLENDED WITH SUITABLE BORROW MATERIAL AS SPECIFIED.
13. THE CONTRACTOR SHALL PROTECT EXISTING TREES TO REMAIN. CONTRACTOR SHALL INSTALL TREE PROTECTION BARRIER AFTER CLEARING UNDERBRUSH AND TAKE DUE CARE TO PREVENT INJURY TO TREES DURING CLEARING OPERATIONS.

GRADING, UTILITIES & DRAINAGE NOTES

1. ALL WORK RELATING TO INSTALLATION, RENOVATION OR MODIFICATION OF WATER, DRAINAGE AND/OR SEWER SERVICES SHALL BE PERFORMED IN ACCORDANCE WITH THE STANDARDS OF THE TOWN OF NORWOOD.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND GRADES ON THE GROUND AND REPORT ANY DISCREPANCIES IMMEDIATELY TO THE OWNER.
3. ALL GRADING IS TO BE SMOOTH AND CONTINUOUS WHERE PROPOSED GRAVEL SURFACE MEETS EXISTING SURFACE, BLEND THE TWO PAVEMENTS AND ELIMINATE ROUGH SPOTS AND ABRUPT GRADE CHANGES AND MEET LINE AND GRADE OF EXISTING CONDITIONS WITH NEW IMPROVEMENTS.
4. CONTRACTOR SHALL MAINTAIN POSITIVE DRAINAGE (1.5% MINIMUM) AWAY FROM ALL BUILDING FOUNDATIONS AND STRUCTURES.
5. CONTRACTOR SHALL ENSURE ALL AREAS ARE PROPERLY PITCHED TO DRAIN, WITH NO SURFACE WATER PONDING OR PUDDLING.
6. ALL NEW WALKWAYS / ACCESS PATHS MUST CONFORM TO CURRENT AMERICANS WITH DISABILITIES ACT (ADA) REGULATIONS: WALKWAYS SHALL MAINTAIN A CROSS PITCH OF NOT MORE THAN ONE AND A HALF PERCENT (1.5%) AND THE RUNNING SLOPE (PARALLEL TO THE DIRECTION OF TRAVEL) BETWEEN 1% MIN. AND 5% MAX.
7. MINIMUM SLOPE ON ALL WALKWAYS WILL BE 1:100 OR 1% TO PROVIDE POSITIVE DRAINAGE. ANY DISCREPANCIES NOT ALLOWING THIS TO OCCUR SHALL BE REPORTED TO THE OWNER PRIOR TO CONTINUING WORK.
8. ALL UTILITY GRATES, COVERS OR OTHER SURFACE ELEMENTS INTENDED TO BE EXPOSED AT GRADE SHALL BE FLUSH WITH THE ADJACENT FINISHED GRADE AND ADJUSTED TO PROVIDE A SMOOTH TRANSITION AT ALL EDGES.
9. THE CONTRACTOR SHALL SET SUBGRADE ELEVATIONS TO ALLOW FOR POSITIVE DRAINAGE AND PROVIDE EROSION CONTROL DEVICES, STRUCTURES, MATERIALS AND CONSTRUCTION METHODS TO DIRECT SILT MIGRATION AWAY FROM DRAINAGE AND OTHER UTILITY SYSTEMS, PUBLIC/PRIVATE STREETS AND WORK AREAS. CLEAN BASINS REGULARLY AND AT THE END OF THE PROJECT.
10. EXCAVATION REQUIRED WITHIN PROXIMITY OF KNOWN EXISTING UTILITY LINES SHALL BE DONE BY HAND. CONTRACTOR SHALL REPAIR ANY DAMAGE TO EXISTING UTILITY LINES OR STRUCTURES INCURRED DURING CONSTRUCTION OPERATIONS AT NO COST TO THE OWNER.
11. WHERE NEW EARTHWORK MEETS EXISTING EARTHWORK, CONTRACTOR SHALL BLEND NEW EARTHWORK SMOOTHLY INTO EXISTING, PROVIDING VERTICAL CURVES OR ROUNDS AT ALL TOP AND BOTTOM OF SLOPES.
12. WHERE A SPECIFIC LIMIT OF WORK LINE IS NOT OBVIOUS OR IMPLIED, BLEND GRADES TO EXISTING CONDITIONS WITHIN 5 FEET OF PROPOSED CONTOURS.
13. RESTORE ALL DISTURBED AREAS AND LIMITS OF ALL REMOVALS TO LOAM AND SEED (L&S) UNLESS OTHERWISE NOTED.
14. SEE EARTHWORK SECTION OF SPECIFICATIONS FOR SPECIFIC EXCAVATION AND FILLING PROCEDURES.
15. FOR STRUCTURE REMODELING (REMOD), CONSTRUCTION METHODS SHALL FOLLOW MASSACHUSETTS DOT STANDARD SPEC. LATEST EDITION (SECTION 220)

ABBREVIATIONS

GENERAL

PROP	PROPOSED
ADJ	ADJUST
BIT. CONC.	BITUMINOUS CONCRETE
CEM. CONC.	CEMENT CONCRETE
℄	BASELINE
N.T.S.	NOT TO SCALE
B.M.	BENCH MARK
ABAN	ABANDON
MB	MAIL BOX
GRAN. CURB	GRANITE CURB
EXIST. (OR EX.)	EXISTING
FDN	FOUNDATION
F.L. (OR F)	FLOW LINE
℄	PROPERTY LINE
PVMT	PAVEMENT
P.W.W.	PAVED WATERWAY
RC	REINFORCED CONCRETE
M.H.B.	MASSACHUSETTS HIGHWAY BOUND
REM	REMOVE
REMOD	REMODEL
RET	RETAIN
R.O.W.	RIGHT-OF-WAY
R&R	REMOVE AND RESET
R,R&R	REMOVE, RELOCATED AND RESET
R&S	REMOVE AND STACK
R&D	REMOVE AND DISPOSE
SB	STONE BOUND
NIC	NOT IN CONTRACT
H.C.	HANDICAP
WCR	WHEELCHAIR RAMP
FF	FINISHED FLOOR
HMA	HOT MIX ASPHALT
G.C.	GENERAL CONTRACTOR
E.C.	ELECTRICAL CONTRACTOR
P.C.	PLUMBING CONTRACTOR
SWEL	SOLID WHITE EDGE LINE
BWLL	BROKEN WHITE LANE LINE
SYEL	SOLID YELLOW EDGE LINE
SB/DH	STONE BOUND/ DRILL HOLE
CLF	CHAIN LINK FENCE
TEMP.	TEMPORARY
TYP.	TYPICAL
EQ	EQUIPMENT
EOP	EDGE OF PAVEMENT
PROT	PROTECT
CTE	CONNECT TO EXISTING
RL	ROOF LEADER
L.O.W.	LIMIT OF WORK
VIF	VERIFY IN FIELD
APPROX.	APPROXIMATE
TBM	TEMPORARY BENCHMARK
ALT.	ALTERNATE

UTILITIES

GICI	GUTTER INLET W/ CURB INLET
CBCI	CATCH BASIN W/ CURB INLET
CB	CATCH BASIN
C.I.T.	CHANGE IN TYPE
CTE	CONNECT TO EXISTING
F&G	FRAME AND GRATE
F&C	FRAME AND COVER
CI	CURB INLET
CIP	CAST IRON PIPE
CMP	CORRUGATED METAL PIPE
DI	DUCTILE IRON PIPE
GI	GUTTER INLET
ACCM PIPE	ASPHALT COATED CORRUGATED METAL PIPE
HYD	HYDRANT
INV. ELEV.	INVERT ELEVATION
UP	UTILITY POLE
SMH	SEWER MANHOLE
WG	WATER GATE
DS	DOWN SPOUT
HDPE	HIGH DENSITY POLYETHYLENE PIPE
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
DMH	DRAIN MANHOLE
LB	LEACHING BASIN
LG	LEACHING GALLEY
CI	CAST IRON
OCS	OUTLET CONTROL STRUCTURE
OGT	OIL AND GRIT TRAP
VC	VITRIFIED CLAY PIPE
LP	LIGHT POLE
OHW	OVERHEAD WIRE
UPLP	UTILITY POLE WITH LIGHT
SWTU	STORM WATER TREATMENT UNIT
HH	HANDHOLE
GW	GARAGE WASTE
CO	CLEANOUT
LC	LEACHING CHAMBER
GV	GATE VALVE
GALV.	GALVANIZED
F&I	FURNISH & INSTALL
BGS	BELOW GRADE SURFACE

ALIGNMENT/GRADING

BW	BOTTOM OF WALL
BC	BOTTOM OF CURB
ELEV	ELEVATION
H.P.	HIGH POINT
L.P.	LOW POINT
STA	STATION
TC	TOP OF CURB
TW	TOP OF WALL

GENERAL SYMBOLS

EXISTING	PROPOSED	
CB	CB	CATCH BASIN
CBCI		CATCH BASIN CURB INLET
		LEACHING GALLEY
		CURB (OR BERM)-TYPE NOTED
		EDGE OF ROAD
HH		HANDHOLE (NUMBER AS NOTED)
EMH		ELECTRIC MANHOLE
TMH		TELEPHONE MANHOLE
SMH	S	SEWER MANHOLE
DMH	D	DRAINAGE MANHOLE
GG		GAS GATE
WG		WATER GATE VALVE
		HYDRANT
	W	WELL
LP	OR LP	LIGHTPOLE
D		DRAIN PIPE
S		SEWER MAIN
	S	SEWER MAIN BY P.C.
E		ELECTRIC DUCT
C		TELEPHONE/COMMUNICATIONS/FIRE ALARM
	GW GW	GARAGE WASTE LINE
	GW	GARAGE WASTE LINE BY P.C.
	V	VENTS BY P.C.
G		GAS MAIN
W		WATER MAIN
OHW OHW		OVERHEAD WIRES
GUARD RAIL	OR	GUARD RAIL (SIZE AND TYPE NOTED)
LABEL / DATE		HIGHWAY / PROPERTY BOUND (TYPE NOTED)
NAME		CITY OR TOWN OR COUNTY LAYOUT LINE
12 N00°00'00"E		CITY,TOWN OR COUNTY BOUNDARY
+57.59 PC		BASE OR SURVEY LINE
		CENTERLINE OF CONSTRUCTION
		PROPERTY LINE
	WCR	WHEELCHAIR RAMP (WCR)
CLF	SEE PLANS	TREE (SIZE AND TYPE NOTED)
OR WOOD FENCE	SEE PLANS	FENCE (SIZE AND TYPE NOTED)
		EASEMENT LINE/ FUTURE CITY PROPERTY LINE
M#.#.#		MADOT STANDARD SPECIFICATION REFERENCE NUMBER
B3 TP1	TP-2 OR TP1	TEST PIT/BORINGS
MON WELL (TYP)		MONITORING WELL
UP 8	OHW OHW	UTILITY POLE
FLAG POLE		GUY POLE
		FLAG POLE
		SIGN
		TREE LINE
B		BOLLARD
		BIKE RACK
		SAWCUT
		EROSION CONTROL (SPECIFIED ON PLANS)
CBF		OBSERVATION WELL
		LIMIT OF WORK
		TEMPORARY FENCE
		CONCRETE BOUND FOUND
		TEMPORARY BENCHMARK (TBM)
		DI WATER REDUCER

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Revisions:

No.	Date	Description

Seal:

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W&S Project No.:	2180658
W&S File No.:	

Drawing Title:

GENERAL NOTES & LEGEND

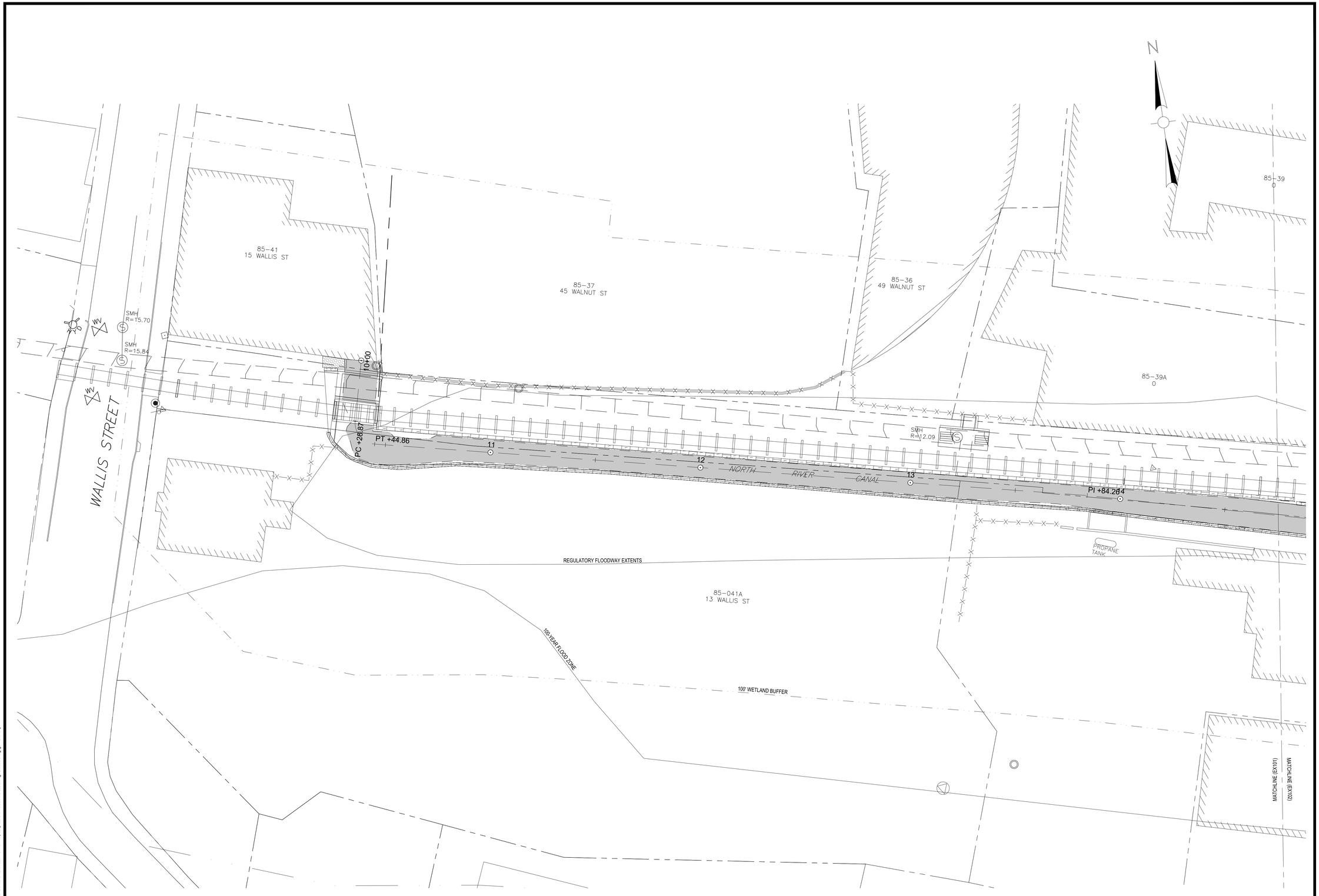
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Rev. 1.6 Date: 04/10/2019

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Reviewed By:	SRB
Approved By:	SRB
W&S Project No.:	2180658
W&S File No.:	

Drawing Title:

EXISTING CONDITIONS PLAN I

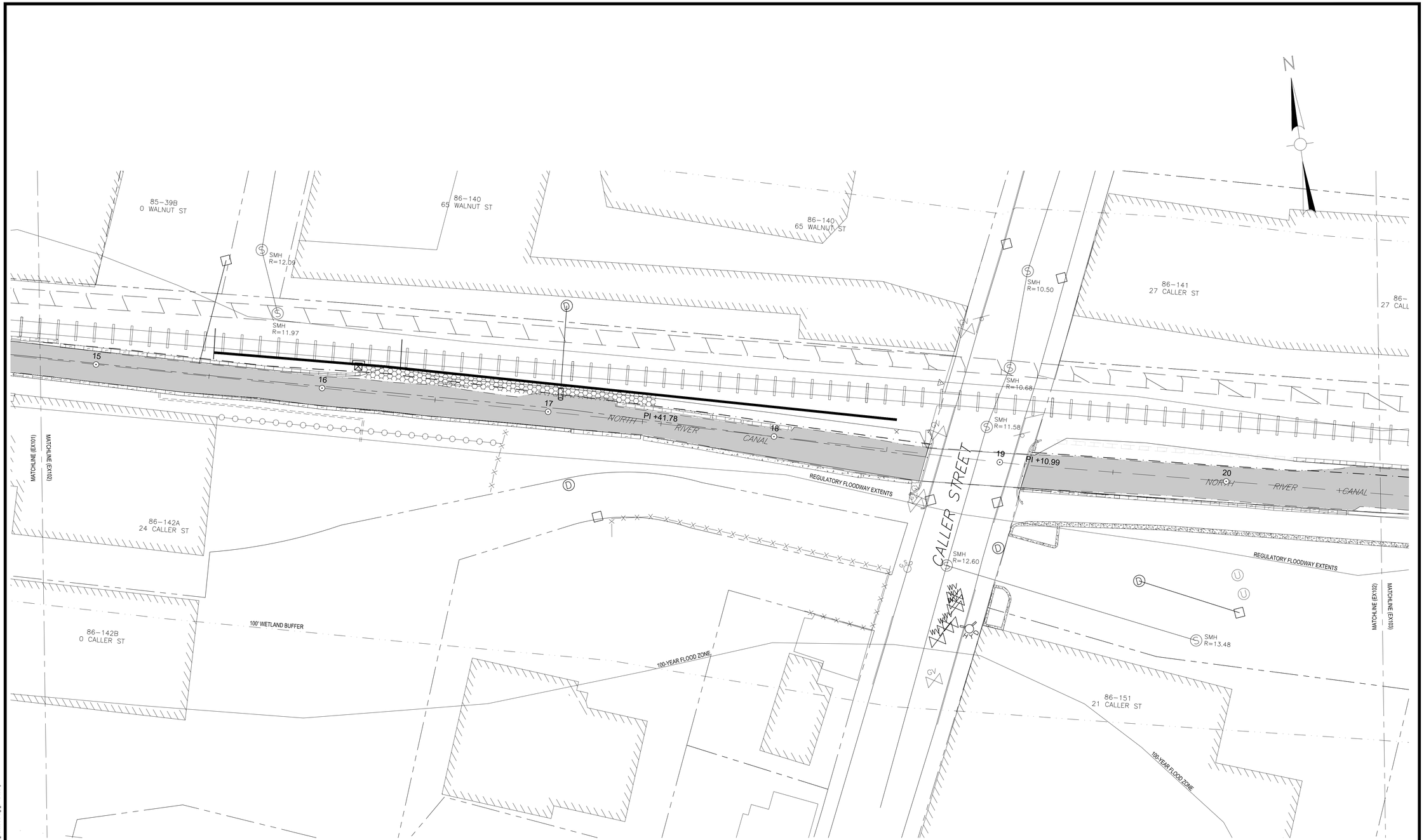
Sheet Number:

EX101

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\\wes01fs-vol\WSE\Projects\MA\Peabody MVAAP Action Grant 2018\Task 1 - South Trail Preliminary Design\100 CAD Models and Drawings\100_5_Structural\101_5_SHT-101.dwg



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W&S Project No.:	2180658
W&S File No.:	

Drawing Title:

EXISTING CONDITIONS PLAN II

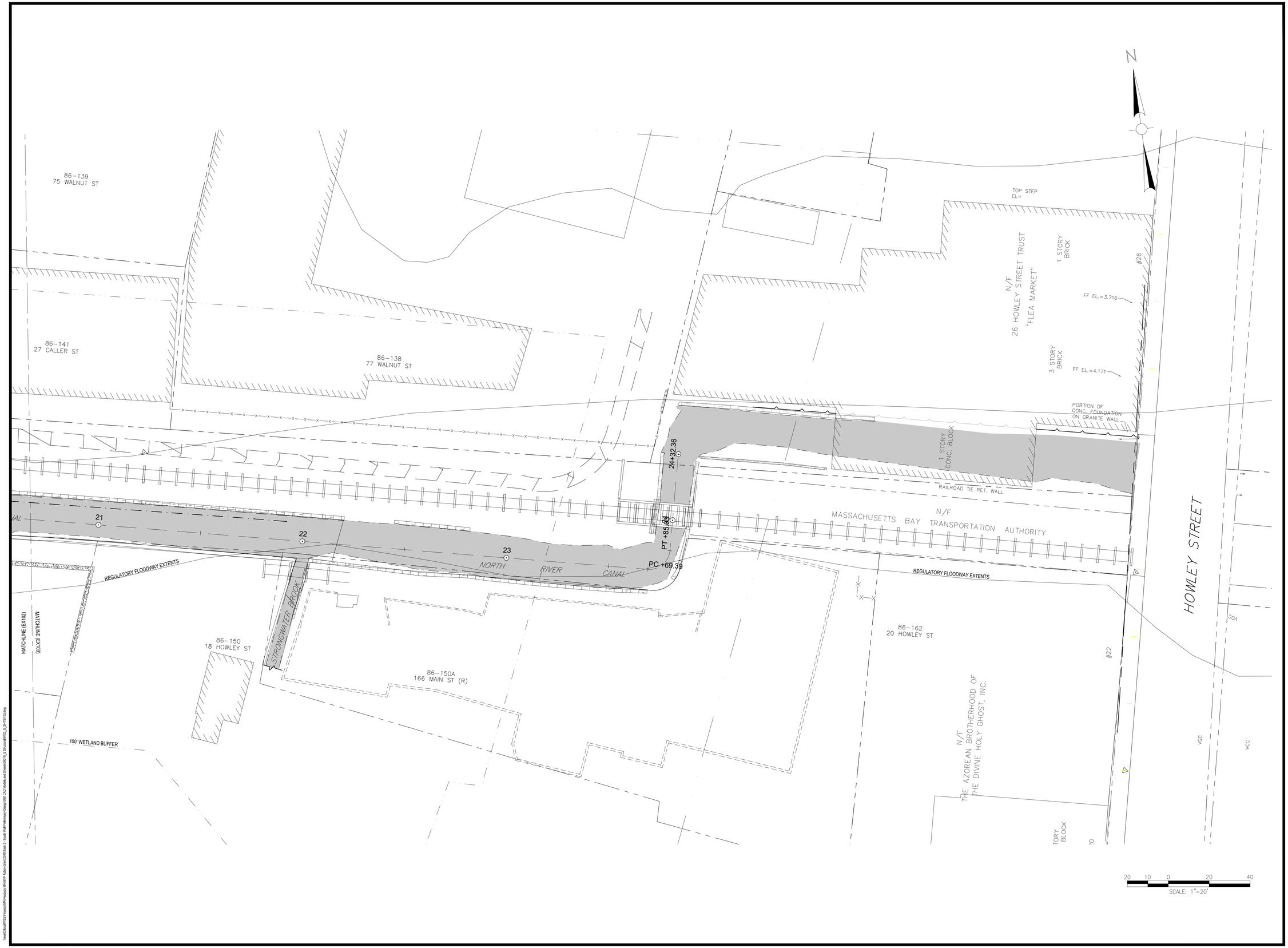
Sheet Number:

EX102

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\\wsboi1fs\allw\SP\Projects\MA\Peabody MA\MVP Action Grant 2019\Task 1_ South Rail Preliminary Design\99-CAD Models and Drawings\99-0_Structural\99-03_Sheets\99-03_Sht EX102.dwg



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W&S File No.:	

Drawing Title:

EXISTING CONDITIONS PLAN III

Sheet Number:

EX103

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I:\wse43.ma\WSP\Projects\MA\Peabody MVAP Action Grant 2019\Task 1- South Wall Preliminary Design\99-CAD Models and Sheets\99-0_5_Structural\99-03_5_SHT-EX103.dwg

N

85–41
15 WALLIS ST

85–37
45 WALNUT ST

85–36
49 WALNUT ST

85–39
0

85–39A
0

APPROXIMATE LOCATION OF 78 IN. SEWER

SMH
R=15.70

SMH
R=15.8

SMH
R=12.09

10+00

WALLIS STREET

FACE OF EXIST. CONCRETE ABUTMENT

APPROX. START OF SHEET PILING AT STATION 10+30

START DEMO. OF EXIST. MASONRY WALL

CONCRETE INFILL DOWN TO 3'-0" BELOW T.O. STREAM BED

SHEET PILING

TOP OF SLOPE

PERMANENT EASEMENT

TEMPORARY EASEMENT

REGULATORY FLOODWAY EXTENTS

TOP OF SLOPE

REMOVE BUILDING AND FENCE

REMOVE PROPANE TANK

PROPANE TANK

11

12

13

14

NORTH RIVER CANAL

14.8'

15.4'

23.6'

29.4'

12.0'

12.9'

29.7'

29.9'

29.9'

30.5'

15.0'

15.0'

1
S601

85–041A
13 WALLIS ST

13 WALLIS ST.
PERMANENT EASEMENT: 14,794 SQFT
TEMPORARY EASEMENT: 4,566 SQFT

24 CALLER ST.
PERMANENT EASEMENT: 18,317 SQFT
TEMPORARY EASEMENT: 5,077 SQFT

86–142A
24 CALLER ST

86–142B
0 CALLER ST

PROPERTY LINE

MATCHLINE (S101)

MATCHLINE (S101)

100-YEAR FLOOD ZONE

100' WETLAND BUFFER

20 10 0 20 40
SCALE: 1"=20'

Project:

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W&S File No.:	

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PROPOSED LAYOUT PLAN I

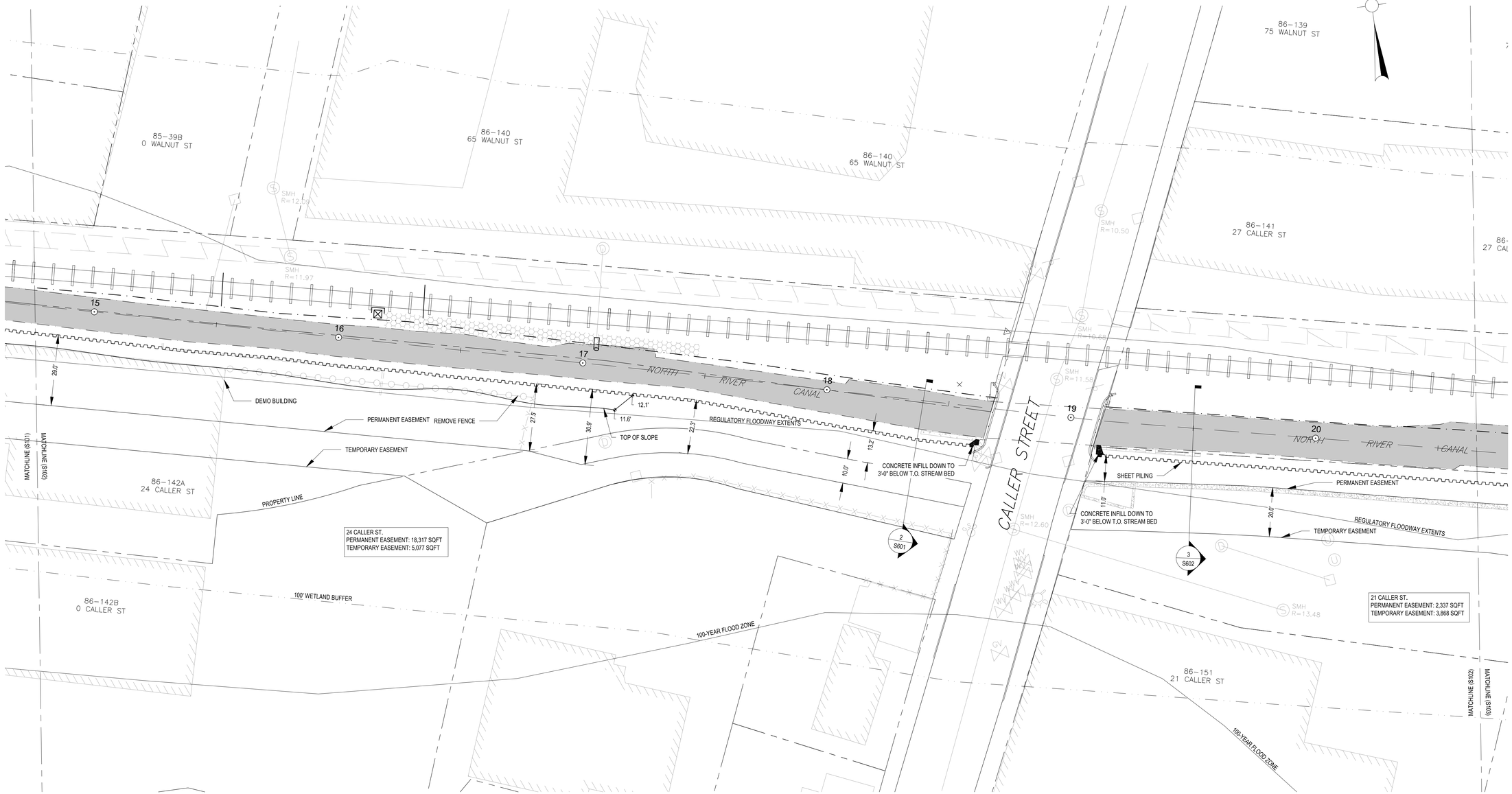
Sheet Number:

S201

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W&S File No.:	

Drawing Title:

PROPOSED LAYOUT PLAN II

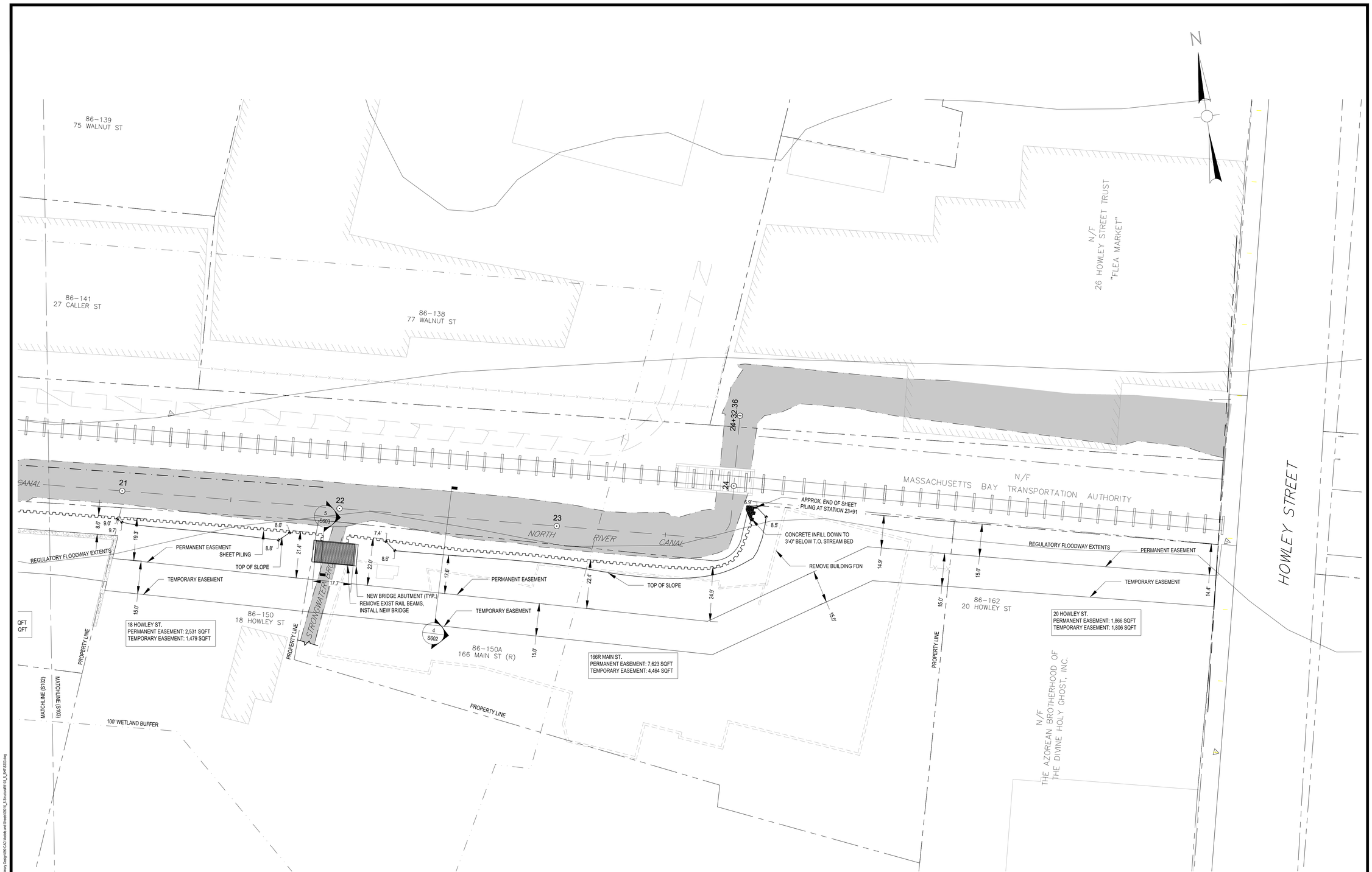
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S202

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\\wsfs1\bos\WSP\Projects\MA\Peabody MVMAP Action Grant 2018\Task 3 - South Bridge\Preliminary Design\90K CAD Models and Sheets\S202_S_SouthBridge_Plan2.dwg



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W&S File No.:	

Drawing Title:

PROPOSED LAYOUT PLAN III

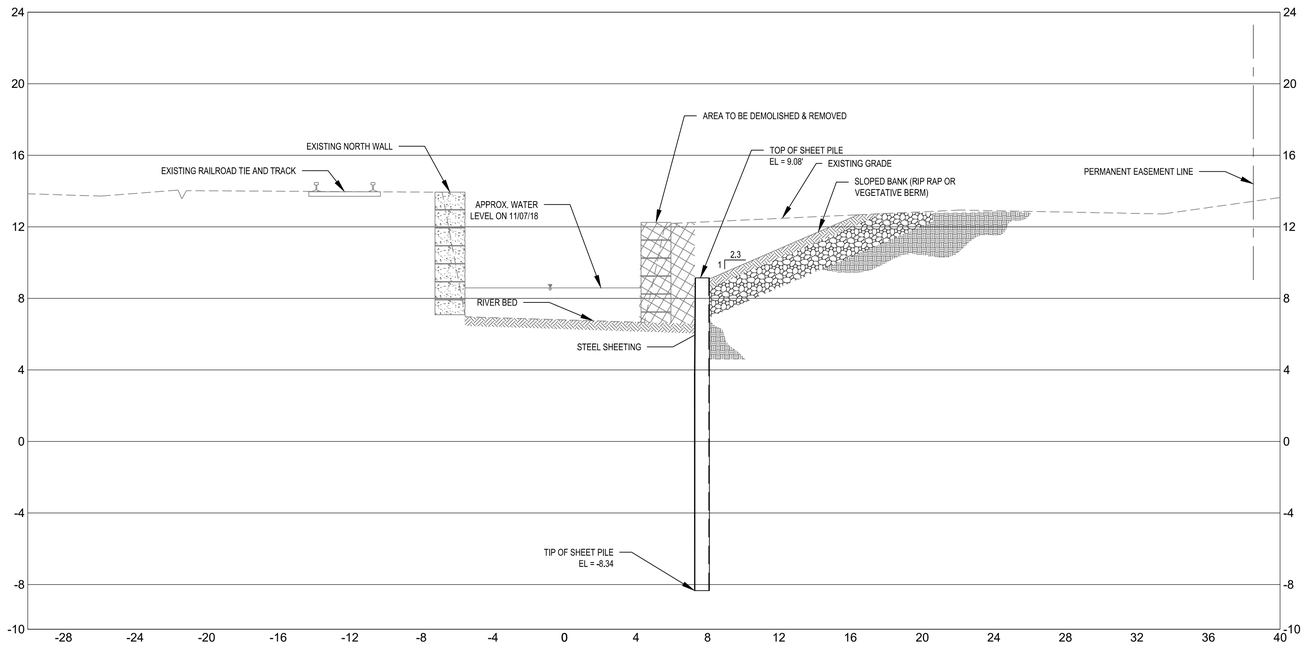
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S203

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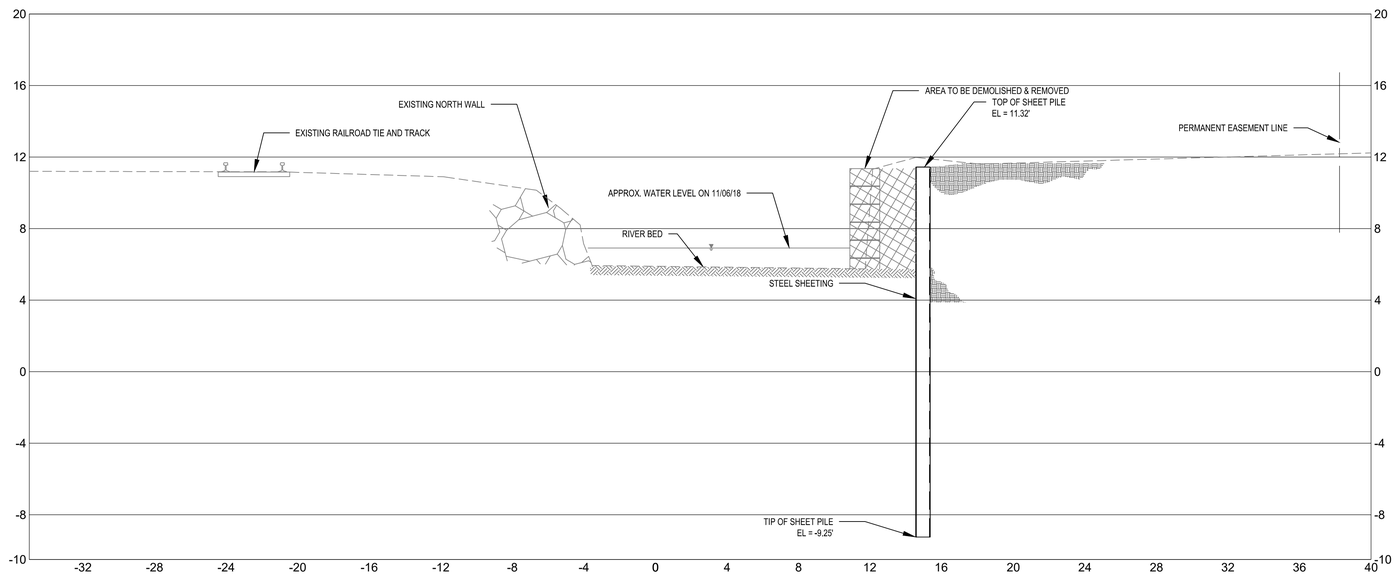
Rev. 1.5 Date: 06/10/2019

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1 SECTION @ STATION 11+50

SCALE: 1"=4'-0"



2 SECTION @ STATION 18+50

SCALE: 1"=4'-0"

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Approved By:	SRB
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W&S File No.:	

Drawing Title:

WALL SECTIONS AND DETAILS I

Sheet Number:

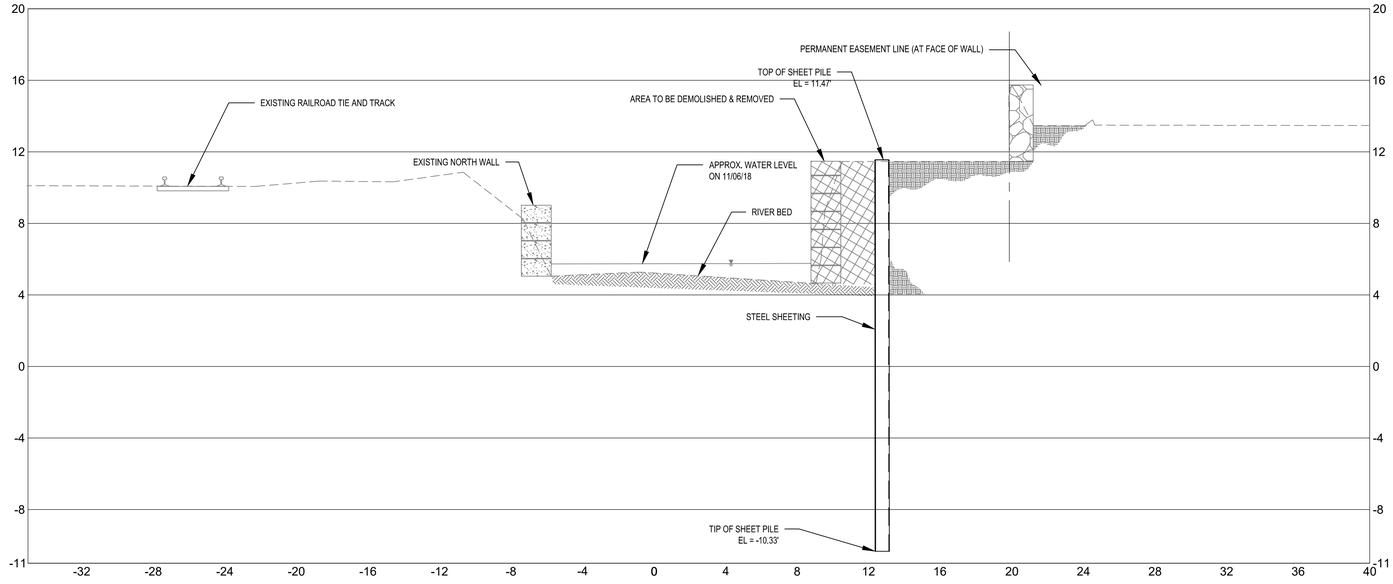
S601

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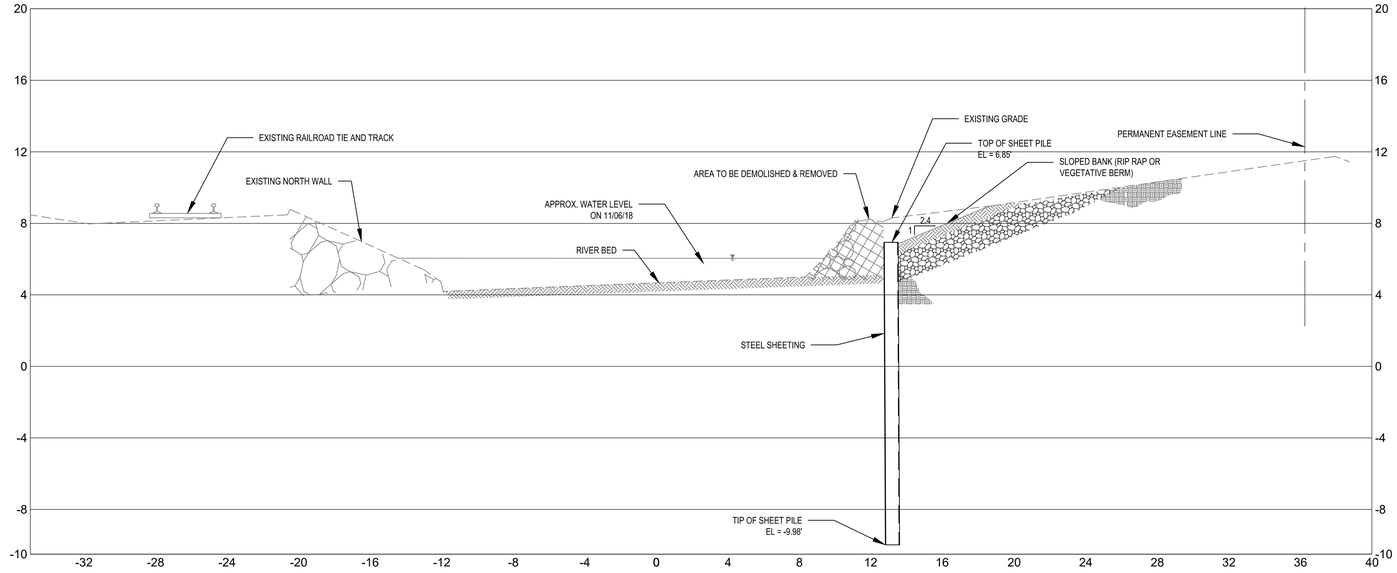
19+50



3 SECTION @ STATION 19+50

SCALE: 1"=4'-0"

22+50



4 SECTION @ STATION 22+50

SCALE: 1"=4'-0"

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WALL SECTIONS AND DETAILS II

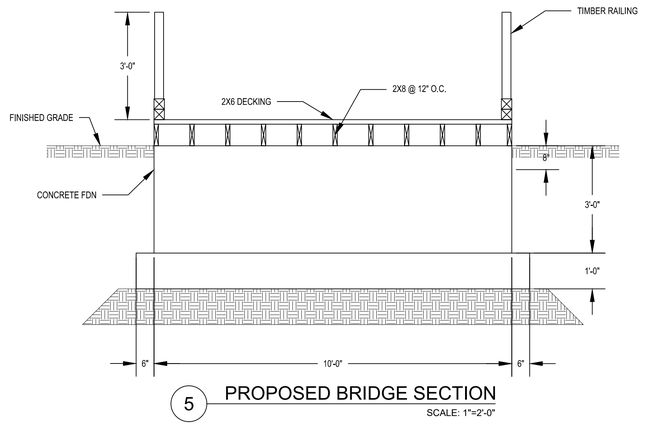
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S602

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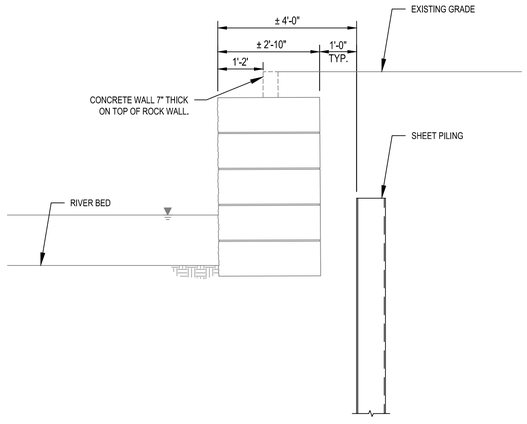
Rev. 1.6 Date: 04/10/2019

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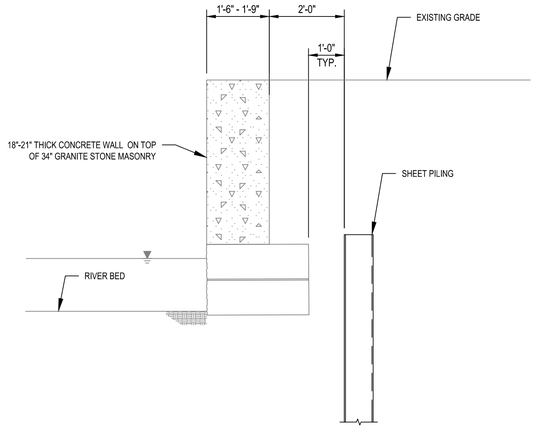
5 PROPOSED BRIDGE SECTION

SCALE: 1"=2'-0"



6 TYPICAL WALL CROSS SECTION @ TP1

SCALE: 1"=2'-0"



7 TYPICAL WALL CROSS SECTION @ TP2

SCALE: 1"=2'-0"

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W&S File No.:	

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PEDESTRIAN BRIDGE & TYP. WALL SECTION

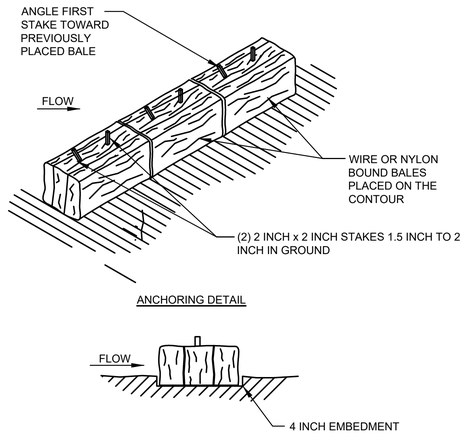
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S603

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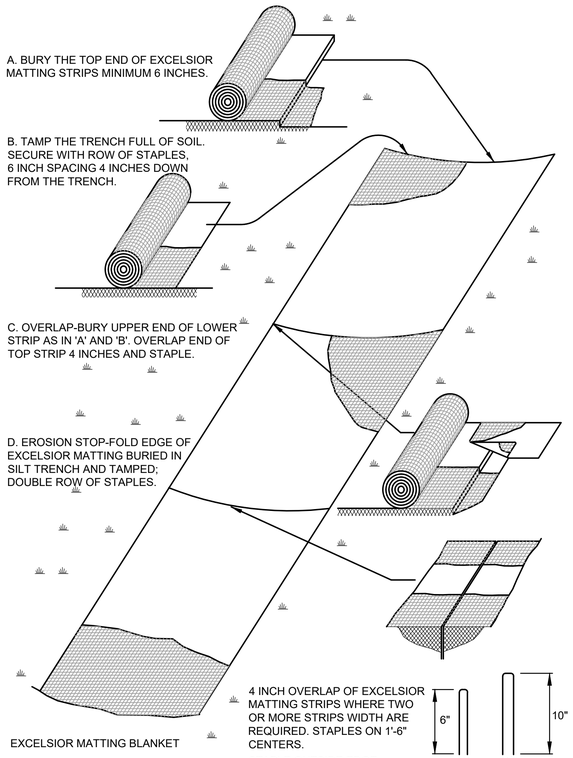


ANCHORING DETAIL

EMBEDDING DETAIL

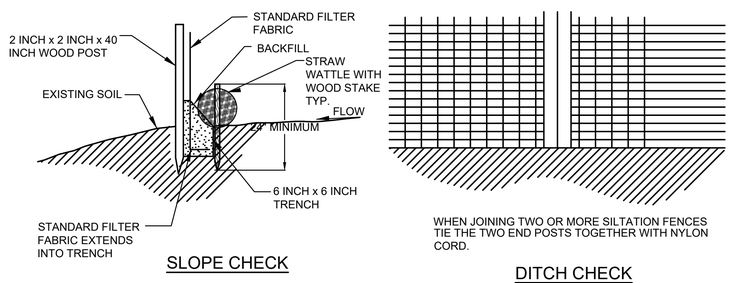
3 STAKED HALE BALES- EROSION CONTROL
SCALE: N.T.S.

1. EROSION CONTROL MEASURES SHALL BE INCORPORATED IN THE SEQUENCE OF CONSTRUCTION TO PREVENT SEDIMENT LADEN WATER FROM LEAVING THE SITE.
2. AREAS SUBJECT TO EROSION SHALL BE MINIMIZED IN TERMS OF TIME AND AREA.
3. IN GENERAL, WORK REQUIRING EROSION CONTROL INCLUDES EXCAVATIONS, FILLS, DRAINAGE, SWALES AND DITCHES, ROUGH AND FINISH GRADING, AND STOCKPILING OF EARTH.
4. DO NOT DISTURB VEGETATION AND TOPSOIL BEYOND THE PROPOSED LIMIT OF SILT FENCE ACTIVITIES.
5. TEMPORARY SILT CONTROLS SHALL BE PLACED AS SHOWN ON THE PLAN. PERMANENTLY STABILIZE EACH COMPLETED SEGMENT OF CONSTRUCTION.
6. THE CONTRACTOR SHALL REMOVE TEMPORARY SILT CONTROLS AND ALL ACCUMULATED SILT AND DEBRIS AFTER COMPLETION OF CONSTRUCTION OPERATIONS.
7. SILT CONTROLS SHALL BE IN PLACE AT ALL TIMES DURING CONSTRUCTION.
8. THE CONTRACTOR SHALL REMOVE AND LEGALLY DISPOSE OF ALL SILT AND DEBRIS FROM EACH DRAINAGE STRUCTURE UPON COMPLETION OF THE PROJECT.
9. OBJECTS AND/OR AREAS DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED TO THEIR ORIGINAL CONDITION.
10. ALL DISTURBED AREAS SHALL BE RESTORED TO EXISTING GRADE. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE AS NEEDED.
11. SILT CONTROLS SHALL BE REMOVED UPON THE SATISFACTORY COMPLETION OF ALL WORK SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
12. SITE PERIMETER SHALL HAVE STRAW WATTLES INSTALLED AT THE LIMIT OF WORK.



NOTE:
JUTE NETTING TO BE USED ON ALL SLOPES GREATER THAN 4H:1V AS INDICATED ON GRADING PLANS

4 EROSION CONTROL BLANKET
SCALE: N.T.S.



SLOPE CHECK

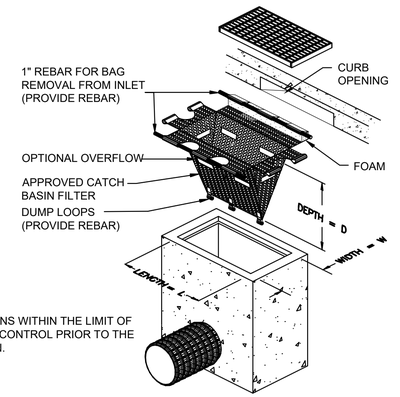
WHEN JOINING TWO OR MORE SILTATION FENCES TIE THE TWO END POSTS TOGETHER WITH NYLON CORD.

DITCH CHECK

4 SILT FENCE- EROSION CONTROL
SCALE: N.T.S.

SIDE VIEW INSTALLED

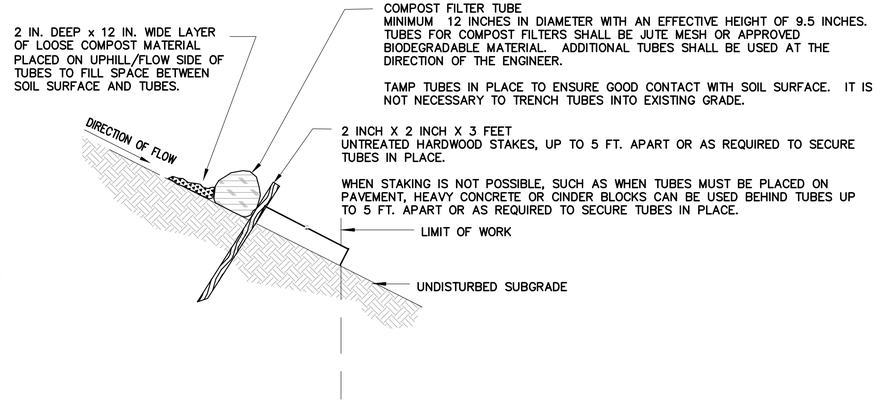
NOTE:
ALL EXISTING CATCH BASINS WITHIN THE LIMIT OF WORK SHALL HAVE INLET CONTROL PRIOR TO THE START OF CONSTRUCTION.



1 INLET SEDIMENT CONTROL
SCALE: N.T.S.

GENERAL NOTES:

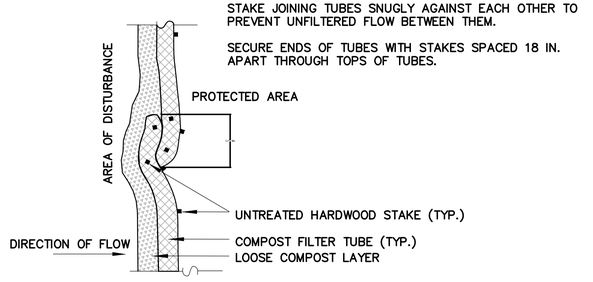
1. PROVIDE A MINIMUM TUBE DIAMETER OF 12 INCHES FOR SLOPES UP TO 50 FEET IN LENGTH WITH A SLOPE RATIO OF 3H:1V OR STEEPER. LONGER SLOPES OF 3H:1V MAY REQUIRE LARGER TUBE DIAMETER OR ADDITIONAL COURSING OF FILTER TUBES TO CREATE A FILTER BERM. REFER TO MANUFACTURER'S RECOMMENDATIONS FOR SITUATIONS WITH LONGER OR STEEPER SLOPES.
2. INSTALL TUBES ALONG CONTOURS AND PERPENDICULAR TO SHEET OR CONCENTRATED FLOW.
3. DO NOT INSTALL IN PERENNIAL, EPHEMERAL OR INTERMITTENT STREAMS.
4. CONFIGURE TUBES AROUND EXISTING SITE FEATURES TO MINIMIZE SITE DISTURBANCE AND MAXIMIZE CAPTURE AREA OF STORMWATER RUN-OFF.
5. MULCH MATERIAL FOR THE FILTER TUBES SHALL BE WEED-FREE STRAW, WOOD EXCELSIOR, COMPOST, OR WOOD CHIPS, OR COIR. STRAW SHALL BE WEED FREE AND DERIVED FROM THRESHING OF GRAIN CROP.
6. CURVE ENDS UPHILL TO PREVENT DIVERSION OF UNFILTERED RUN-OFF.



3 SINGLE COMPOST FILTER TUBE DETAIL
SCALE: N.T.S.

PROVIDE A 3 FT. MINIMUM OVERLAP AT ENDS OF TUBES TO JOIN IN A CONTINUOUS BARRIER AND MINIMIZE UNIMPEDED FLOW.
STAKE JOINING TUBES SNUGLY AGAINST EACH OTHER TO PREVENT UNFILTERED FLOW BETWEEN THEM.

SECURE ENDS OF TUBES WITH STAKES SPACED 18 IN. APART THROUGH TOPS OF TUBES.



PLAN VIEW – JOINING DETAIL

Project:
CITY OF PEABODY
MVP ACTION GRANT
24 LOWELL STREET
PEABODY, MA 01960

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Foxborough, MA 02035
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EROSION AND SEDIMENT CONTROL DETAILS

Sheet Number:

C601

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APPENDIX E

Riverwalk – Preliminary 25% Design Plans

WALNUT STREET

WALLIS STREET

WALLIS GATEWAY

EAST END PEABODY VETERANS MEMORIAL PARK

POST OFFICE

REGULATORY FLOODWAY EXTENTS

PEABODY-SALEM RAIL

PALEOLOGOS STREET

100 YEAR FLOOD ZONE

CALLER GATEWAY

"WALLIS RIVERWALK VISTA"
SEATING & CANAL OVERLOOK

PEABODY INSTITUTE LIBRARY

PEDESTRIAN CONNECTION TO MAIN STREET

"CALLER OPEN SPACE"
OPPORTUNITY FOR STORMWATER MANAGEMENT

CALLER STREET

"THE CALLER DECK"
ELEVATED BOARDWALK

REGULATORY FLOODWAY EXTENTS

HOWLEY GATEWAY

HOWLEY STREET

"THE STRONGWATER BRIDGE"
BRIDGE CROSSING & SEATING

HOWLEY RIVERWALK VISTA
SEATING PLAZA & CANAL OVERLOOK

MAIN STREET

LEGEND

- NORTH RIVER CANAL
- RIVERWALK
- 100 YEAR FLOOD ZONE
- REGULATORY FLOODWAY EXTENTS
- DESIRED PATH
- PERMANANT EASEMENT
- TEMPORARY EASEMENT
- COMMUNITY SOCIAL OPPORTUNITIES

SCALE 0 50 100 150

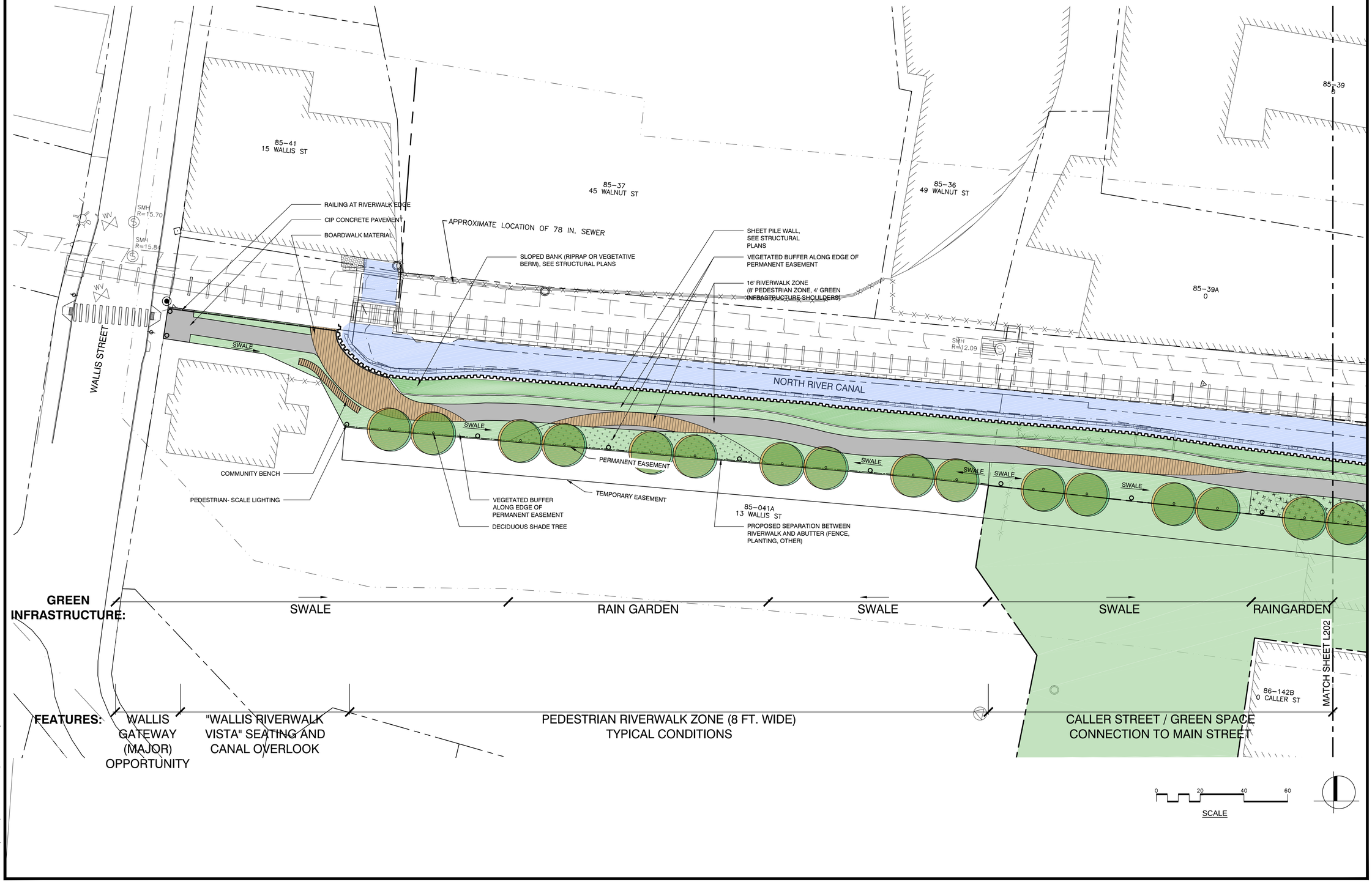
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OVERALL RIVERWALK

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LAYOUT AND MATERIALS PLAN

Sheet Number:

L201

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85–39B
0 WALNUT ST

86–140
65 WALNUT ST

86–140
65 WALNUT ST

86–139
75 WALNUT ST

86–141
27 CALLER ST

86–142A
24 CALLER ST

86–142B
0 CALLER ST

86–151
21 CALLER ST

16' RIVERWALK ZONE
(8' PEDESTRIAN ZONE, 4' GREEN INFRASTRUCTURE SHOULDERS)

CIP CONCRETE PAVEMENT

BOARDWALK MATERIAL

SLOPED BANK (RIPRAP OR VEGETATIVE BERM), SEE STRUCTURAL PLANS

SHEET PILE WALL, SEE STRUCTURAL PLANS

VEGETATED SWALE ALONG EDGE OF PERMANENT EASEMENT

RAINGARDEN ALONG EDGE OF PERMANENT EASEMENT

BOLLARD, TYP. AT EACH RAILROAD CROSSING

EXISTING RETAINING WALL, TO REMAIN/ENHANCED

CANTILEVERED BOARDWALK/OVERLOOK

CONSULT PARKING LOT PROPERTY OWNER REGARDING PROJECT INSTALLATION OF NEW TREES WITHIN LOT

NORTH RIVER CANAL

SWALE

PERMANENT EASEMENT

TEMPORARY EASEMENT

DECIDUOUS SHADE TREE

PEDESTRIAN- SCALE LIGHTING

PROPOSED SEPARATION BETWEEN RIVERWALK AND ABUTTER (FENCE, PLANTING, OTHER)

CALLER STREET

SMH R=11.97

SMH R=10.50

SMH R=10.68

SMH R=11.58

SMH R=12.60

SMH R=13.48

MATCH SHEET L201

MATCH SHEET L203

RAIN GARDEN | SWALE | RAIN GARDEN | SWALE

GREEN INFRASTRUCTURE:

CALLER STREET / GREEN SPACE CONNECTION TO MAIN STREET

PEDESTRIAN RIVERWALK ZONE (8 FT. WIDE) TYPICAL CONDITIONS

CALLER STREET GATEWAY (MINOR) OPPORTUNITY

"THE CALLER DECK" ELEVATED BOARDWALK

FEATURES:

0 20 40 60

SCALE

Project:

CITY OF PEABODY

MVP ACTION GRANT

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PEABODY, MA01960

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LAYOUT AND MATERIALS PLAN

Sheet Number:

L202

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86-141
27 CALLER ST

86-138
77 WALNUT ST

CIP CONCRETE PAVEMENT

SLOPED BANK (RIPRAP OR VEGETATIVE BERM), SEE STRUCTURAL PLANS

BOARDWALK BRIDGE AT STRONGWATER BROOK

NORTH RIVER CANAL

SHEET PILE WALL, SEE STRUCTURAL PLANS

86-150
18 HOWLEY ST

16' RIVERWALK ZONE
(8' PEDESTRIAN ZONE, 4' GREEN INFRASTRUCTURE SHOULDERS)

STRONGWATER BROOK

TEMPORARY EASEMENT

86-150A
166 MAIN ST (R)

PERMANENT EASEMENT

SWALE

VEGETATED SWALE ALONG EDGE OF PERMANENT EASEMENT

PROPOSED SEPARATION BETWEEN RIVERWALK AND ABUTTER (FENCE, PLANTING, OTHER)

DECIDUOUS SHADE TREE

PEDESTRIAN- SCALE LIGHTING

RAINGARDEN ALONG EDGE OF PERMANENT EASEMENT

86-162
20 HOWLEY ST

N/F
26 HOWLEY STREET TRUST
"FLEA MARKET"

1 STORY BRICK

3 STORY BRICK

RAMP

TOP STEP
EL=

R=3.076
l=2.46

FF EL.=3.716

R=2.733
STONE SHELF
EL=1.93
NPO

FF EL.=4.171

GRANITE BLOCK RET. WALL

PORTION OF CONC. FOUNDATION ON GRANITE WALL

0.6m sq. CONC. PIER (TYP.)
EL=3.127

1 STORY CONC. BLOCK ON PIERS (RIVER BELOW)

(EL. UNDER BLDG)

FLOW

STONE BRIDGE

RAILROAD TIE RET. WALL

GRANITE BRIDGE SUPPORTS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

N/F

RAILING AT RAILROAD TRACKS

BOLLARD, TYP. AT EACH RAILROAD CROSSING

PK NAIL
"HOW 1"
EL=2.887

"RR CROSSING"
+40

"RR CROSSING"
+80

250mm

500mm RCP (COND.-NOT FIELD OBSERVED)

R=2.936
l=2.12

R=2.635
PIPE BLOCKED
RZO EL=1.66

R=2.708
PIPE BLOCKED
H20 EL=1.63

HOWLEY STREET

"WEIGHT LIMIT"

CONST. B

VAULT

CONCRETE FOUNDATION

MAG NAIL SET

THE AZOREAN BROTHERHOOD OF THE DIVINE HOLY GHOST, INC.

CONC. BLOCK RET. WALL

#26

#22

#25-4 W/RISER
#5 & TRANS

BM#3

BM#4

MATCH SHEET L202

RAIN GARDEN | SWALE | SWALE | RAINGARDEN | SWALE

GREEN INFRASTRUCTURE:

PEDESTRIAN RIVERWALK ZONE (8 FT. WIDE) TYPICAL CONDITIONS

"THE STRONGWATER BRIDGE" BRIDGE CROSSING AND SEATING

PEDESTRIAN RIVERWALK ZONE (8 FT. WIDE) TYPICAL CONDITIONS

HOWLEY RIVERWALK VISTA SEATING PLAZA AND CANAL OVERLOOK

PEDESTRIAN RIVERWALK ZONE (8 FT. WIDE) TYPICAL CONDITIONS

HOWLEY STREET GATEWAY (MAJOR) OPPORTUNITY

FEATURES:

0 20 40 60
SCALE

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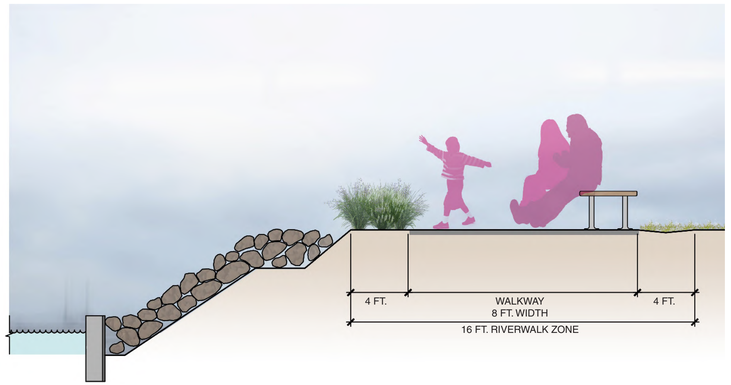
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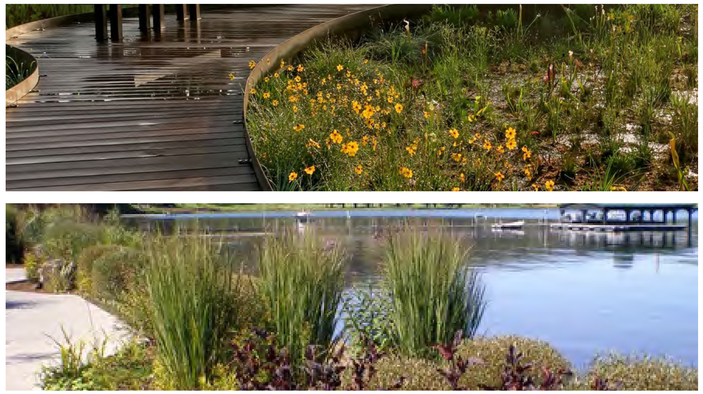
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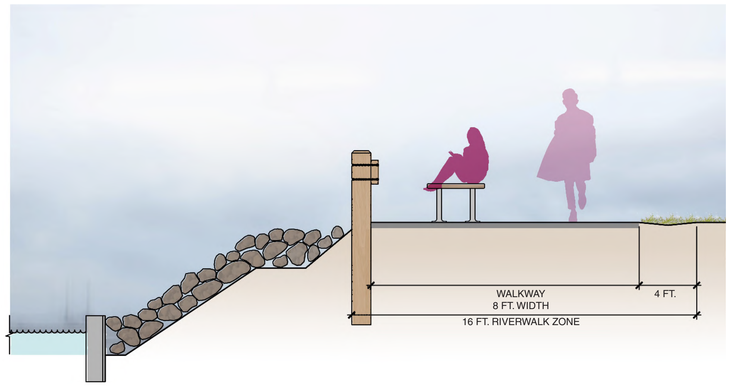


ELEVATION



PRECEDENTS

PLANTING EDGE

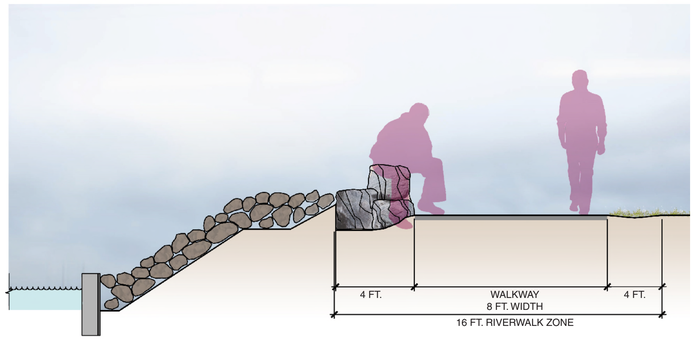


ELEVATION



PRECEDENTS

RAILING EDGE



ELEVATION



PRECEDENTS

SEATING EDGE

0 30 60 90

SCALE

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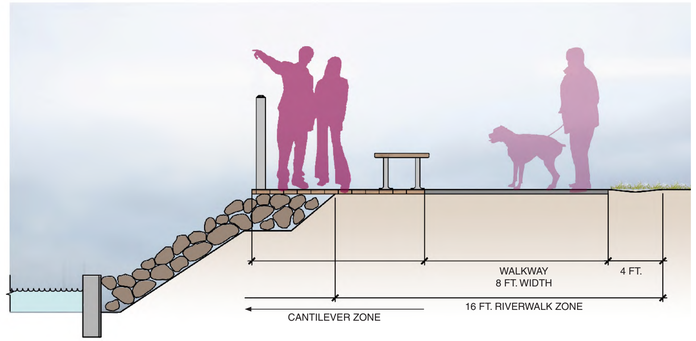
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RIVERBANK/ RIVERWALK EDGE OPPORTUNITIES

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L301

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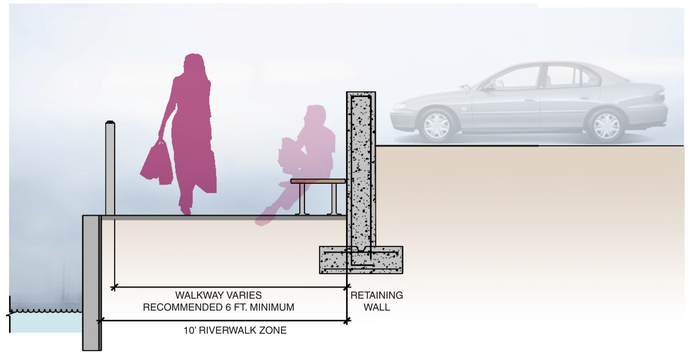




ELEVATION

PRECEDENTS

CANTILEVER EDGE

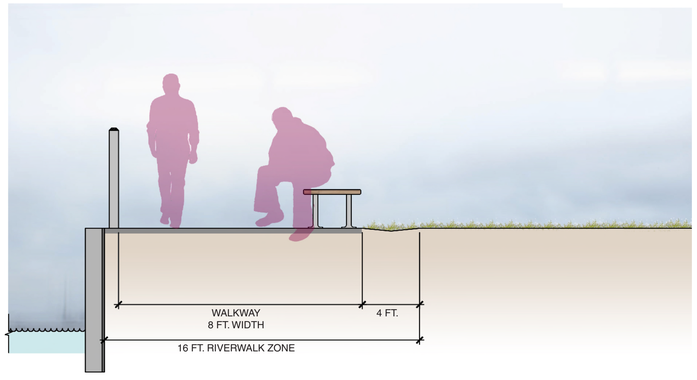




ELEVATION

PRECEDENTS

NO BANK/RETAINING EDGE





ELEVATION

PRECEDENTS

NO BANK/RAILING EDGE

0 30 60 90

SCALE

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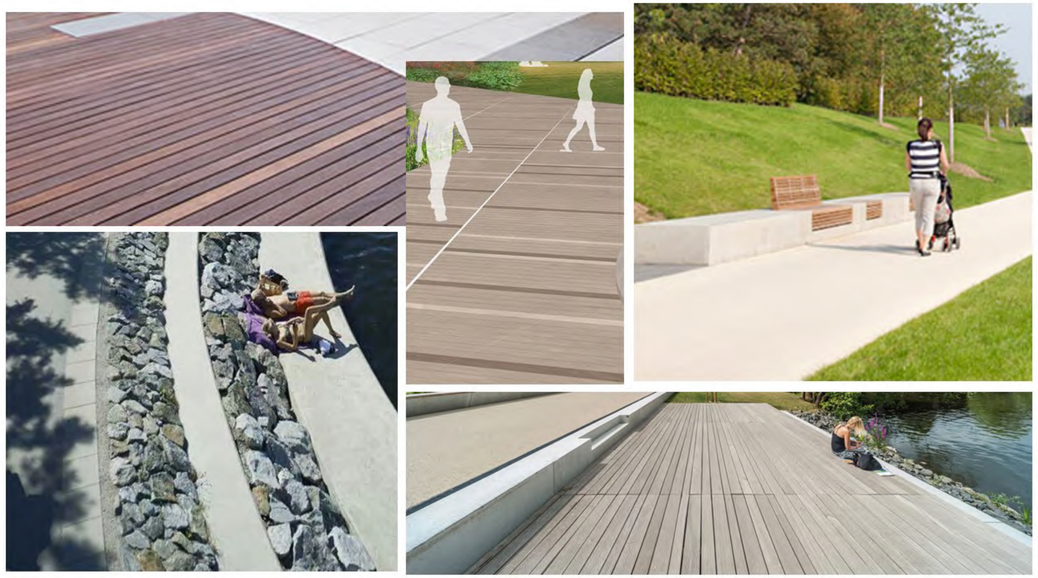
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RIVERBANK/ RIVERWALK EDGE OPPORTUNITIES

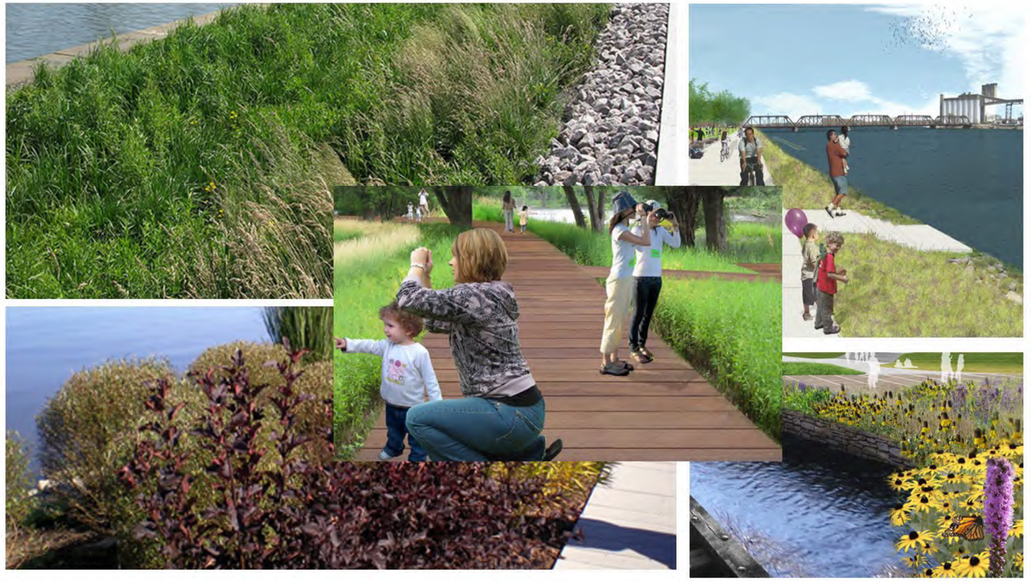
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WALKWAY SURFACING MATERIAL (ALL ARE ADA COMPLIANT)



NATIVE PLANT MATERIAL - LOW MAINTENANCE



SEATING AND GATHERING



RAILING MATERIAL

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RIVERWALK OPPORTUNITIES

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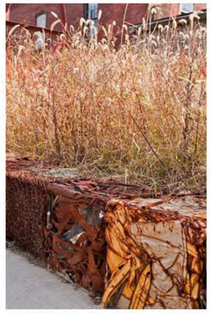
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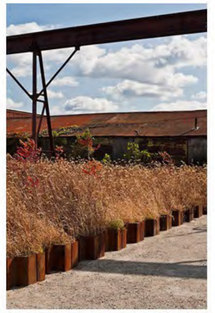
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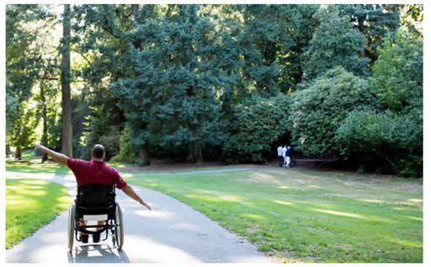
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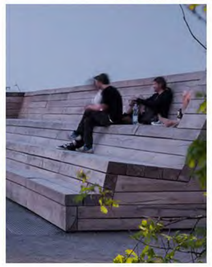














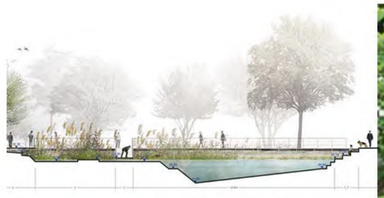
MATERIALS AND DETAILS







RIVER EDGE INTERACTION







FLOOD STORAGE/STORMWATER MANAGEMENT

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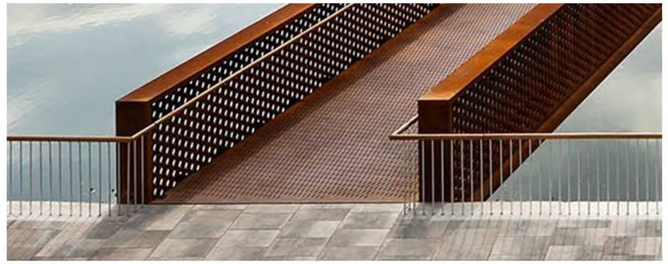
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AMENITIES















PUBLIC ART OPPORTUNITIES

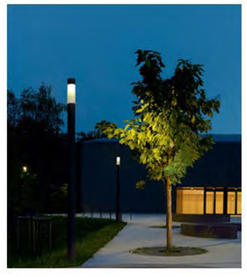
EDUCATIONAL AND WAYFINDING SIGNAGE

















LIGHTING AESTHETICS





LIGHTING PRODUCTS

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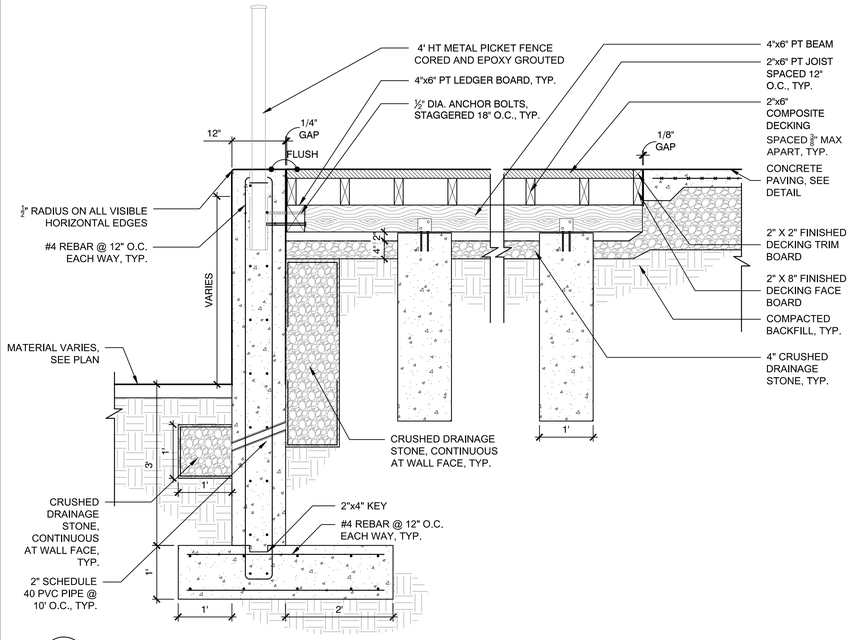
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RIVERWALK OPPORTUNITIES

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1 DECK AT OVERLOOK

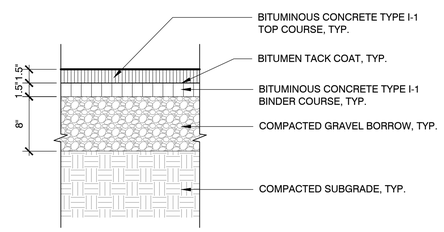
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2 RAILING AT RIVERWALK EDGE

SCALE: N.T.S.

3 DECKING AT PATH

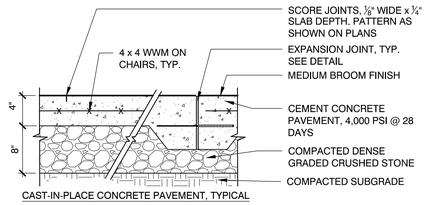
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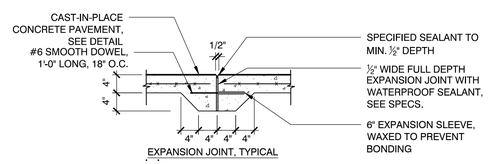
NOTE:
1. CONTRACTOR TO PROVIDE SMOOTH TRANSITION WHERE NEW PAVEMENT ABUTS EXISTING PAVEMENT, TYP.

4 BITUMINOUS CONCRETE PAVEMENT

SCALE: N.T.S.



CAST-IN-PLACE CONCRETE PAVEMENT, TYPICAL



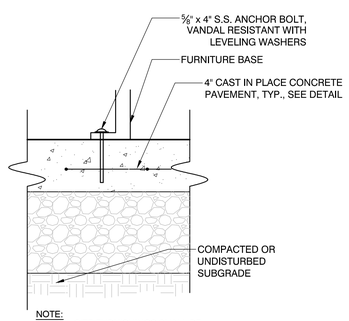
EXPANSION JOINT, TYPICAL

EXPANSION JOINT INSTALLATION NOTES:

1. DOWEL IS TYPICAL AT ALL EXPANSION JOINTS (18" O.C.) WITHIN CONCRETE PAVING AND BETWEEN NEW CONCRETE PAVING AND EXISTING CONCRETE PAVING TO REMAIN.
2. DELETE EXPANSION SLEEVE AND DOWEL WHERE JOINT ABUTS WALL, CURBS, OR OTHER VERTICAL SURFACES, UNLESS OTHERWISE NOTED.
3. EXPANSION JOINTS MAX. 25'-0" O.C. UNLESS SHOWN OTHERWISE.
4. EXPANSIONS JOINTS SHALL BE PLACED WHERE NEW CEMENT CONCRETE PAVEMENT MEETS EXISTING PAVEMENT OR WALLS TO REMAIN.
5. ALL SCORE JOINTS SHALL BE SAW CUT.

5 CIP CONCRETE PAVEMENT

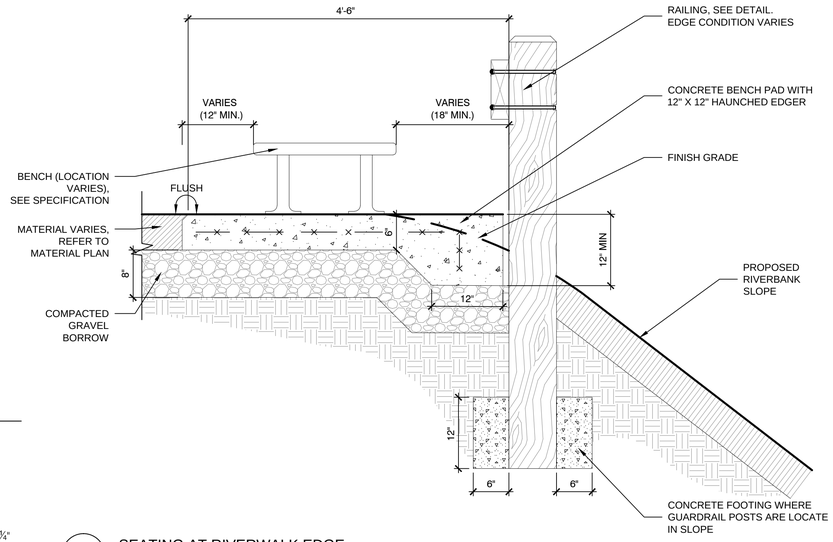
SCALE: N.T.S.



NOTE:
1. ALL SITE FURNISHINGS SHALL BE SURFACE MOUNTED PER MANUFACTURER'S RECOMMENDATIONS.

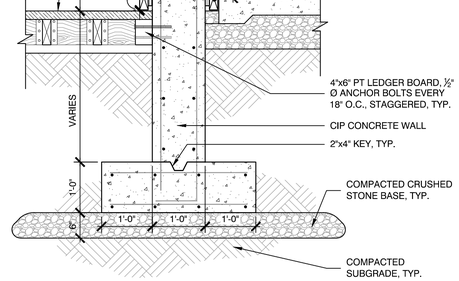
6 FURNITURE SURFACE MOUNT

SCALE: N.T.S.



7 SEATING AT RIVERWALK EDGE

SCALE: N.T.S.



8 CANTILEVERED DECKING

SCALE: N.T.S.

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MVP ACTION GRANT
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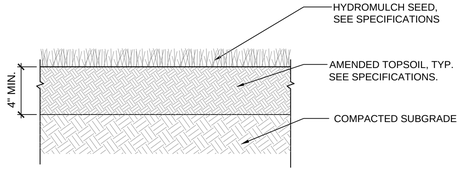
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LANDSCAPE DETAILS

Sheet Number:
L401

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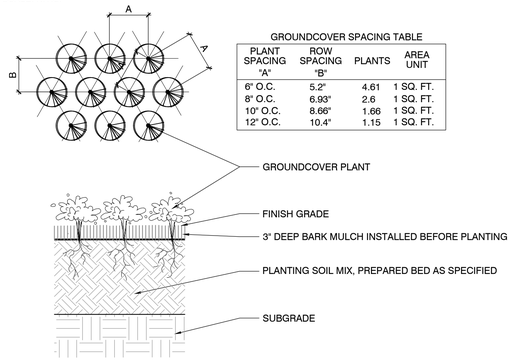
Rev. 1.8 Date: 04/10/2019

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1 LOAM AND SEED

SCALE: N.T.S.



GROUNDCOVER SPACING TABLE

PLANT SPACING "A"	ROW SPACING "B"	PLANTS	AREA UNIT
6" O.C.	5.2"	4.61	1 SQ. FT.
8" O.C.	6.93"	2.6	1 SQ. FT.
10" O.C.	8.66"	1.66	1 SQ. FT.
12" O.C.	10.4"	1.15	1 SQ. FT.

NOTES:
1. ALL GROUNDCOVER TO BE PLANTED IN TRIANGULAR PATTERN. SEE DETAIL PLAN AND GROUNDCOVER SPACING TABLE.
2. JUTE EROSION CONTROL MAT TO BE USED ON ALL SLOPES GREATER THAN 3:1

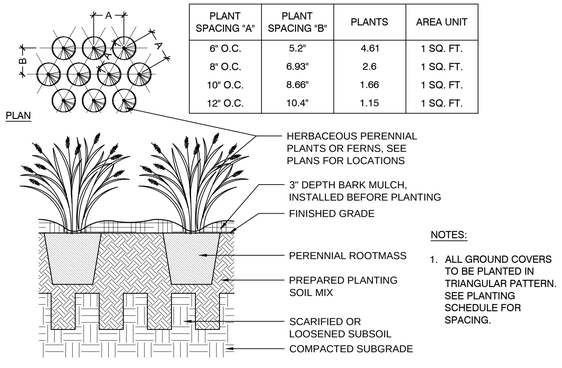
2 GROUNDCOVER PLANTING

SCALE: N.T.S.

HERBACEOUS PERENNIAL & FERN SPACING TABLE

PLANT SPACING "A"	PLANT SPACING "B"	PLANTS	AREA UNIT
6" O.C.	5.2"	4.61	1 SQ. FT.
8" O.C.	6.93"	2.6	1 SQ. FT.
10" O.C.	8.66"	1.66	1 SQ. FT.
12" O.C.	10.4"	1.15	1 SQ. FT.

PLAN

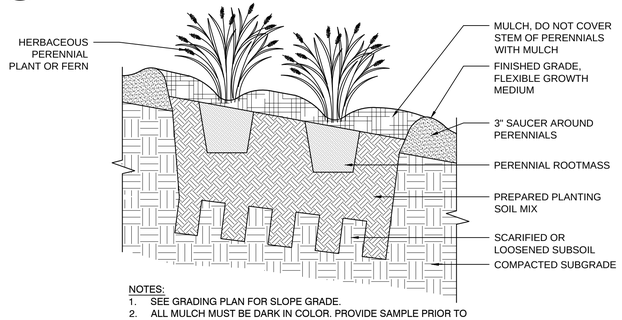


NOTES:
1. ALL GROUND COVERS TO BE PLANTED IN TRIANGULAR PATTERN. SEE PLANTING SCHEDULE FOR SPACING.

SECTION

3 HERBACEOUS PERENNIAL

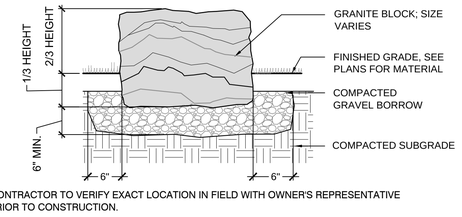
SCALE: N.T.S.



NOTES:
1. SEE GRADING PLAN FOR SLOPE GRADE.
2. ALL MULCH MUST BE DARK IN COLOR. PROVIDE SAMPLE PRIOR TO INSTALLATION TO BE APPROVED BY OWNER'S REPRESENTATIVE.

4 HERBACEOUS PERENNIAL ON SLOPE

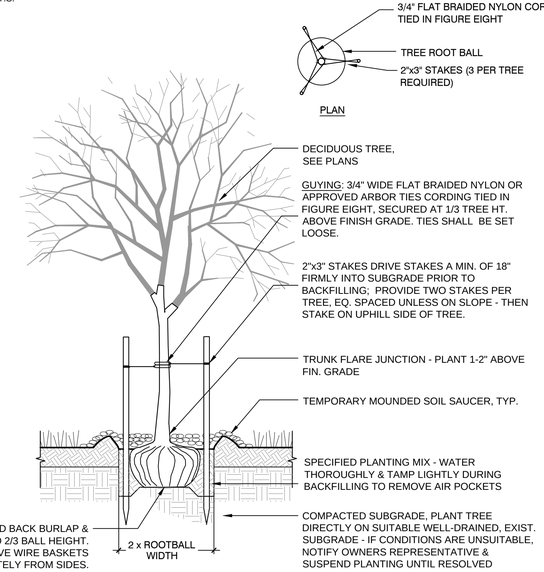
SCALE: N.T.S.



NOTE:
1. CONTRACTOR TO VERIFY EXACT LOCATION IN FIELD WITH OWNER'S REPRESENTATIVE PRIOR TO CONSTRUCTION.

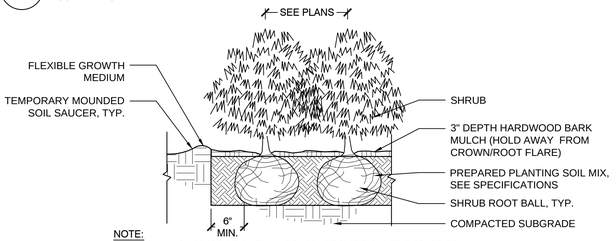
5 GRANITE BLOCK WALL/SEATING

SCALE: N.T.S.



6 TREE PLANTING AND STAKING - DECIDUOUS

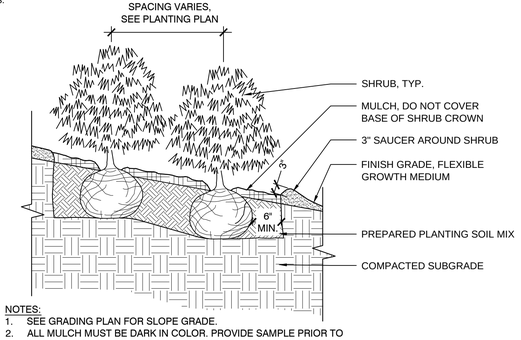
SCALE: N.T.S.



NOTE:
1. ALL MULCH MUST BE DARK IN COLOR. PROVIDE SAMPLE PRIOR TO INSTALLATION TO BE APPROVED BY OWNER'S REPRESENTATIVE.

7 SHRUB PLANTING

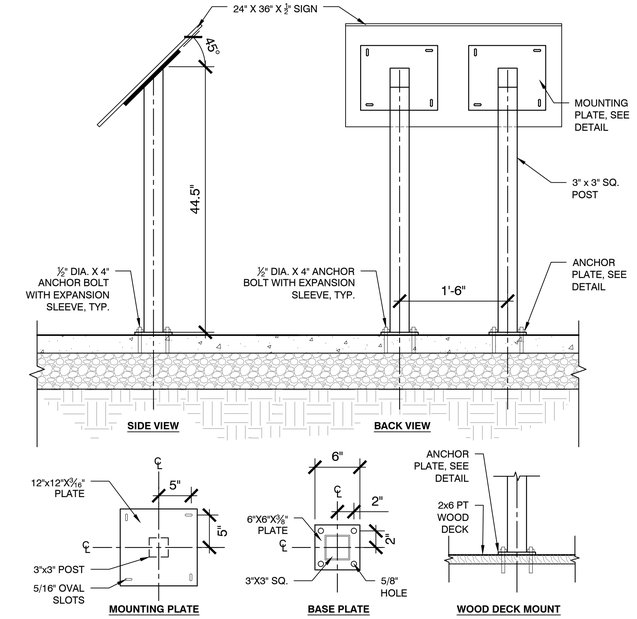
SCALE: N.T.S.



NOTES:
1. SEE GRADING PLAN FOR SLOPE GRADE.
2. ALL MULCH MUST BE DARK IN COLOR. PROVIDE SAMPLE PRIOR TO INSTALLATION TO BE APPROVED BY OWNER'S REPRESENTATIVE.

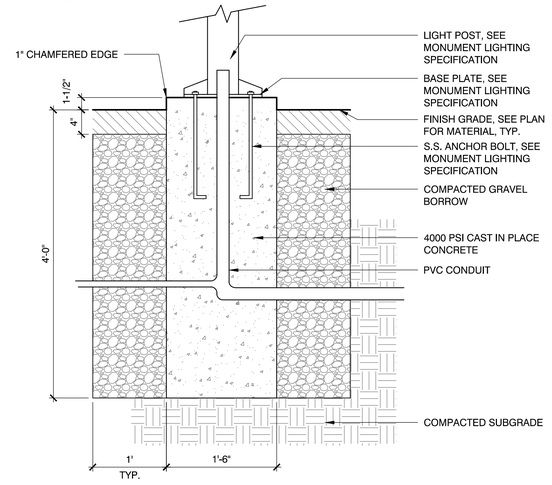
8 SHRUB PLANTING ON SLOPE

SCALE: N.T.S.



9 INTERPRETIVE SIGNAGE - DOUBLE POST

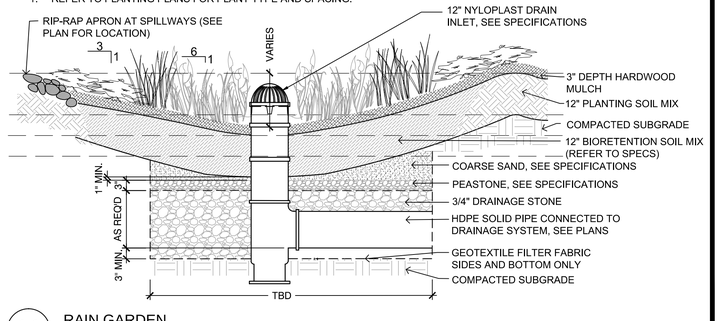
SCALE: N.T.S.



10 LIGHT POST FOOTING

SCALE: N.T.S.

NOTE:
1. REFER TO PLANTING PLANS FOR PLANT TYPE AND SPACING.



11 RAIN GARDEN

SCALE: N.T.S.

Project:

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MVP ACTION GRANT

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Peabody Riverwalk
25% Preliminary Cost Estimate
Peabody, MA

		Quantity	Unit	Unit Price	Total	Notes
1.	**Pathway Surfacing**					
	Concrete Pavement (4" depth)	604	SY	$85	$51,340	1/3 of total riverwalk
	Gravel Borrow Base at Full-depth Asphalt (6" depth)	302	CY	$35	$10,570	
	Boardwalk	5440	SF	$50	$272,000	1/3 of total riverwalk
	6" Crushed Stone under Boardwalk	302	CY	$40	$12,080	
	Boardwalk Pavers	5440	SF	$25	$136,000	1/3 of total riverwalk
	Gravel Borrow at Boardwalk Pavers (6" depth)	302	CY	$35	$10,570	
				Subtotal:	**$492,560**	
2.	**Riverwalk Edge**					
	Edge Type 1- Planting	1	Allowance	$500,000	$500,000	
	Edge Type 2- Granite Blocks	1	Allowance	$100,000	$100,000	
	Edge Type 3- Retaining Wall	1	Allowance	$100,000	$100,000	
	Edge Type 4- Railing	260	LF	$100	$26,000	
				Subtotal:	**$726,000**	
3.	**Community Social Opportunity Areas & Gateways**					
	Gateways					Includes special signage, additional planting, special pavement, a feature / sculptural element
	Wallis Gateway (major)	1	Allowance	$100,000	$100,000	
	Caller Gateway (minor)	1	Allowance	$100,000	$100,000	
	Howley Gateway (major)	1	Allowance	$100,000	$100,000	
	4 Community Social Opportunity Areas					Includes special signage, additional planting, special pavement, a feature / sculptural element
	Wallis Riverwalk Vista	1	Allowance	$100,000	$100,000	Specialty seating and canal overlook
	The Caller Deck	1	Allowance	$100,000	$100,000	Elevated boardwalk-
	The Strongwater Bridge	1	Allowance	$100,000	$100,000	Bridge crossing and seating
	Howley Riverwalk Vista	1	Allowance	$100,000	$100,000	Seating plaza and canal overlook
				Subtotal:	**$700,000**	
5.	**Site Amenities and Improvements**					
	Pedestrian Light Poles	32	EA	$10,000	$320,000	
	Electrical Service	1	LS	$40,000	$40,000	Cabinet, conduit, wiring
	Trash Receptacles	16	EA	$1,200	$19,200	
	Benches	32	EA	$2,500	$80,000	
	Signage	5	LS	$5,000	$25,000	
				Subtotal:	**$484,200**	
	Construction Subtotal				**$2,402,760**	
	Construction Contingency (20%)				$480,552	
	Contractor Mobilization, Overhead and Profit (15%)				$360,414	
				GRAND TOTAL:	**$3,243,726**	

Please note that the preliminary cost estimate provided above is not a final construction cost estimate. The preliminary cost estimate provided only includes major items associated with the design and is to be used for comparative purposes only. The preliminary cost estimate is not representative of the final construction costs as it does not include other items that will be required for the implementation of the riverwalk such as site preparation work, clearing and grubbing, erosion controls, grading, stormwater, etc. In addition, please note that the current cost estimates does not include any soils that may need to be removed from the project area and disposed-off site associated with the future construction of the proposed Riverwalk, etc.

Project:
CITY OF PEABODY
MVP ACTION GRANT
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COST ESTIMATE

Sheet Number:

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APPENDIX F

Community Engagement Materials & Solicited Feedback

City of Peabody – Municipal Vulnerability Preparedness (MVP) North River Resiliency, Canal Wall, & Riverwalk Project

Mayor Edward A. Bettencourt, Jr.



Public Presentation
May 30, 2019

Presented by:
Brendan Callahan, City of Peabody
George Naslas, Weston & Sampson
Julie Eaton, Weston & Sampson
Scott Bruso, Weston & Sampson
Jeanne Lukenda, Weston & Sampson

Presentation Overview

- Project Summary - Brendan Callahan, City of Peabody
- Introduction to Weston & Sampson – George Naslas, Weston & Sampson (W&S)
- Resiliency Report - Julie Eaton, W&S
- Wall Analysis & Repair Alternatives – Scott Bruso, W&S
- Conceptual Riverwalk Plan – Jeanne Lukenda, W&S
- Next Steps – Brendan Callahan, City of Peabody
- Questions & Answers

History of the North River Corridor



- Historically the heart of the heart of a thriving industrial corridor
- Heavily utilized by mills and leather tanneries
- Water from river utilized for processing and disposal
- Currently large vacant parcels of underutilized, potentially contaminated land that impact the quality of life for the community

MVP Project Goals & Scope

Project Goals:

- Increase flood resiliency in North River Corridor
- Create an open space amenity that enhances public access and vitality

Project Scope

- Evaluate five repair and replacement alternatives for the south side of the North River Canal wall
- Develop permitting strategy, cost estimate, and 25% design plans for future Riverwalk



Background & Recent Activity

2015 to Present:

- City began Due Diligence Investigations
- Applied/secured approx. $500K in State funding for design, acquisition, and environmental assessment activities







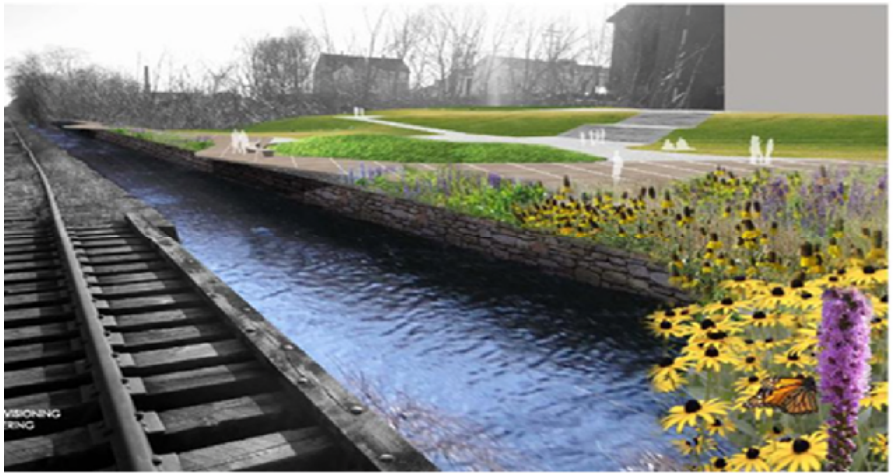
Funding the City has Received for Riverwalk

- EPA Brownfield Assessment Grant:
  - Conducted Phase I & Limited Phase II ESA
    - Flood Mitigation
  - Developed Riverwalk Vision Plan
    - Further the 2001 Riverwalk Plan
- MassDevelopment TDI Program & Brownfields Program
  - Developed North River Neighborhood District Master Plan
  - Conduct Phase II ESA
- Community Development Authority
  - Acquisition of 24 Caller Street
- Community Development Block Grant
  - Obtained specific survey information
  - Developed surveyed plans
  - Property Acquisition Report
  - Developed Due Diligence Evaluation & Report
- MassEEA Municipal Vulnerability Preparedness (MVP) Grant
- Massachusetts Division of Conservation Services PARC Grant
  - Acquisition of 24 Caller Street

Downtown Corridor Riverwalk



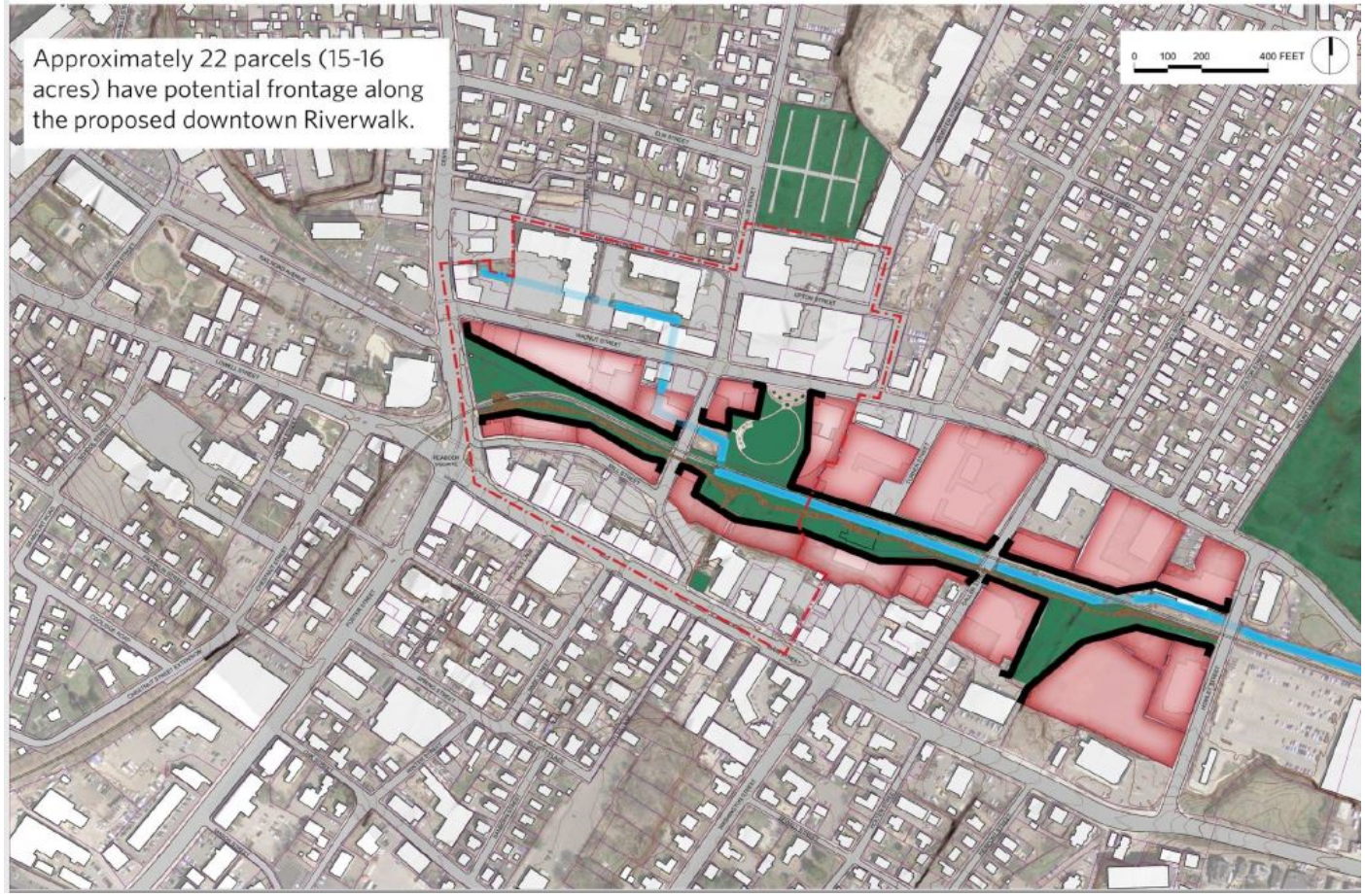
Goals of the Riverwalk





- Preserve and enhance the ecology of the river corridor
- Reconnect with the river & create additional flood storage
- Provide greenspace, create a new urban park & recreational opportunities
- Promote economic development opportunities
- Encourage redevelopment of underutilized abutting properties
- Create an auto-free zone for pedestrians

Downtown Corridor
Redevelopment Potential & Riverwalk





Why Weston & Sampson?

- Since 1899
- Municipally-focused
- Engineering & design firm
- **Multidisciplinary**

OUR MISSION IS TO PROTECT, IMPROVE, AND SUSTAIN THE NATURAL AND BUILT ENVIRONMENT TO ENHANCE THE QUALITY OF LIFE.

- Site Assessment and Remediation
- ASTM Phase I / Phase II ESA Due Diligence
- Hazardous Building Material Assessment & Abatement
- Vapor Intrusion Evaluation & Remediation
- Remedial Planning & Design
- Remediation Implementation Oversight
- Master Planning
- Risk Assessment
- Climate Resiliency & Vulnerability Assessments
- Permitting
- Site Civil Engineering
- Geophysical Surveys & Groundwater Impact Investigations
- Geotechnical / Structural Engineering
- Transportation/Utility /Infrastructure
- Landscape Architecture / Urban Design / Visioning
- Renewable Energy
- Public Outreach

Weston & Sampson℠ Assisting the City

- 2009 EPA Brownfield Coalition Assessment Grant
  - Property Assessments & Conceptual Riverwalk
  - Public Outreach to Support Downtown Visioning Session
- Licensed Site Professional (LSP) Services
- Structural Improvements to North Wall of Canal
- Howley Street Bridge Project
- Grant Application Assistance
- Property Acquisition Due Diligence Assistance
- 2018 MVP Grant
  - Resiliency Evaluation
  - Engineering Evaluation of the South Wall of the Canal
  - Reuse and Visioning Services
  - Permitting Requirements
  - Meeting with MassDEP and other Regulatory Agencies

Resiliency Evaluation



- Flood Mapping
  - Current flood conditions
  - Future flood conditions under climate change
- Potential Opportunities to Store Flood Water
- Evaluate Wall Options

Resiliency Evaluation:
Flooding Scenarios

Climate Scenario	Flood Scenario	
	50-Year	100-Year
Current Conditions		
Year 2050		
Year 2100		

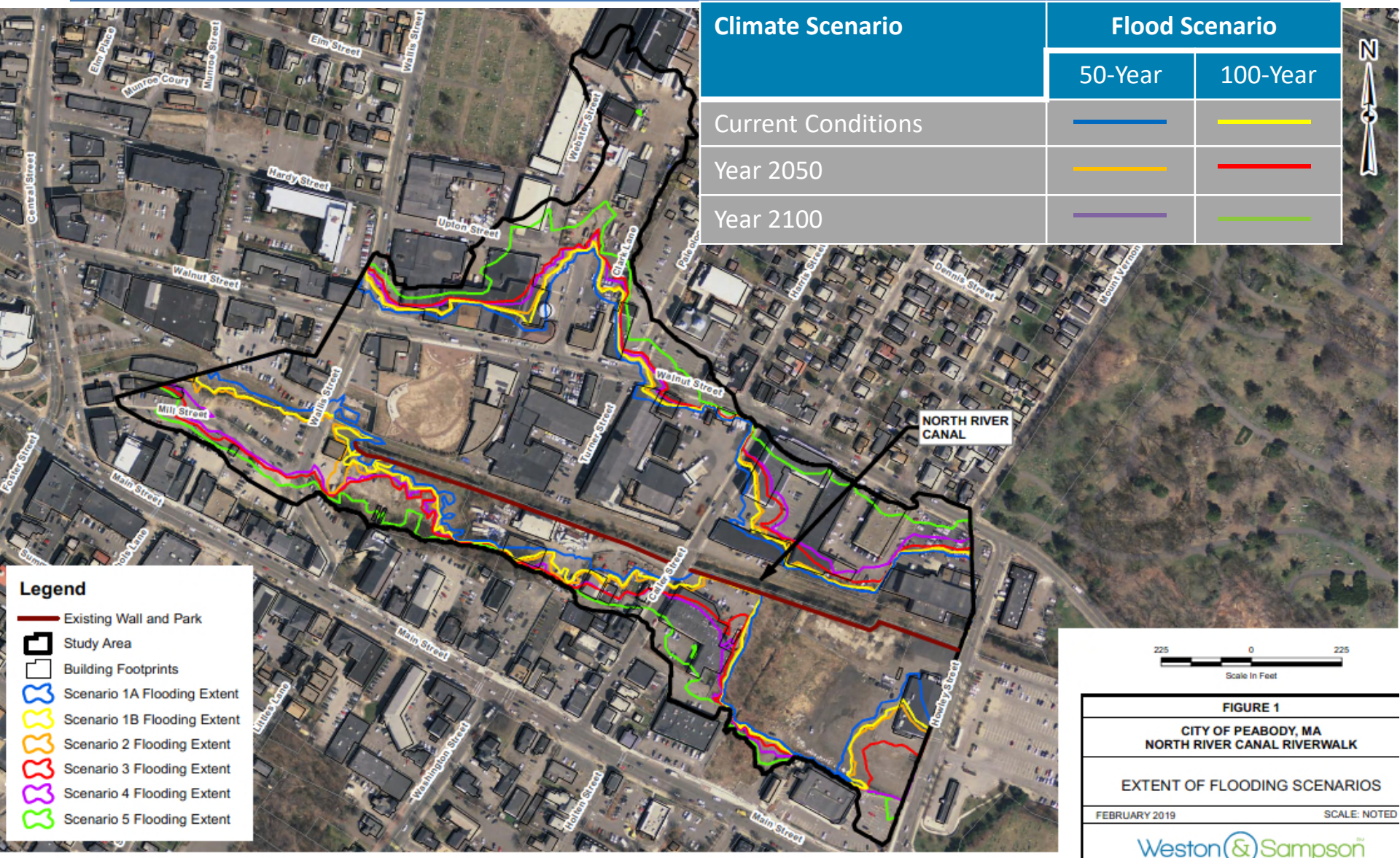


FIGURE 1

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

EXTENT OF FLOODING SCENARIOS

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

Resiliency Evaluation:

100-Year Flood under Current Conditions

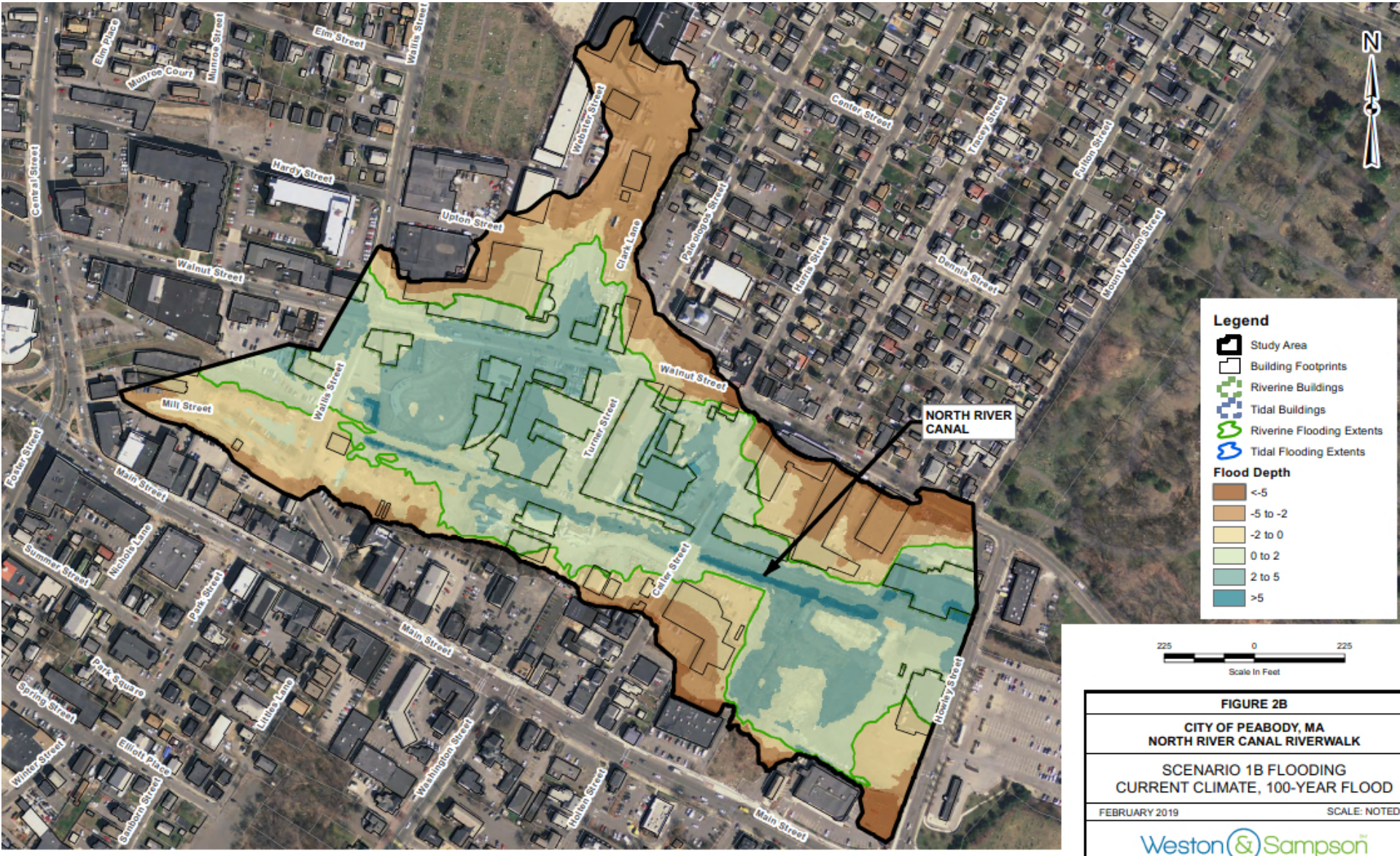


FIGURE 2B

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 1B FLOODING
CURRENT CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

Resiliency Evaluation:

100-Year Flood under Climate Change (2050)



FIGURE 2D

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 3 FLOODING
2050 CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

Resiliency Evaluation:

100-Year Flood under Climate Change (2100)



FIGURE 2F

CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

SCENARIO 5 FLOODING
2100 CLIMATE, 100-YEAR FLOOD

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

Resiliency Evaluation:
Potential Sites for Flood Storage

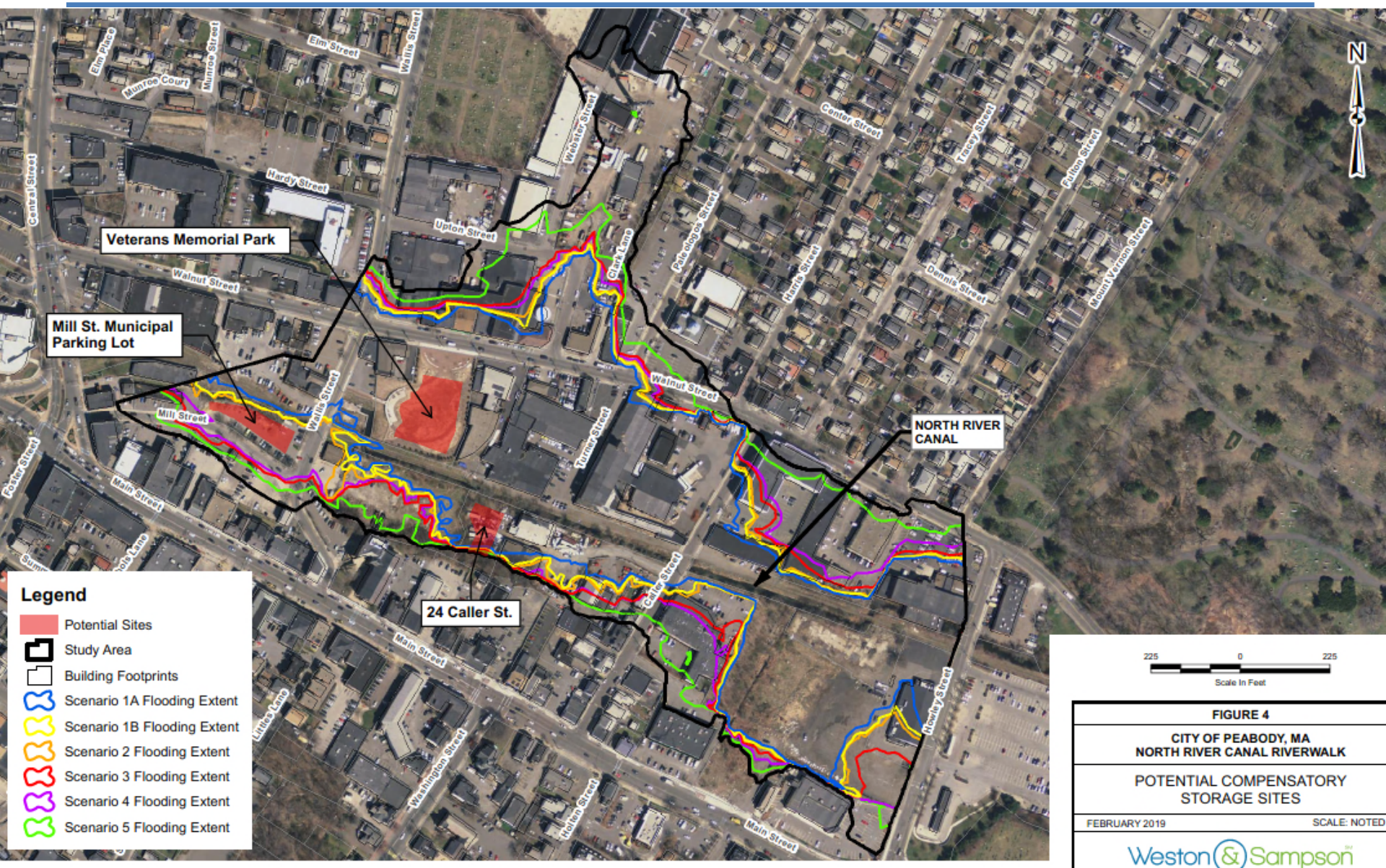


FIGURE 4

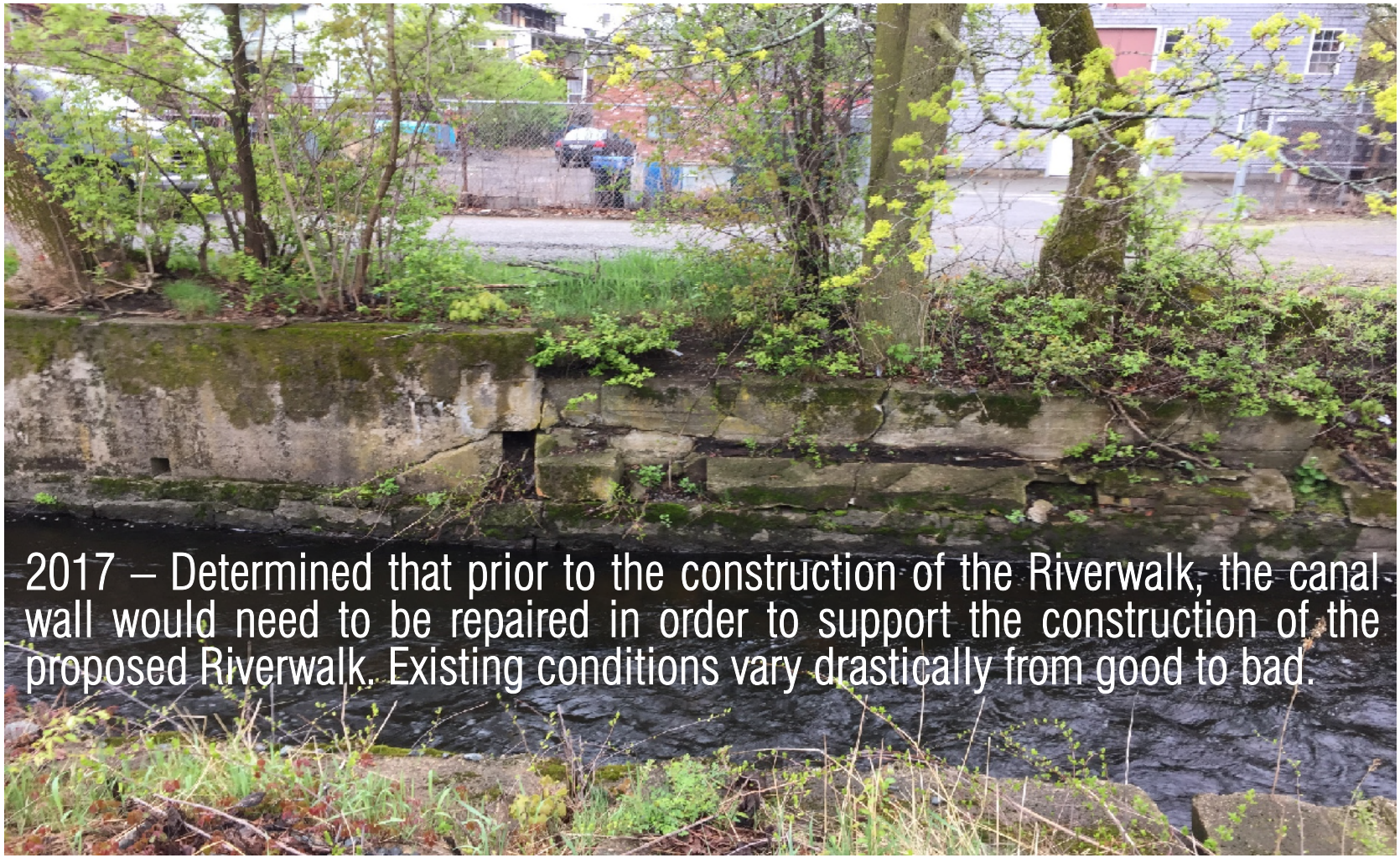
CITY OF PEABODY, MA
NORTH RIVER CANAL RIVERWALK

POTENTIAL COMPENSATORY STORAGE SITES

FEBRUARY 2019 SCALE: NOTED

Weston & Sampson

Wall Analysis & Repair Alternatives

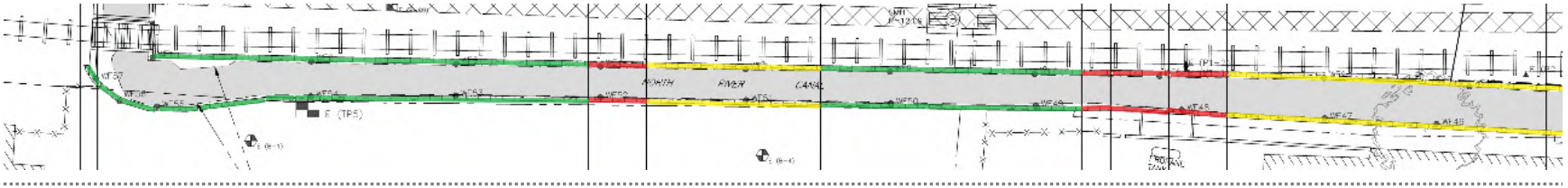


Wall Analysis & Repair Alternatives







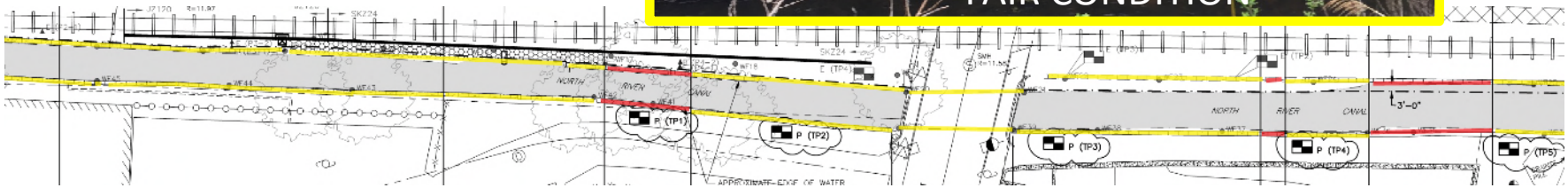


Wall Analysis & Repair Alternatives









Wall Analysis & Repair Alternatives









Wall Analysis & Repair Alternatives

- Five (5) Wall Alternatives Considered:

1) Rip Rap Slope
2) Vegetative Berm Above Rip Rap Slope
3) Sheet Pile Wall
4) Cantilever Concrete Retaining Wall
5) Stone Masonry Wall

- Evaluation Criteria for Alternatives:

a) Resiliency & Flood Storage
b) Durability & Maintenance
c) Environmental Impact
d) Construction & Easements
e) Permitting
f) Regulatory Favorability
g) Cost

This evaluation was used to rank and prioritize alternatives for the canal wall

Wall Analysis & Repair Alternatives



1) Rip Rap Slope

Wall Analysis & Repair Alternatives



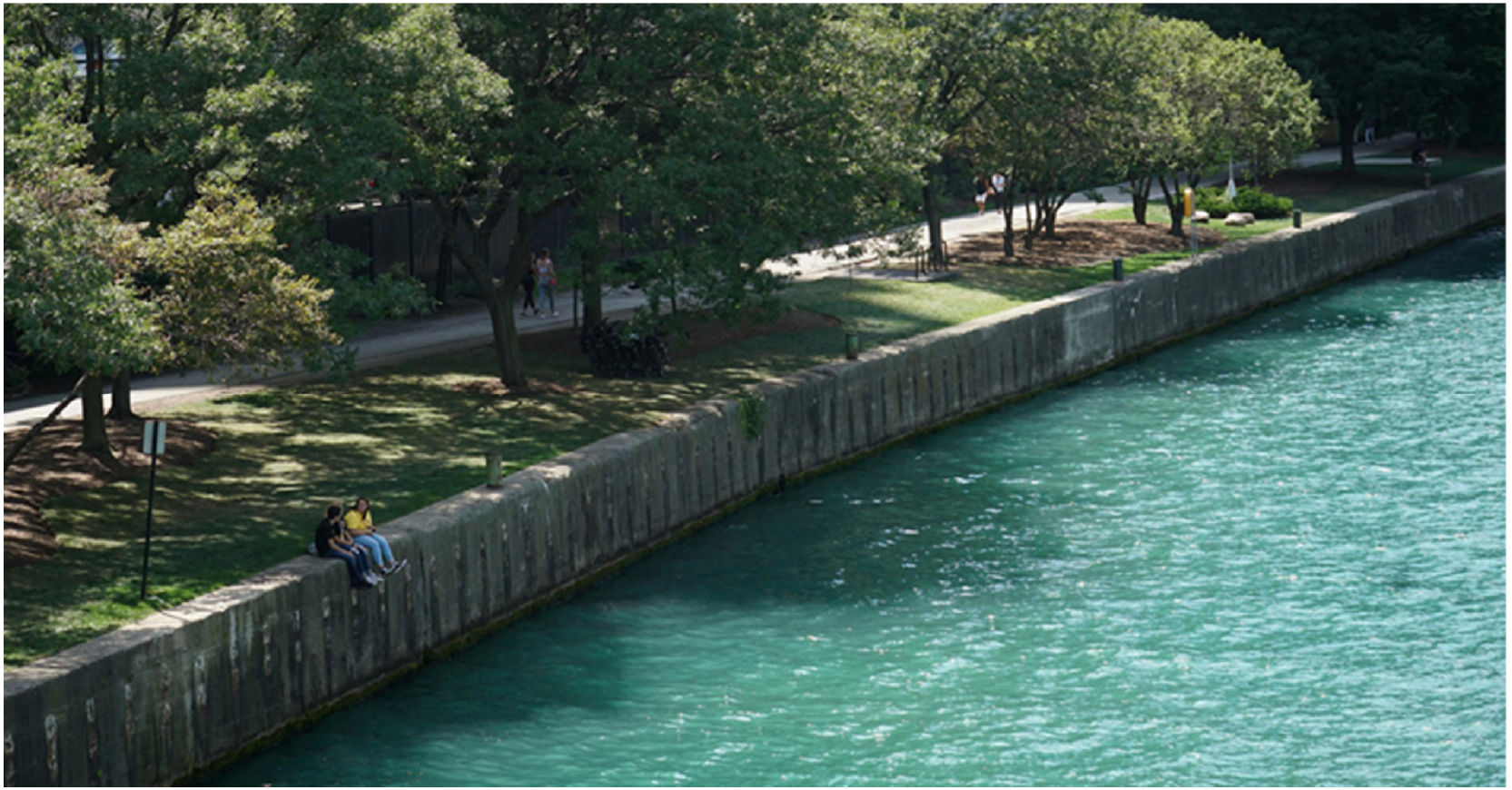
2) Vegetative Berm Above Rip Rap Slope

Wall Analysis & Repair Alternatives



3) Sheet Pile Wall

Wall Analysis & Repair Alternatives



4) Cantilever Concrete Retaining Wall

Wall Analysis & Repair Alternatives



5) Stone Masonry Wall

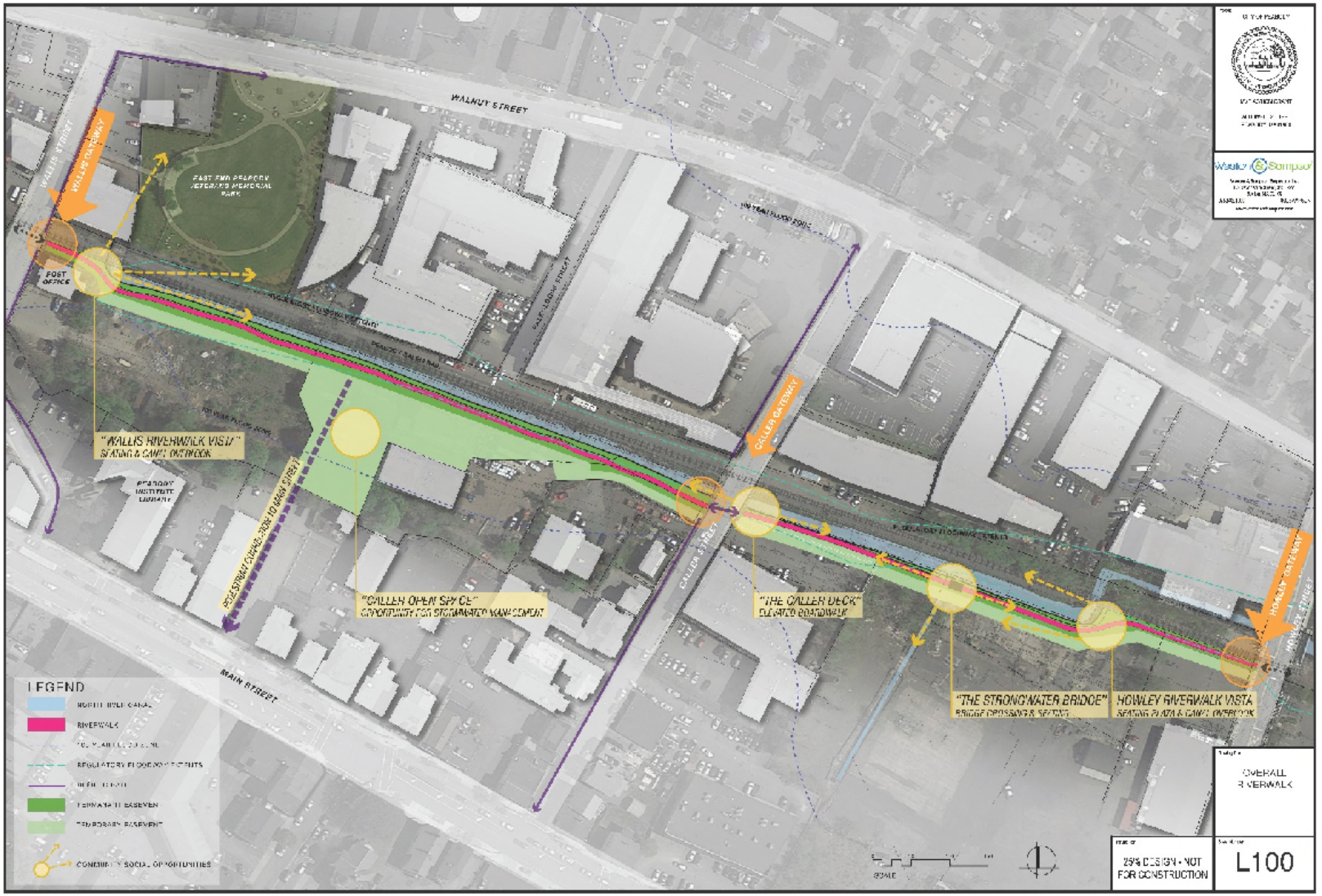
Recommended Wall Alternative



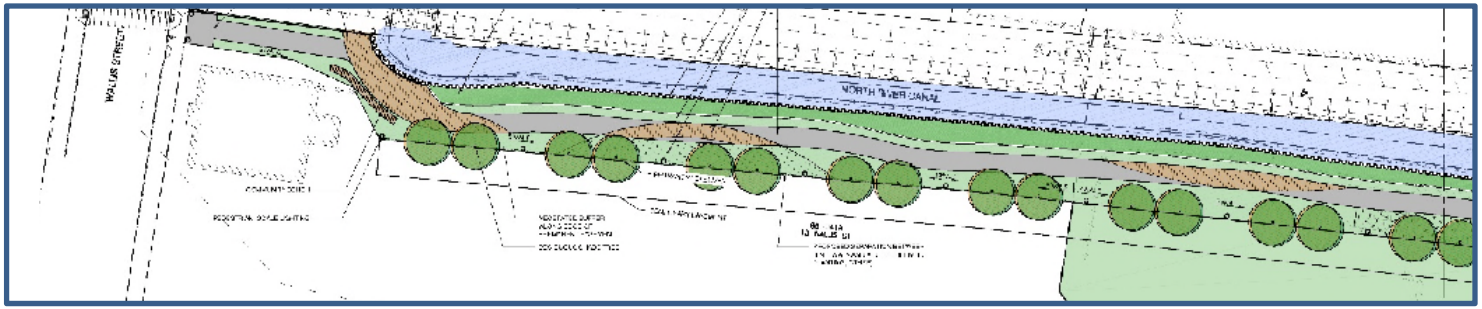
3) Sheet Pile with Sloped Bank

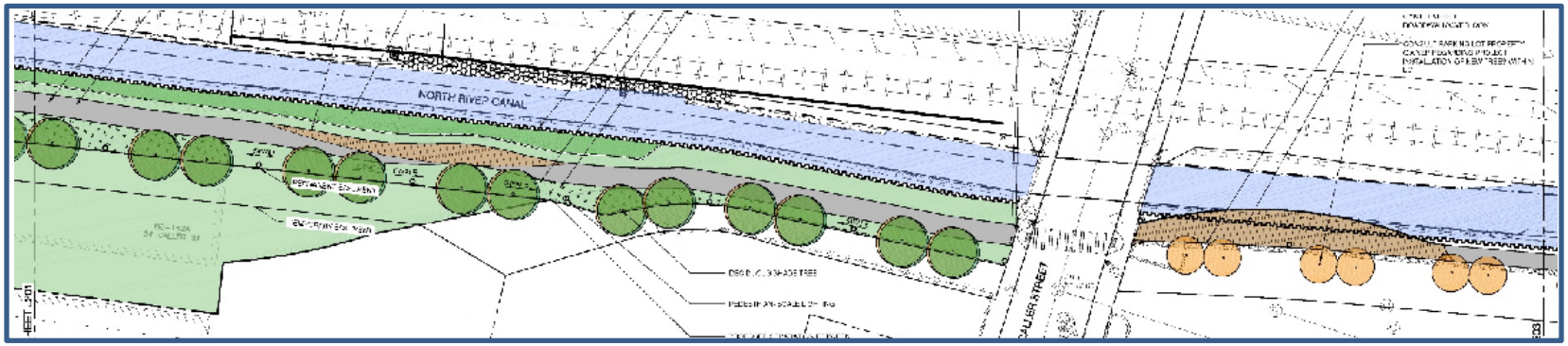
- Highest total scoring alternative & permitting favorability
- Provides the most additional flood storage
- Relatively low total cost & minimal maintenance when compared to other alternatives
- Reasonable easement widths
- No dredging required

Riverwalk Concept



Riverwalk Concept Plan

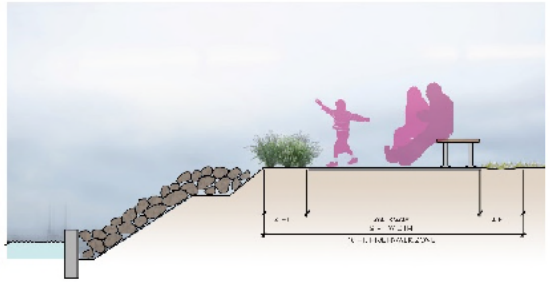






Weston & Sampson

Riverwalk and Edges

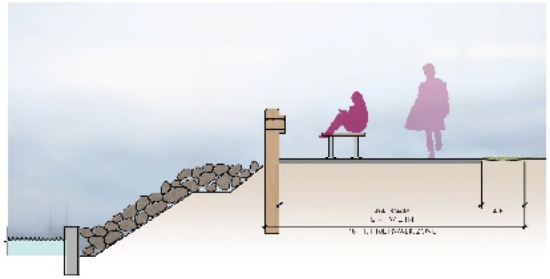


ELEVATION



PRECEDENTS

Planting Edge

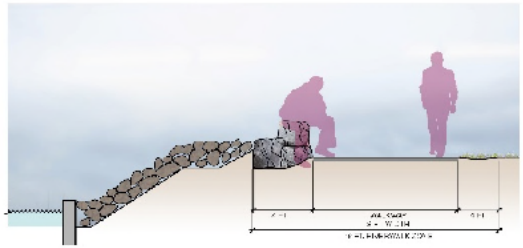


ELEVATION



PRECEDENTS

Railing Edge



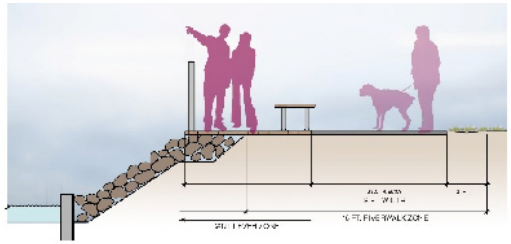
ELEVATION



PRECEDENTS

Seating Edge

Riverwalk and Edges

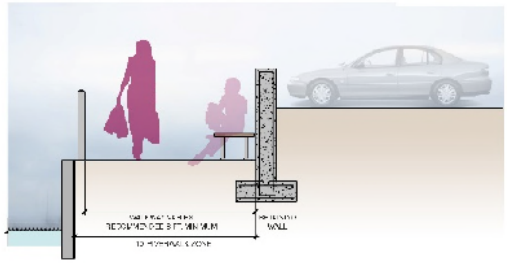


ELEVATION



PRECEDENTS

Cantilever Edge

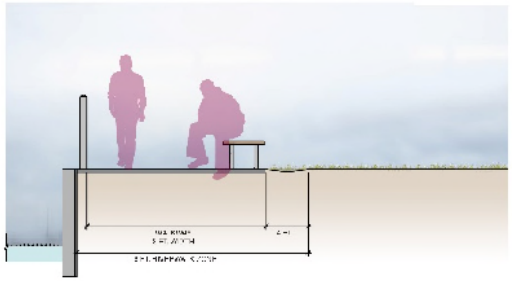


ELEVATION



PRECEDENTS

No Bank / Retaining Edge



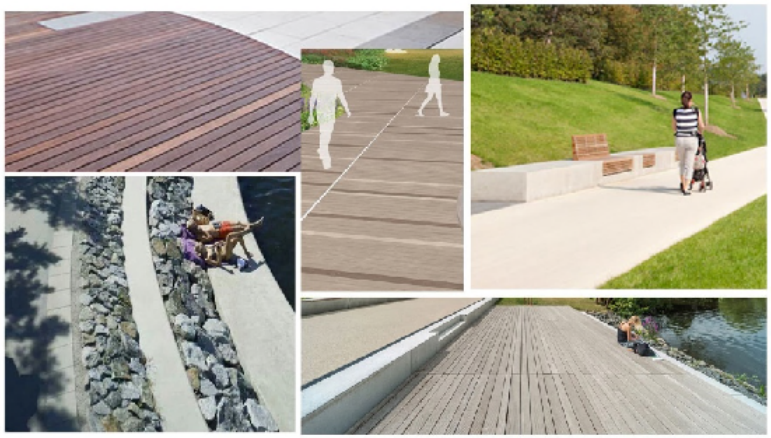
ELEVATION



PRECEDENTS

No Bank / Railing Edge

Riverwalk Elements



Walkway Surfacing Material



Native Plant Material



Seating and Gathering

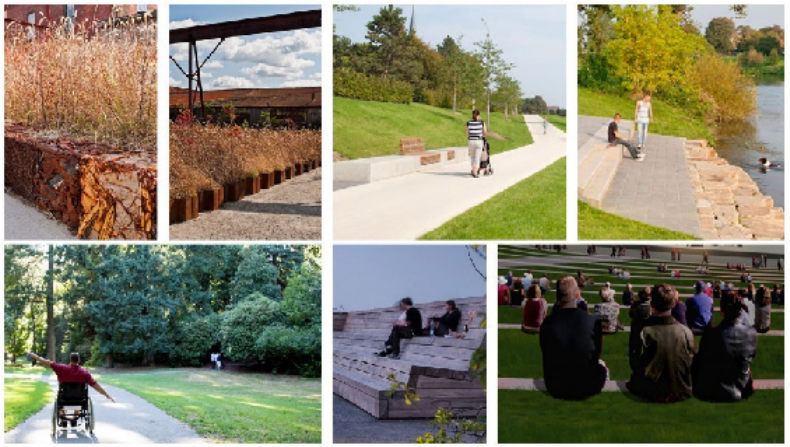


Railing Material

Riverwalk Elements



Retaining / Integrated Seating



Materials and Details



River Edge Interaction

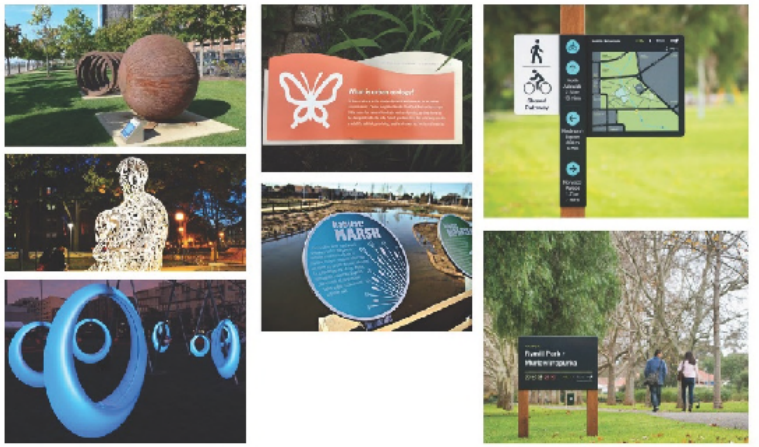


Flood Storage / Stormwater Management

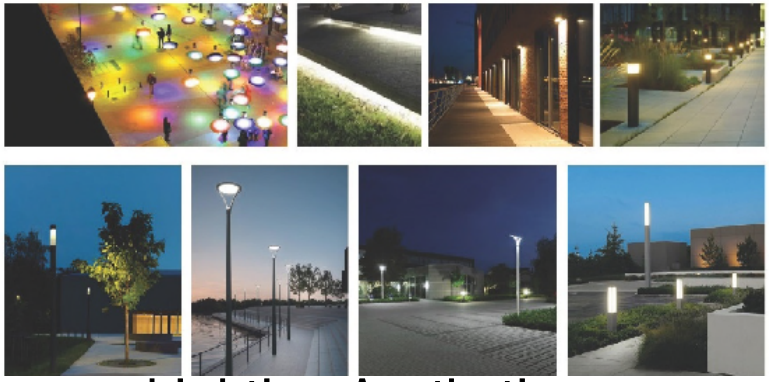
Riverwalk Elements



Amenities



Educational and Wayfinding Signage

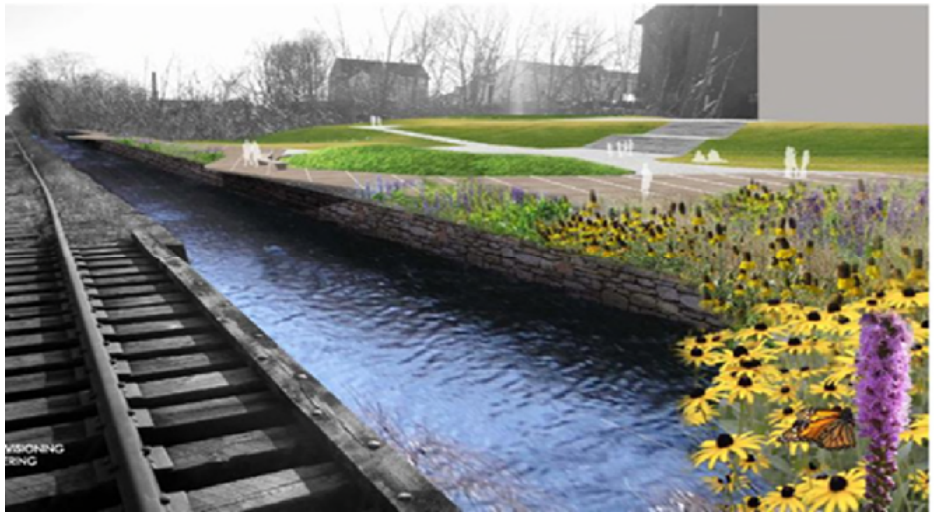


Lighting Aesthetics



Lighting Products

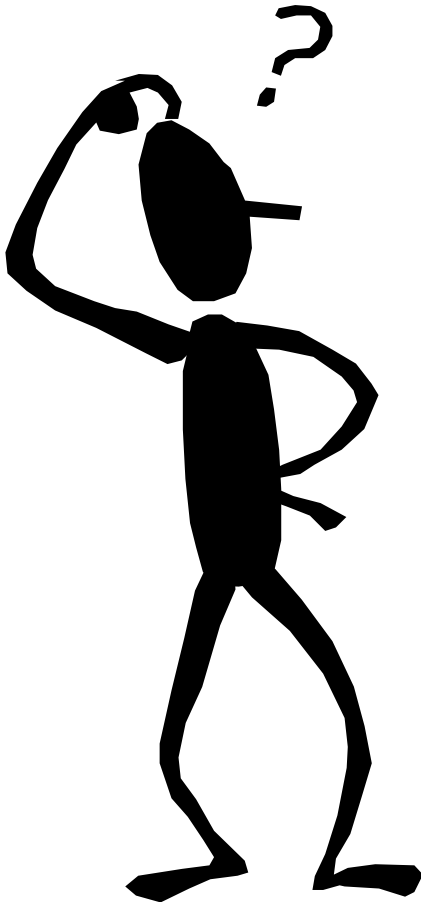
Next Steps





- Solicit Feedback from the Public
- Conduct Phase II Environmental Site Assessment Activities at 24 Caller Street
- Cleanup & Reuse Planning based on Future Use Scenarios
- Develop Path to Regulatory Closure
- Climate Resiliency
- Design & Permitting
- Apply for Future Funding Opportunities

Questions / Answers



For More Information or to Provide Additional Feedback:

Brendan Callahan - Asst. Director of Planning, City of Peabody

978-538-5780

brendan.callahan@peabody-ma.gov

George Naslas – Vice President, Weston & Sampson

naslasg@wseinc.com

Sarah DeStefano – Senior Project Manager, Weston & Sampson

destefanos@wseinc.com

thank you

Mayor Ted Bettencourt, City of Peabody

Weston & Sampson SM

transform your environment

SIGN-IN SHEET

project: **Peabody MVP Canal Wall & Riverwalk** date: May 30, 2019

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Stewart Lazares	shalom@AOL.com	978-828-4212

COMMUNITY ENGAGEMENT SOLICITED FEEDBACK





COMMUNITY ENGAGEMENT SOLICITED FEEDBACK

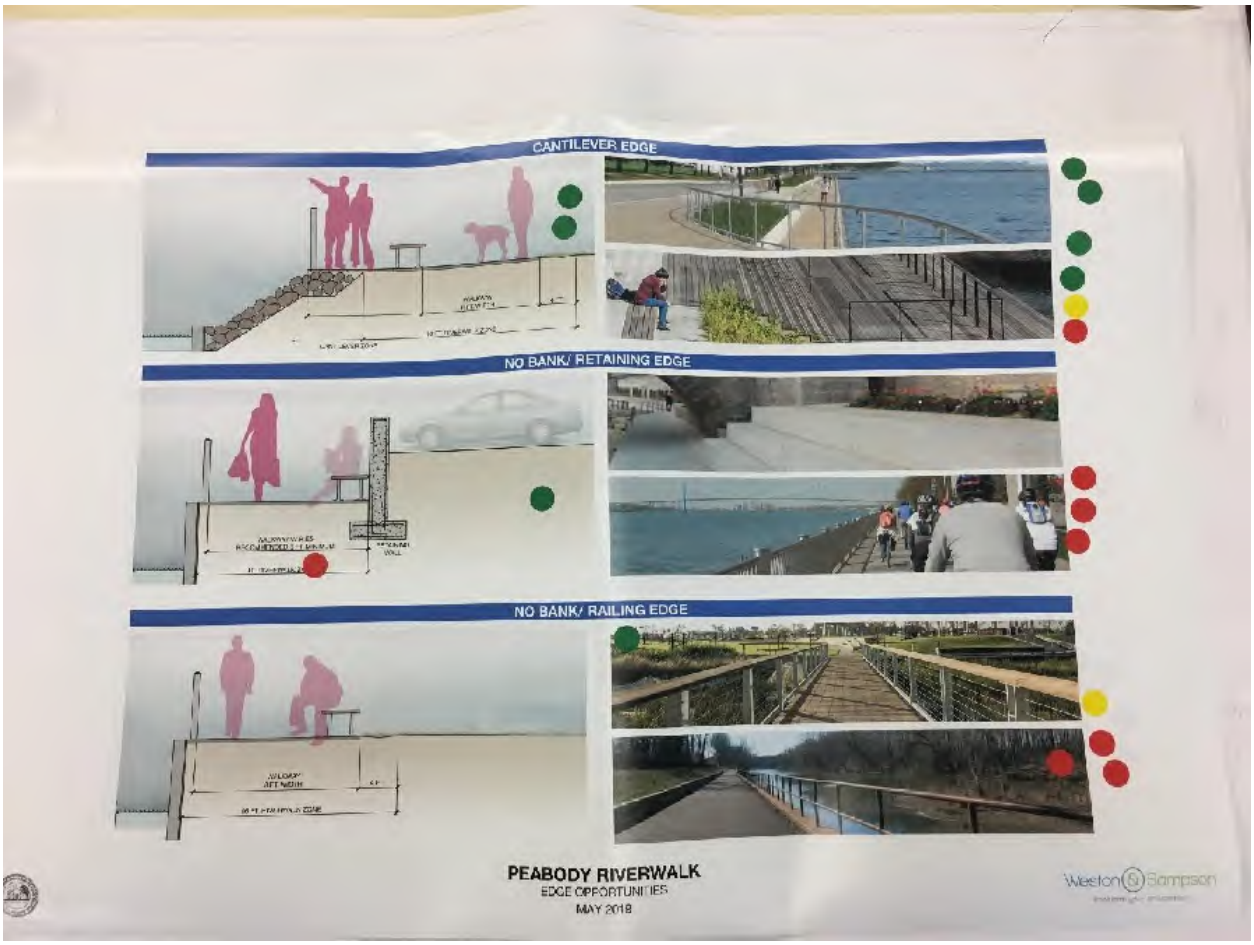




COMMUNITY ENGAGEMENT SOLICITED FEEDBACK



COMMUNITY ENGAGEMENT SOLICITED FEEDBACK



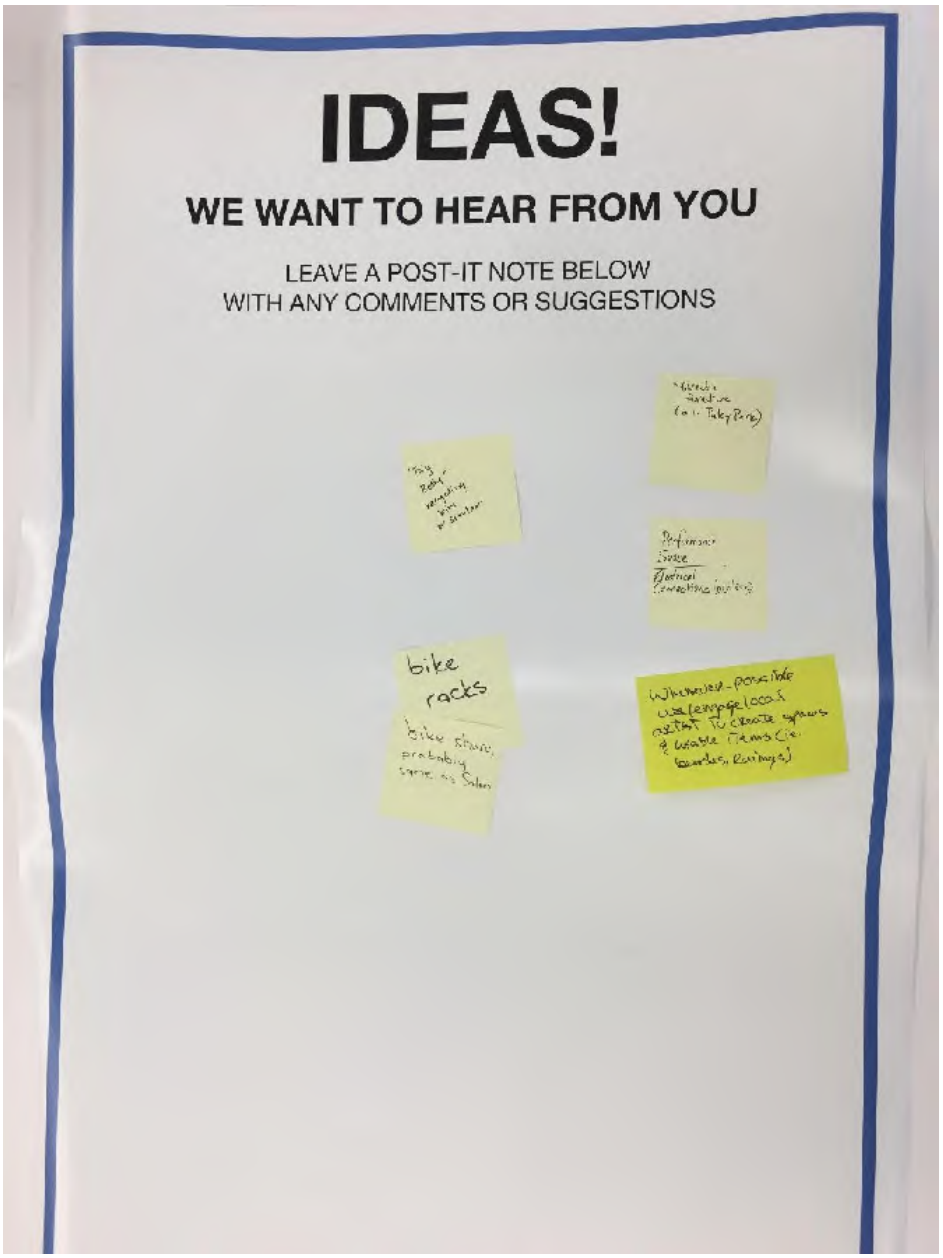
COMMUNITY ENGAGEMENT SOLICITED FEEDBACK



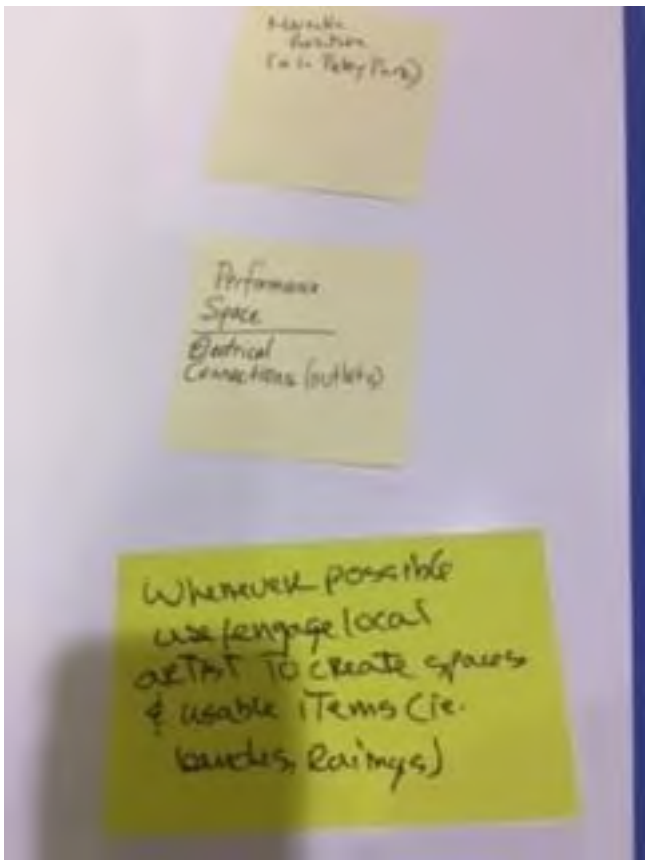
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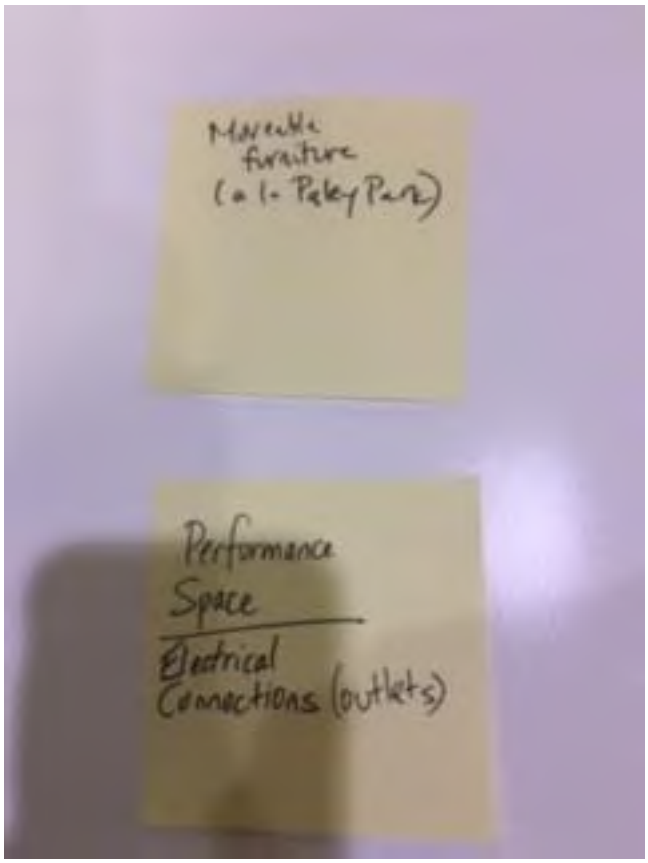


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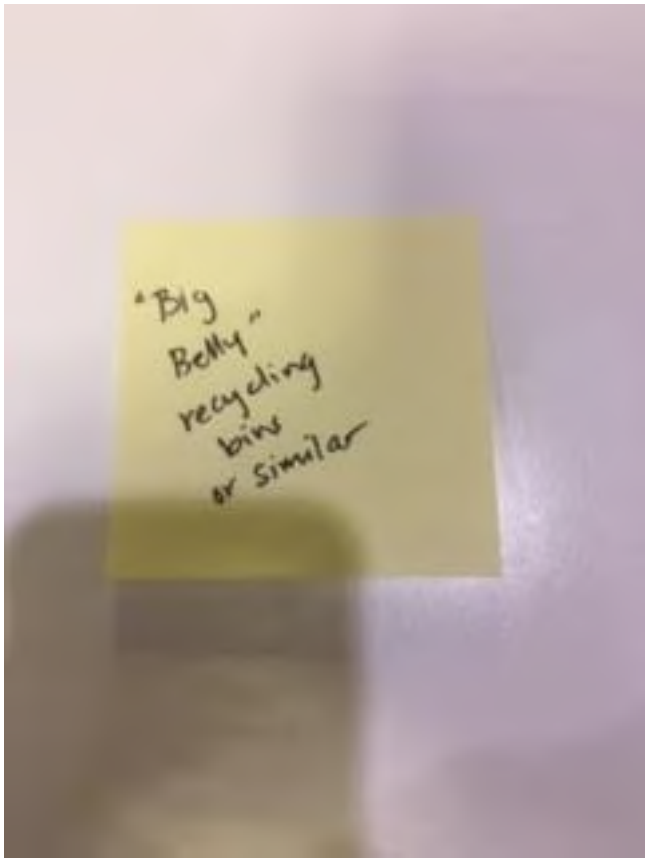


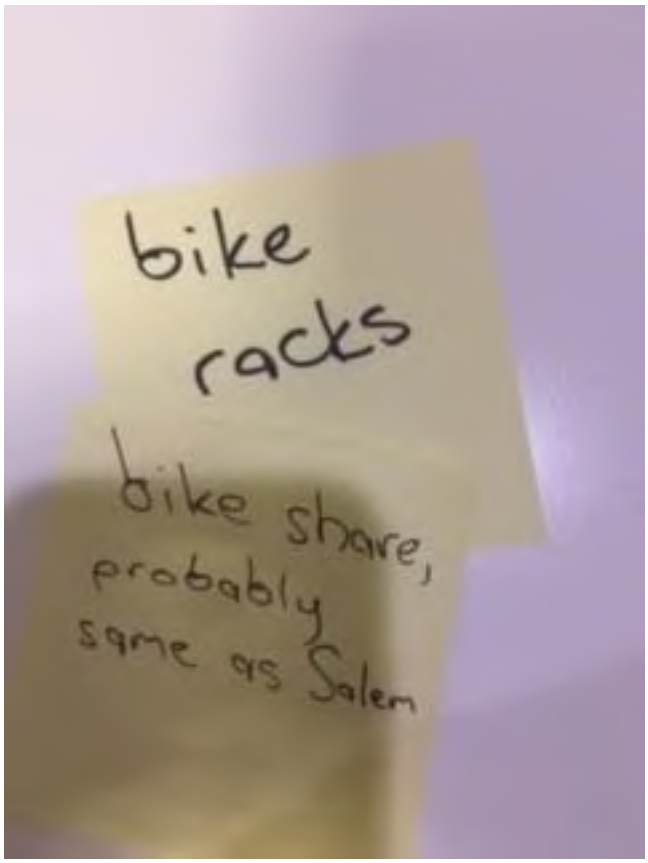
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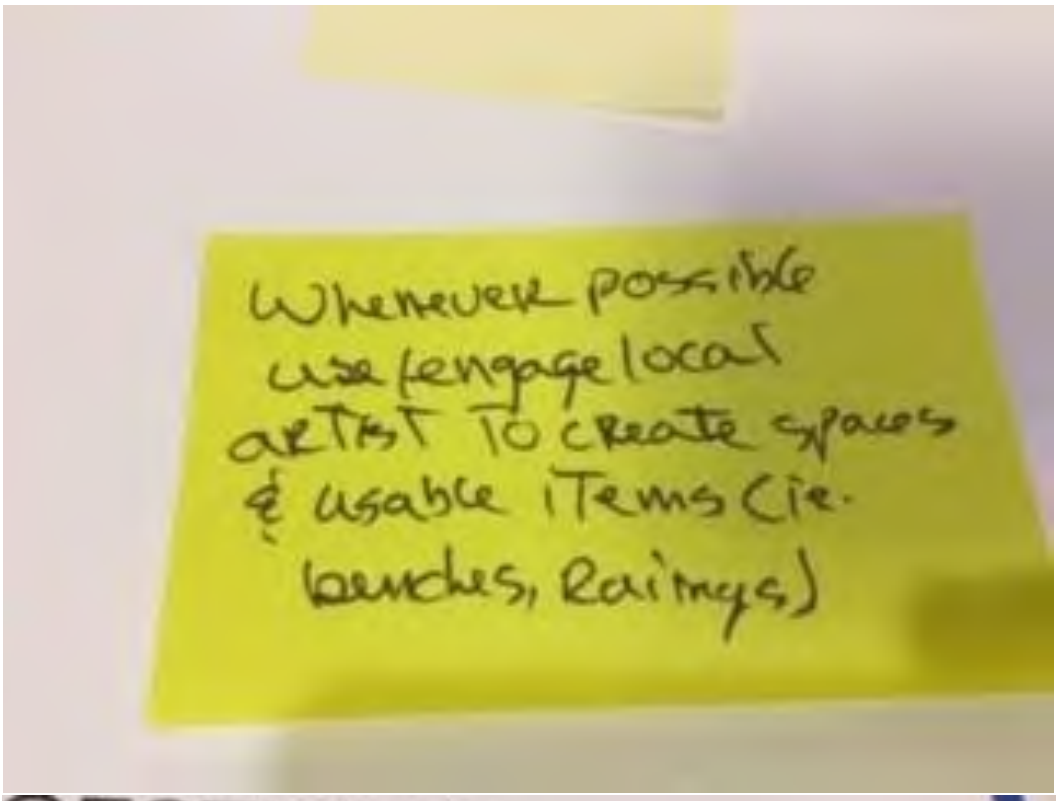


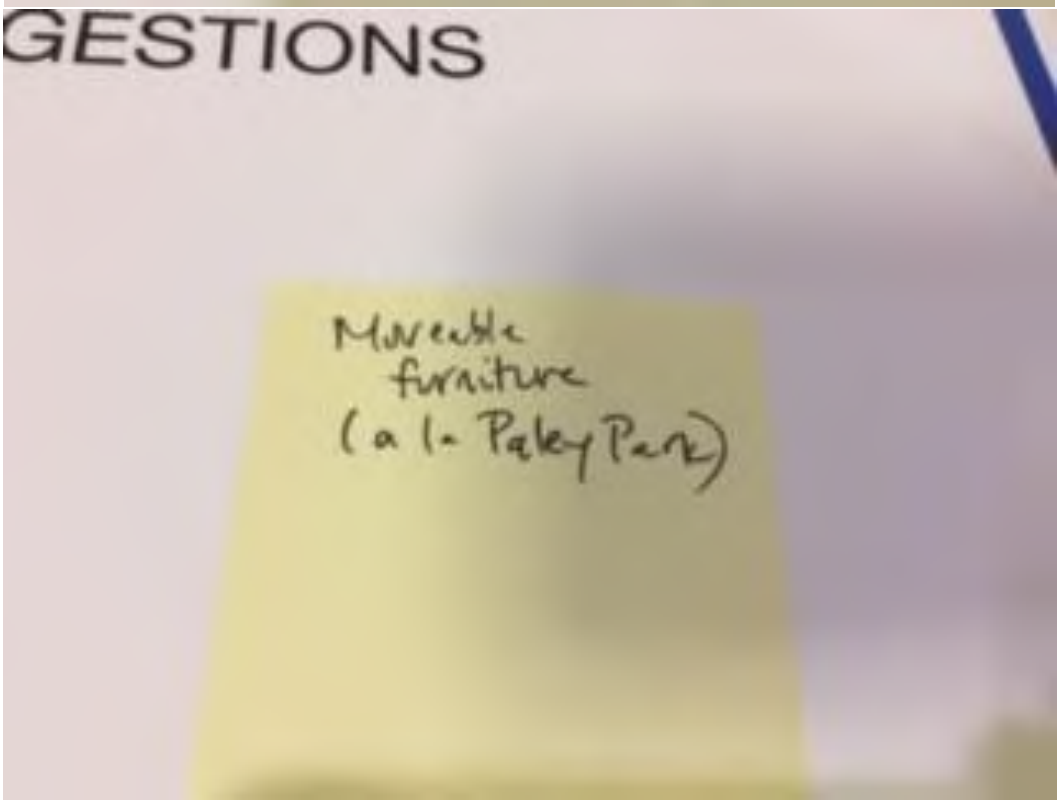


COMMUNITY ENGAGEMENT SOLICITED FEEDBACK






Whenever possible
use/engage local
artist to create spaces
& usable items (ie.
benches, Railings)


GESTIONS
Movable
furniture
(a la Paley Park)

COMMUNITY ENGAGEMENT SOLICITED FEEDBACK





COMMUNITY ENGAGEMENT SOLICITED FEEDBACK





COMMUNITY ENGAGEMENT SOLICITED FEEDBACK





COMMUNITY ENGAGEMENT SOLICITED FEEDBACK





APPENDIX G

Project Management – Monthly Progress Reports

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

MEMORANDUM

TO:	Brendan Callahan, Assistant Director of Planning – City of Peabody Massachusetts Margot Mansfield - Executive Office of Energy & Environmental Affairs (MassEEA)
FROM:	Sarah DeStefano, Senior Project Manager – Weston & Sampson
DATE:	1/2/19
SUBJECT:	Monthly Progress Report Reporting Period of December 1, 2018 – December 31, 2018 Report Number No. 3 2018 MVP Action Grant - Peabody North River Canal Resilient Wall, Riverwalk and Park

---

Weston & Sampson is pleased to provide this summary of the status of engineering and design services related to the execution of the City of Peabody's North River Canal Resilient Wall, Riverwalk and Park Grant Project, which is funded by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA) through its Municipal Vulnerability Preparedness (MVP) Action Grant Program.

TASK 1. PRELIMINARY RESILIENCE EVALUATION

- Weston & Sampson's resiliency team coordinated with the structural team, providing flood elevations for the conceptual wall design.

- The resiliency team prepared a technical memorandum describing recommendations for climate scenarios using available climate change projections. This memo underwent an internal technical review. The final draft memorandum was emailed to Brendan Callahan of the City of Peabody and Margot Mansfield of MA Executive Office of Energy and Environmental Affairs on December 11.

- The resiliency team participated in a call on December 17, 2018 with Brendan Callahan of the City of Peabody to discuss the recommendations of the technical memo. During the discussion, Weston & Sampson's resiliency team clarified that it was proposing to simulate five scenarios, rather than two, as required in our scope. Brendan noted that the 2008 study on flood control had used the 50-year storm, because addressing flooding using the current 100-year storm was considered extremely expensive and there were more options when addressing flooding from the 50-year storm. Therefore, to present a broader range of possible impacts that might need to be addressed in the future, the resiliency team agreed to substitute the 50-year storm for precipitation for the "Low-Intermediate" Climate Change (RCP4.5) scenarios and leave the 100-year storm for precipitation for the "High-Intermediate" Climate Change (RCP8.5) scenarios. This will also create a new baseline of the present-day 50-year flooding event for a total of six scenarios to be considered in Task 1.

- On December 21, 2018 the resiliency team submitted a revised climate scenario technical memorandum to Brendan Callahan and Margot Mansfield and left a voicemail for Margot explaining the changes.

- The resiliency team anticipates submitting the Final Resiliency Evaluation Report to the City on approximately January 31, 2019.

TASK 2. PRELIMINARY ENGINEERING SERVICES AND ALTERNATIVES ANALYSIS

- Weston & Sampson received the analytical data for the soil samples that were submitted to the laboratory for geotechnical testing, including particle size testing or Atterberg limits tests, per exploration location.

- Based upon the finding of the geotechnical explorations and laboratory analytical data, Weston & Sampson's Geotechnical Engineering Team further developed the technical memorandum to provide recommendations for allowable soil bearing capacity, lateral earth pressures, frictional resistance, and seismic design considerations as part of the wall alternative analysis.

- Weston & Sampson's structural engineering team further developed the alternatives analysis report including, but not limited to:

    - Preparation of conceptual cost estimates for each wall alternative;
    - Updating typical cross sections for each wall alternative; and
    - Updating plan figures for each wall alternative.

- Weston & Sampson's Geotechnical & Structural Engineering Teams anticipate sharing a draft of the preliminary alternatives analysis findings to the City for their review and consideration in early January while the Permitting and Environmental Teams complete their respective portions of the technical report. This will allow the City to evaluate the wall alternative options and expedite the process for selecting a preferred design. The City anticipates scheduling a meeting with the MassDEP to discuss the preferred alternative and permitting requirements in early/mid-February 2019.

TASK 3. SOUTH WALL PRELIMINARY DESIGN

- No activities this month.

TASK 4. RIVERWALK PRELIMNARY DESIGN

- No activities this month.

TASK 5. PERMITTING STRATEGY

- Weston & Sampson's Permitting Team commenced developing the permitting strategy, including potential permits, schedule and costs for the five (5) wall alternatives, based upon the recommendations in Task 2.

TASK 6. COMMUNITY ENGAGEMENT

- No activities this month.

TASK 7. PROGRAM MANAGEMENT

- Resiliency and Project Management Team members participated in a call on December 17, 2018 with Brendan Callahan of the City of Peabody to discuss the recommendations in the technical memorandum for climate scenarios.

- On Wednesday, December 12, 2018, Weston & Sampson's Project Management, Landscape Architecture and Structural Engineering Team members met with representatives from the City of Peabody (Brendan Callahan / William Paulitz / Parks & Recreation Director - Jennifer Davis and Ward Councilor McGinn) to discuss the City's conceptual vision and other desired features for the proposed Riverwalk design, as well as proposed future public engagement activities. Weston & Sampson recommended that the City create a Stakeholder Committee for the Riverwalk Design.

- Weston & Sampson performed general project management activities including work plan implementation; correspondence and coordination with appropriate Site contacts and subcontractors, the laboratory, and the City; project staffing oversight; schedule, budget tracking and control; invoice preparation and submittal; monthly progress reports and status calls to discuss progress and findings, and/or other miscellaneous project management activities.

SCOPE & BUDGET

- There were no changes to the scope or proposed project budget this month.

- No additional assistance from EEA is requested at this time.

- A copy of the budget draw down / tracking table is attached.

- The anticipated project deliverable schedule has been updated based upon the delay in the receiving the written Notice to Proceed (NTP) for the contract from the City, as well as the addition of a technical memorandum for City approval regarding climate change scenario selection. This was unanticipated in the original scoping but came up as a request early on in conversations with the City. Also, there was an approximate two to three-week delay caused by discussions surrounding the considerations of whether to incorporate the Woods Hole Group's updated sea level rise and coastal surge modeling, as detailed in last month's progress report.

Anticipated Project Deliverable Schedule (All Task to be Completed by **6/30/19**)

i. **Task 1** - FINAL Resiliency Evaluation Report ~ January 31, 2019.

ii. **Task 2 & 4** - Engineering Evaluation & Wall Alternatives and Permitting Strategy Report ~ January 31, 2019.

iii. **Task 6** - Community Outreach
   - Meeting #1 ~ March 2019 to solicit ideas from public on conceptual Riverwalk design.
   - Meeting #2 ~ April 2019 to present two (2) conceptual (10%) Riverwalk design options.

iv. **Task 3** - FINAL South Wall 25% Preliminary Design Plans ~ March 31, 2019.

v. **Task 5** - Riverwalk Preliminary Design Plans
   - Two (2) draft conceptual 10% Design Plans prior to April public meeting ~ March 1, 2019.
   - FINAL 25% Preliminary Design Plans ~ May 15, 2019.

vi. **Draft FINAL REPORT** ~ June 14, 2019.

vii. **FINAL REPORT** ~ June 28, 2019 (grant deadline 6/30/19).

TASK	DESCRIPTION		GRANT AMOUNT	MATCH AMOUNT	TOTAL		INVOICED TO DATE	GRANT SPENT	MATCH SPENT	TOTAL SPENT		GRANT BALANCE	MATCH BALANCE	TOTAL BALANCE	
1	RESLIENCY EVALUATION		$31,717.00	$10,572.00	**$42,289.00**		$13,155.00	$9,866.25	$3,288.75	**$13,155.00**		$21,850.75	$7,283.25	**$29,134.00**	
2	PRELIMINARY ENGINEERING & ALTERNATIVES		$94,453.00	$31,485.00	**$125,938.00**		$37,462.71	$28,097.03	$9,365.68	**$37,462.71**		$66,355.97	$22,119.32	**$88,475.29**	
3	WALL PRELIMINARY DESIGN		$33,933.00	$11,310.00	**$45,243.00**		$0.00	$0.00	$0.00	**$0.00**		$33,933.00	$0.00	**$45,243.00**	
4	WALK PRELIMINARY DESIGN		$34,867.00	$11,622.00	**$46,489.00**		$0.00	$0.00	$0.00	**$0.00**		$34,867.00	$0.00	**$46,489.00**	
5	PERMITTING STRATEGY		$10,858.00	$3,620.00	**$14,478.00**		$0.00	$0.00	$0.00	**$0.00**		$10,858.00	$0.00	**$14,478.00**	
6	COMMUNITY ENGAGEMENT		$10,983.00	$3,661.00	**$14,644.00**		$0.00	$0.00	$0.00	**$0.00**		$10,983.00	$0.00	**$14,644.00**	
7	PROGRAM MANAGEMENT & FINAL REPORT		$7,405.00	$2,469.00	**$9,874.00**		$2,202.50	$1,651.88	$550.62	**$2,202.50**		$5,753.12	$1,918.38	**$7,671.50**	
TOTAL			$224,216.00	$74,739.00	**$298,955.00**		$52,820.21	$39,615.16	$13,205.05	**$52,820.21**		$184,600.84	$61,533.95	**$246,134.79**	

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

MEMORANDUM

TO:	Brendan Callahan, Assistant Director of Planning – City of Peabody Massachusetts Margot Mansfield - Executive Office of Energy & Environmental Affairs (MassEEA)
FROM:	Sarah DeStefano, Senior Project Manager – Weston & Sampson
DATE:	2/13/19
SUBJECT:	Monthly Progress Report Reporting Period of January 1, 2019 – January 31, 2019 Report Number No. 4 2018 MVP Action Grant - Peabody North River Canal Resilient Wall, Riverwalk and Park

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Weston & Sampson is pleased to provide this summary of the status of engineering and design services related to the execution of the City of Peabody's North River Canal Resilient Wall, Riverwalk and Park Grant Project, which is funded by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA) through its Municipal Vulnerability Preparedness (MVP) Action Grant Program.

TASK 1. PRELIMINARY RESILIENCE EVALUATION

- 1/10/19: Submitted revised draft climate change scenario memorandum to Peabody and EEA for further review. This version included current flooding conditions for the 50-year and 100-year flood events, and the 50-yer flood with the RCP 4.5 emissions scenario and the 100-year flood with the RCP 8.5 emissions scenario for both 2050 and 2100.

- 1/17/19: Participated in a call with Peabody about further refinements needed to the memorandum. Selection of climate change scenarios was confirmed during this call.

- 1/24/19: Sent revised memo, which addressed Peabody's comments, to Peabody

- 1/25/19: Peabody approved the climate change scenario memo as final.

- 1/26/19: Final climate change memo sent to EEA and Peabody.

- Following the call on January 17, 2019, Weston & Sampson's resiliency team evaluated the water level at locations in the study area for each of the six climate change scenarios. Weston & Sampson created cross-sections of flood elections in GIS and worked with our GIS team to prepare six gridded datasets of flood levels throughout the floodplain for the six scenarios.

- 1/30/19: Weston & Sampson had a meeting with the City to decide on methodology alternatives for how the City wants to identify and analyze options for flood storage, such as excavating City owned parcels, for example.

TASK 2. PRELIMINARY ENGINEERING SERVICES AND ALTERNATIVES ANALYSIS

- 1/9/19: Weston & Sampson's Geotechnical & Structural Engineering Teams shared a draft of the preliminary alternatives analysis findings to the City for their review and consideration while the Permitting and Environmental Teams completed their respective portions of the technical report. This allowed the City to evaluate the wall alternative options and provide comments in hopes of expediting the selection process for a preferred design alternative.

- 1/17/19: Weston & Sampson participated in a conference call with the City to discuss their comments and questions regarding the preliminary alternatives analysis findings.

- Weston & Sampson's Geotechnical, Structural and Environmental Engineering Teams finalized the draft alternatives analysis report for submission to the City at the end of the month.

- Weston & Sampson's Geotechnical team worked to compile a site-specific technical memorandum to provide to the owner of 166R Main Street, pursuant to their access agreement request.

TASK 3. SOUTH WALL PRELIMINARY DESIGN

- No activities this month.

TASK 4. RIVERWALK PRELIMNARY DESIGN

- No activities this month.

TASK 5. PERMITTING STRATEGY

- Weston & Sampson's Permitting Team finalized the draft permitting strategy, including potential permits, schedule and costs for the five (5) wall alternatives, based upon the recommendations in Task 2 and comments provides by the

TASK 6. COMMUNITY ENGAGEMENT

- No activities this month.

TASK 7. PROGRAM MANAGEMENT

- Project Management Team members participated in a call on January 17, 2019 with the City of Peabody and the Resiliency Team to discuss refinements in the technical memorandum and climate scenario selections. Following that discussion, Weston & Sampson's Project Management Team participated in a conference call with the City to discuss their comments and questions regarding the preliminary alternatives analysis findings.

- Weston & Sampson performed general project management activities including work plan implementation; correspondence and coordination with appropriate Site contacts and subcontractors, the laboratory, and the City; project staffing oversight; schedule, budget tracking and control; invoice preparation and submittal; monthly progress reports and status calls to discuss progress and findings, and/or other miscellaneous project management activities.

SCOPE & BUDGET

- There were no changes to the scope or proposed project budget this month.

- No additional assistance from EEA is requested at this time.

- A copy of the budget draw down / tracking table is attached.

- The anticipated project deliverable schedule has been updated based upon the delay in the receiving the written Notice to Proceed (NTP) for the contract from the City, as well as the addition of a technical memorandum for City approval regarding climate change scenario selection. This was unanticipated in the original scoping but came up as a request early on in conversations with the City. Also, there was an approximate two to three-week delay caused by discussions surrounding the considerations of whether to incorporate the Woods Hole Group's updated sea level rise and coastal surge modeling, as detailed in last month's progress report.

Anticipated Project Deliverable Schedule (All Task to be Completed by **6/30/19**)

i. **Task 1** - FINAL Resiliency Evaluation Report – delivered January 26, 2019.

ii. **Task 2 & 4** - Engineering Evaluation & Wall Alternatives and Permitting Strategy Report - Draft report delivered to City February 1, 2019. W&S currently addressing the City's comments and evaluating if there is sufficient budget to include an additional alternative option to the report.

iii. **Task 6** - Community Outreach
   - Meeting #1 ~ March 2019 to solicit ideas from public on conceptual Riverwalk design.
   - Meeting #2 ~ April 2019 to present two (2) conceptual (10%) Riverwalk design options.

iv. **Task 3** - FINAL South Wall 25% Preliminary Design Plans ~ March 31, 2019.

v. **Task 5** - Riverwalk Preliminary Design Plans
   - Two (2) draft conceptual 10% Design Plans prior to April public meeting ~ March 1, 2019.
   - FINAL 25% Preliminary Design Plans ~ May 15, 2019.

vi. **Draft FINAL REPORT** ~ June 14, 2019.

vii. **FINAL REPORT** ~ June 28, 2019 (grant deadline 6/30/19).

TASK	DESCRIPTION	GRANT AMOUNT	MATCH AMOUNT	TOTAL	INVOICED TO DATE	GRANT SPENT	MATCH SPENT	TOTAL SPENT	GRANT BALANCE	MATCH BALANCE	TOTAL BALANCE
1	RESLIENCY EVALUATION	$31,717.00	$10,572.00	**$42,289.00**	$26,017.50	$19,513.12	$6,504.38	**$26,017.50**	$12,203.88	$4,067.62	**$16,271.50**
2	PRELIMINARY ENGINEERING & ALTERNATIVES	$94,453.00	$31,485.00	**$125,938.00**	$68,732.07	$51,549.05	$17,183.02	**$68,732.07**	$42,903.95	$14,301.98	**$57,205.93**
3	WALL PRELIMINARY DESIGN	$33,933.00	$11,310.00	**$45,243.00**	$0.00	$0.00	$0.00	**$0.00**	$33,933.00	$0.00	**$45,243.00**
4	WALK PRELIMINARY DESIGN	$34,867.00	$11,622.00	**$46,489.00**	$0.00	$0.00	$0.00	**$0.00**	$34,867.00	$0.00	**$46,489.00**
5	PERMITTING STRATEGY	$10,858.00	$3,620.00	**$14,478.00**	$641.25	$480.94	$160.31	**$1,282.50**	$10,377.06	$0.00	**$13,195.50**
6	COMMUNITY ENGAGEMENT	$10,983.00	$3,661.00	**$14,644.00**	$0.00	$0.00	$0.00	**$0.00**	$10,983.00	$0.00	**$14,644.00**
7	PROGRAM MANAGEMENT & FINAL REPORT	$7,405.00	$2,469.00	**$9,874.00**	$3,357.50	$2,518.13	$839.37	**$3,357.50**	$4,886.87	$1,629.63	**$6,516.50**
TOTAL		$224,216.00	$74,739.00	**$298,955.00**	$98,748.32	$74,061.24	$24,687.08	**$98,748.32**	$150,154.76	$50,051.92	**$200,206.68**

Weston & Sampson

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

MEMORANDUM

TO:	Brendan Callahan, Assistant Director of Planning – City of Peabody Massachusetts Margot Mansfield - Executive Office of Energy & Environmental Affairs (MassEEA)
FROM:	Sarah DeStefano, Senior Project Manager – Weston & Sampson
DATE:	3/13/19
SUBJECT:	Monthly Progress Report Reporting Period of February 1, 2019 – February 28, 2019 Report Number No. 5 2018 MVP Action Grant - Peabody North River Canal Resilient Wall, Riverwalk and Park

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Weston & Sampson is pleased to provide this summary of the status of engineering and design services related to the execution of the City of Peabody's North River Canal Resilient Wall, Riverwalk and Park Grant Project, which is funded by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA) through its Municipal Vulnerability Preparedness (MVP) Action Grant Program.

TASK 1. PRELIMINARY RESILIENCE EVALUATION

- Weston & Sampson's Resiliency Team refined the cross-sections of the flood elections associated with the six climate change scenarios and developed a conceptual plan for evaluating storage options under the climate change scenarios.

- On January 30, 2019, the Weston & Sampson Resiliency Team and Project Manager had a conference call with the City of Peabody to discuss options for evaluating storage options. Specifically, Weston & Sampson was looking for guidance from the City on pin-pointing exact areas of excavation for creation of flood storage and properties that would and would not benefit from creation of flood storage. During the month of February, Weston & Sampson refined the evaluation of storage options based on the feedback we received from the City at that meeting.

- The Resiliency Team finalized the Task 1 – deliverable, the River Resiliency Report, and submitted it to the City and EEA for review on February 28, 2019.

TASK 2. PRELIMINARY ENGINEERING SERVICES AND ALTERNATIVES ANALYSIS

- On February 1, 2019, Weston & Sampson's Geotechnical, Structural, Permitting and Environmental Engineering Teams finalized the Alternatives Analysis Report for submission to the City and EEA.

- Weston & Sampson participated in a conference call with the City on February 6, 2019 to discuss their comments and questions regarding the Alternatives Analysis Report. W&S revised the report to address the City's comments and determined that there was sufficient budget to include an additional hybrid alternative option to the report.

- On February 12, 2019, Weston & Sampson's Geotechnical team provided a site-specific technical memorandum for the owner of 166R Main Street, pursuant to their access agreement request.

- Weston & Sampson's Geotechnical, Structural and Permitting Teams revised the report to include an additional hybrid alternative option (Sheet Pile with Banked Slope) for consideration by the City. The final Alternatives Analysis Report was submitted to the City and EEA at the end of the month.

TASK 3. SOUTH WALL PRELIMINARY DESIGN

- No activities this month.

TASK 4. RIVERWALK PRELIMNARY DESIGN

- On February 26, 2019, at the monthly status meeting, Weston & Sampson's Landscape Architect (LA) Team discussed the potential timeline and format for presenting conceptual Riverwalk design plans to the community at future public meetings.

TASK 5. PERMITTING STRATEGY

- Weston & Sampson's Permitting Team finalized the permitting strategy, including potential permits, schedule and costs for the wall alternatives, based upon the recommendations in Task 2 and comments provides by the City.

TASK 6. COMMUNITY ENGAGEMENT

- No activities this month.

TASK 7. PROGRAM MANAGEMENT

- Project Management Team members participated in a call on February 6, 2019 with the City of Peabody and the Engineering and Permitting Teams to discuss their comments and questions regarding the draft Alternatives' Analysis Report.

- At the monthly status meeting on February 26, 2019, the Project Management team provided an update regarding the status of the final Alternative Analysis Report and discussed the potential timeline and format for presenting project information to the community at future public meetings.

- Weston & Sampson performed general project management activities including work plan implementation; correspondence and coordination with appropriate Site contacts and subcontractors, the laboratory, and the City; project staffing oversight; schedule, budget tracking and

control; invoice preparation and submittal; monthly progress reports and status calls to discuss progress and findings, and/or other miscellaneous project management activities.

SCOPE & BUDGET

- There were no changes to the scope or proposed project budget this month. Although there are no changes to the proposed scope or project budget the City recognized recently that the MVP Grant Task Budget and the City's Task Budget for the Weston and Sampson contract do not match. The City added a new section to the budget drawdown/tracking table to reflect the discrepancy between the State Contract task budgets and City's contract with Weston and Sampson Task budget.

- No additional assistance from EEA is requested at this time.

- A copy of the budget draw down / tracking table is attached.

- The anticipated project deliverable schedule has been updated based upon the addition of a technical memorandum for City approval regarding climate change scenario selection and the request to add an additional wall option to the Alternative Analysis Report. This was unanticipated in the original scoping but was requested by the City. Also, there was an approximate two to three-week delay in the climate change scenario memo caused by discussions surrounding the considerations of whether to incorporate the Woods Hole Group's updated sea level rise and coastal surge modeling, as detailed in the previous progress report.

Anticipated Project Deliverable Schedule (All Task to be Completed by **6/30/19**)

i. **Task 1** – Resiliency Evaluation Report
   - FINAL Climate Change Scenario Memo – delivered January 26, 2019.
   - FINAL Resiliency Evaluation Report – delivered February 28, 2019.

ii. **Task 2 & 4** - Engineering Evaluation & Wall Alternatives and Permitting Strategy Report
   - Draft Alternative Analysis Report - delivered February 1, 2019.
   - FINAL Alternative Evaluation Report – delivered March 1, 2019.

iii. **Task 6** - Community Outreach
   - Meeting #1 ~ early April 2019 to present two (2) conceptual (10%) Riverwalk design options and solicit ideas from public on conceptual Riverwalk design.
   - Meeting #2 ~ early June 2019 to present 25% Riverwalk design and gather feedback (plans will not be updated following meeting – feedback gathered and will be considered during future design phases)

iv. **Task 3** - FINAL South Wall 25% Preliminary Design Plans
   - DRAFT South Wall 25% Design Plans ~ April 30, 2019
   - Two-week review period. City comments due to W&S ~ May 14, 2019.
   - FINAL South Wall 25% Design Plans ~ May 28, 2019.

Task 5 - Riverwalk Preliminary Design Plans

- DRAFT Riverwalk 25% Design Plans~ April 30, 2019
- Two-week review period. City comments due to W&S ~ May 14, 2019.
- FINAL Riverwalk 25% Design Plans ~ May 28, 2019.

v. **FINAL REPORT**

- Draft FINAL REPORT ~ June 7, 2019
- 2-week review period. City & EEA comments due to W&S by ~ June 14, 2019
- FINAL REPORT ~ June 28, 2019 (grant deadline 6/30/19)

TASK	DESCRIPTION	GRANT AMOUNT	MATCH AMOUNT	TOTAL	INVOICED TO DATE	GRANT SPENT	MATCH SPENT	TOTAL SPENT	GRANT BALANCE	MATCH BALANCE	TOTAL BALANCE	WS Contract Amounts	MVP/WS Difference	MVP Contract Adjustment
1	RESLIENCY EVALUATION	$31,717.00	$10,572.00	**$42,289.00**	$31,986.25	$23,989.68	$7,996.57	**$31,986.25**	$7,727.32	$2,575.43	**$10,302.75**	$44,750.00	-$2,461.00	$42,289.00
2	PRELIMINARY ENGINEERING & ALTERNATIVES	$94,453.00	$31,485.00	**$125,938.00**	$90,842.59	$68,131.94	$22,710.65	**$90,842.59**	$26,321.06	$8,774.35	**$35,095.41**	$114,075.00	$11,863.00	$125,938.00
3	WALL PRELIMINARY DESIGN	$33,933.00	$11,310.00	**$45,243.00**	$0.00	$0.00	$0.00	**$0.00**	$33,933.00	$11,310.00	**$45,243.00**	$48,635.00	-$3,392.00	$45,243.00
4	WALK PRELIMINARY DESIGN	$34,867.00	$11,622.00	**$46,489.00**	$330.00	$247.50	$82.50	**$330.00**	$34,619.50	$11,539.50	**$46,159.00**	$44,740.00	$1,749.00	$46,489.00
5	PERMITTING STRATEGY	$10,858.00	$3,620.00	**$14,478.00**	$9,840.00	$7,380.00	$2,460.00	**$9,840.00**	$3,478.00	$1,160.00	**$4,638.00**	$9,840.00	$4,638.00	$14,478.00
6	COMMUNITY ENGAGEMENT	$10,983.00	$3,661.00	**$14,644.00**	$0.00	$0.00	$0.00	**$0.00**	$10,983.00	$0.00	**$14,644.00**	$6,715.00	$7,929.00	$14,644.00
7	PROGRAM MANAGEMENT & FINAL REPORT	$7,405.00	$2,469.00	**$9,874.00**	$3,357.50	$2,518.13	$839.37	**$3,357.50**	$4,886.87	$1,629.63	**$6,516.50**	$30,200.00	-$20,326.00	$9,874.00
TOTAL		$224,216.00	$74,739.00	**$298,955.00**	$136,356.34	$102,267.25	$34,089.09	**$136,356.34**	$121,948.75	$40,649.91	**$162,598.66**	$298,955.00	$0.00	$298,955.00

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MEMORANDUM

TO:	Brendan Callahan, Assistant Director of Planning – City of Peabody Massachusetts Margot Mansfield - Executive Office of Energy & Environmental Affairs (MassEEA)
FROM:	Sarah DeStefano, Senior Project Manager – Weston & Sampson
DATE:	4/10/19
SUBJECT:	Monthly Progress Report Reporting Period of March 1, 2019 – March 31, 2019 Report Number No. 6 2018 MVP Action Grant - Peabody North River Canal Resilient Wall, Riverwalk and Park

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Weston & Sampson is pleased to provide this summary of the status of engineering and design services related to the execution of the City of Peabody's North River Canal Resilient Wall, Riverwalk and Park Grant Project, which is funded by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA) through its Municipal Vulnerability Preparedness (MVP) Action Grant Program.

TASK 1. PRELIMINARY RESILIENCE EVALUATION

- On March 18, 2019, Weston & Sampson received comments from Margot Mansfield of EEA/CZM on resiliency report.
- On March 27, 2019, the Resiliency Team from Weston & Sampson had a call with Margot Mansfield of EEA/CZM to discuss the comments.
- On March 29, 2019, the Resiliency Team formally addressed EEA/CZM's comments and finalize the river resilience report and submitted it to the City and EEA.

TASK 2. PRELIMINARY ENGINEERING SERVICES AND ALTERNATIVES ANALYSIS

- On March 3, 2019, Weston & Sampson's Geotechnical, Structural, Permitting and Environmental Engineering Teams participated in a conference call with the City to discuss their final comments and questions regarding the Alternatives Analysis Report prior to the City's meeting with Mayor and other key City personnel (DPS / finance / planning /etc).
- On March 8, 2019, the City debriefed Weston & Sampson on the outcome of the meeting with the Mayor. The City is in agreement with the preferred alternative, Option C – Alt. 2 (Sheet pile with sloped bank). The City will also be making a final purchase offer to the owner of 24 Caller St.

- On March 18, 2019, Weston & Sampson received comments from Margot Mansfield of EEA/CZM on the Alternative Analysis Report.

- On March 18, 2018, the City and Weston & Sampson's permitting and environmental teams discussed planning a pre-application meeting with several departments of MassDEP to get their feedback regarding the proposed wall repair alternative and Riverwalk project. Weston & Sampson coordinated the meeting time, location, attendees, etc. The meeting with MassDEP, EEA, and MEPA was scheduled for April 2, 2019.

- On March 29, 2019, the Geotechnical, Structural, Permitting and Environmental Teams formally addressed EEA/CZM's comments and finalize the Alternative Analysis report and submitted it to the City and EEA.

TASK 3. SOUTH WALL PRELIMINARY DESIGN

- No activities this month.

TASK 4. RIVERWALK PRELIMNARY DESIGN

- The Landscape Architectural team worked on the layout of the Riverwalk, as well as typical sections (sheet pile through to Riverwalk) and precedent images.

TASK 5. PERMITTING STRATEGY

- Weston & Sampson's Permitting Team finalized the permitting strategy, including potential permits, schedule and costs for the wall alternatives, based upon the comments provides by the EEA.

TASK 6. COMMUNITY ENGAGEMENT

- No activities this month. A public meeting is not anticipated to be scheduled until after the meeting with DEP and after the City can meet with individual, private property owners that will be impacted by the project.

TASK 7. PROGRAM MANAGEMENT

- Project Management Team members participated in calls on March 3, March 8, and March 26, 2019 with the City of Peabody (See Task 2 above). The Project Management Team also had an internal planning meeting on March 26, 2019 in preparation for the meeting with DEP on April 2, 2019.

- On March 26, 2019, at the monthly status meeting with the City, Weston & Sampson discussed the format and agenda for presenting the conceptual wall repair alternative and Riverwalk plans to the MassDEP at the April 2, 2019 Meeting. Following this meeting, Weston & Sampson's Project Management Team prepared all necessary supporting materials / handouts for the meeting with DEP.

- Weston & Sampson performed general project management activities including work plan implementation; correspondence and coordination with appropriate Site contacts and

subcontractors, the laboratory, and the City; project staffing oversight; schedule, budget tracking and control; invoice preparation and submittal; monthly progress reports and status calls to discuss progress and findings, and/or other miscellaneous project management activities.

SCOPE & BUDGET

- There were no changes to the scope or proposed project budget this month.

- No additional assistance from EEA is requested at this time. However, the City is considering applying for another grant in FY 19 to assist with permitting and 75% design tasks.

- A copy of the budget draw down / tracking table is attached. As mentioned in the City's February Progress report the City has updated the budget table to include the discrepancy between the State Contract task budget and City contract with Weston and Sampson task budget.

- The anticipated project deliverable schedule was previously updated based upon the addition of a technical memorandum for City approval regarding climate change scenario selection and the request to add an additional wall option to the Alternative Analysis Report. This was unanticipated in the original scoping but was requested by the City. Also, there was an approximate two to three-week delay in the climate change scenario memo caused by discussions surrounding the considerations of whether to incorporate the Woods Hole Group's updated sea level rise and coastal surge modeling, as detailed in the previous progress report. In addition, a public meeting is not anticipated to be scheduled until after the meeting with DEP on April 2, 2109 and after the City is able to meet with individual, private property owners that will be impacted by the proposed project.

Anticipated Project Deliverable Schedule (All Task to be Completed by **6/30/19**)

i. **Task 1** – Resiliency Evaluation Report
   - FINAL Climate Change Scenario Memo – delivered to City & EEA on January 26, 2019.
   - FINAL DRAFT Resiliency Evaluation Report – delivered to City & EEA February 28, 2019.
   - FINAL DRAFT Resiliency Evaluation Report – delivered to City & EEA March 29, 2019.

ii. **Task 2 & 4** - Engineering Evaluation & Wall Alternatives and Permitting Strategy Report
   - Draft Alternative Analysis Report - delivered to City February 1, 2019.
   - FINAL DRAFT Alternative Evaluation Report – delivered to City & EEA on March 1, 2019.
   - FINAL Alternative Evaluation Report – delivered to City & EEA on March 29, 2019.

iii. **Task 6** - Community Outreach
   - Meeting #1 ~ early May 2019 to present two (2) conceptual (10%) Riverwalk design options and solicit ideas from public on conceptual Riverwalk design.
   - Meeting #2 ~ early June 2019 to present 25% Riverwalk design and gather feedback (plans will not be updated following meeting – feedback gathered and will be considered during future design phases)

- Exact dates to be determined. A public meeting is not anticipated to be scheduled until after the meeting with DEP on April 2, 2109 and after the City is able to meet with individual, private property owners that will be impacted by the proposed project.

iv. **Task 3** - <u>FINAL South Wall 25% Preliminary Design Plans</u>

- DRAFT South Wall 25% Design Plans ~ April 30, 2019
- Two-week review period. City comments due to W&S ~ May 14, 2019.
- FINAL South Wall 25% Design Plans ~ May 28, 2019.

Task 5 - <u>Riverwalk Preliminary Design Plans</u>

- DRAFT Riverwalk 25% Design Plans~ April 30, 2019
- Two-week review period. City comments due to W&S ~ May 14, 2019.
- FINAL Riverwalk 25% Design Plans ~ May 28, 2019.

v. **FINAL REPORT**

- Draft FINAL REPORT ~ June 7, 2019
- 2-week review period. City & EEA comments due to W&S by ~ June 14, 2019
- FINAL REPORT ~ June 28, 2019 (grant deadline 6/30/19)

TASK	DESCRIPTION	GRANT AMOUNT	MATCH AMOUNT	TOTAL	INVOICED TO DATE	GRANT SPENT	MATCH SPENT	TOTAL SPENT	GRANT BALANCE	MATCH BALANCE	TOTAL BALANCE	WS Contract Amounts	MVP/WS Difference	MVP Contract Adjustment
1	RESLIENCY EVALUATION	$31,717.00	$10,572.00	**$42,289.00**	$39,472.50	$29,604.37	$9,868.13	**$39,472.50**	$2,112.63	$703.87	**$2,816.50**	$44,750.00	-$2,461.00	$42,289.00
2	PRELIMINARY ENGINEERING & ALTERNATIVES	$94,453.00	$31,485.00	**$125,938.00**	$101,030.09	$75,772.57	$25,257.52	**$101,030.09**	$18,680.43	$6,227.48	**$24,907.91**	$114,075.00	$11,863.00	$125,938.00
3	WALL PRELIMINARY DESIGN	$33,933.00	$11,310.00	**$45,243.00**	$0.00	$0.00	$0.00	**$0.00**	$33,933.00	$11,310.00	**$45,243.00**	$48,635.00	-$3,392.00	$45,243.00
4	WALK PRELIMINARY DESIGN	$34,867.00	$11,622.00	**$46,489.00**	$330.00	$247.50	$82.50	**$330.00**	$34,619.50	$11,539.50	**$46,159.00**	$44,740.00	$1,749.00	$46,489.00
5	PERMITTING STRATEGY	$10,858.00	$3,620.00	**$14,478.00**	$9,840.00	$7,380.00	$2,460.00	**$9,840.00**	$3,478.00	$1,160.00	**$4,638.00**	$9,840.00	$4,638.00	$14,478.00
6	COMMUNITY ENGAGEMENT	$10,983.00	$3,661.00	**$14,644.00**	$0.00	$0.00	$0.00	**$0.00**	$10,983.00	$0.00	**$14,644.00**	$6,715.00	$7,929.00	$14,644.00
7	PROGRAM MANAGEMENT & FINAL REPORT	$7,405.00	$2,469.00	**$9,874.00**	$4,265.00	$4,471.89	$1,490.61	**$5,962.50**	$2,933.11	$978.39	**$3,911.50**	$30,200.00	-$20,326.00	$9,874.00
TOTAL		$224,216.00	$74,739.00	**$298,955.00**	$154,937.59	$117,476.33	$39,158.76	**$156,635.09**	$106,739.67	$35,580.24	**$142,319.91**	$298,955.00	$0.00	$298,955.00

Weston & Sampson

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MEMORANDUM

TO:	Brendan Callahan, Assistant Director of Planning – City of Peabody Massachusetts Margot Mansfield - Executive Office of Energy & Environmental Affairs (MassEEA)
FROM:	Sarah DeStefano, Senior Project Manager – Weston & Sampson
DATE:	5/13/19
SUBJECT:	Monthly Progress Report Reporting Period of April 1, 2019 – April 30, 2019 Report Number No. 7 2018 MVP Action Grant - Peabody North River Canal Resilient Wall, Riverwalk and Park

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Weston & Sampson is pleased to provide this summary of the status of engineering and design services related to the execution of the City of Peabody's North River Canal Resilient Wall, Riverwalk and Park Grant Project, which is funded by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA) through its Municipal Vulnerability Preparedness (MVP) Action Grant Program.

TASK 1. PRELIMINARY RESILIENCE EVALUATION

- This task was completed on March 29, 2019, when the Resiliency Team formally addressed EEA/CZM's comments and finalize the river resilience report and submitted it to the City and EEA.

TASK 2. PRELIMINARY ENGINEERING SERVICES AND ALTERNATIVES ANALYSIS

- On March 29, 2019, the Geotechnical, Structural, Permitting and Environmental Teams formally addressed EEA/CZM's comments and finalize the Alternative Analysis report and submitted it to the City and EEA.

- On April 2, 2019, the City and Weston & Sampson's permitting, structural, resiliency and environmental teams had a pre-application meeting with several departments of MassDEP to get their feedback regarding the proposed wall repair alternative and Riverwalk project. Conceptually MassDEP was on board and supported the preferred alternative plan. Below is a brief summary of the MassDEP's feedback:
    - Wetland Division Comment:
        - Suggested exploring as much compensatory flood storage as possible
            - Consider subtle grading changes to gain more flood storage
            - Utilize green infrastructure for stormwater control

- Multi-Modal Path: need to have 4' vegetative shoulder min requirement; said it is possible to get creative as long as meet standard; grade away from waterway
- Rachel Freed stated the preferred alternative would meet the wetlands regulations.

- BWSC Division Comment:
  - MCP cap restrictions to meet open space development
  - Each parcel will have its own MCP strategy

- General Comments: MassDEP appreciated the City reaching out the them this early in the project phase. The Department fully supported the conceptual and preferred alternative and are looking forward to working with the City on the next phase.

TASK 3. SOUTH WALL PRELIMINARY DESIGN

- Using the results of the alternatives analysis conducted in Task 2, Weston & Sampson prepared a preliminary design of the preferred North River Canal's south wall option - Alternative C – Sheet Pile Option 2 with Sloped Bank. Weston & Sampson generated Draft 25% plans for the design for the City's review and comment on April 30, 2019. The 25% plans are a preliminary presentation of the overall concept of the proposed structures and/or the proposed rehabilitation. It will allow the designer and the client to agree on the principal components of the structure types and/or the rehabilitation schemes to be pursued in the final design phase since the 25% plans will show the major features to be incorporated into the construction drawings.

TASK 4. RIVERWALK PRELIMNARY DESIGN

- The Landscape Architectural team submitted a DRAFT 25% Preliminary Design to the City for review and comments on April 30, 2019 which included: one (1) plan drawing showing design intent of pedestrian circulation, bicycle circulation, site lighting placement, seating, signage and planting; and grading design intent; up to two (2) site cross sections; precedent images to convey design intent; and one (1) cost estimate.

TASK 5. PERMITTING STRATEGY

- This task was completed on March 29, 2019, when the Geotechnical, Structural, Permitting and Environmental Teams formally addressed EEA/CZM's comments and finalize the Alternative Analysis report and submitted it to the City and EEA.

TASK 6. COMMUNITY ENGAGEMENT

- After the City had the opportunity to meet with MassDEP and individual, private property owners that will be impacted by the project, a public meeting was scheduled for Thursday, May 30th at 6pm at City Hall. The City anticipates presenting the following information at the meeting:
  - Project Summary - City of Peabody
  - Introduction to Weston & Sampson – Weston & Sampson (W&S)
  - Resiliency Report - W&S
  - Wall Analysis & Repair Alternatives – W&S

- Conceptual Riverwalk Plan – W&S
- Next Steps – City of Peabody
- Questions & Answers

TASK 7. PROGRAM MANAGEMENT

- Project Management Team members participated in the meeting with MassDEP on April 2, 2019.

- On April 30, 2019, at the monthly status meeting with the City, Weston & Sampson discussed the format and agenda for the presentation at the May 30, 2019 Public Meeting. In addition, the City and Weston & Sampson discussed: anticipated deliverable completion schedule; easements; Landscape Design; Contract Amendment. Following this meeting, Weston & Sampson's Team has been coordinating and preparing presentation materials for the public meeting.

- Weston & Sampson performed general project management activities including work plan implementation; correspondence and coordination with appropriate Site contacts and subcontractors, the laboratory, and the City; project staffing oversight; schedule, budget tracking and control; invoice preparation and submittal; monthly progress reports and status calls to discuss progress and findings, and/or other miscellaneous project management activities.

SCOPE & BUDGET

- There were no changes to the scope or proposed project budget this month, other than the scheduling of the public meetings was delayed in order to allow sufficient time to receive feedback from the MassDEP at the April 2, 2019 meeting and allow the City time to meet with individual, private property owners that will be impacted by the proposed project and discussed proposed easements, etc. This also impacted the level of the design plans (10% vs. 25%) that would be presented to the public in order to allow for sufficient time to complete major grant task items prior to the June 30th deadline.

- No additional assistance from EEA is requested at this time. However, the City applied for another grant in FY 19 to assist with permitting and 75% design tasks.

- A copy of the budget draw down / tracking table is attached.

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Anticipated Project Deliverable Schedule (All Task to be Completed by **6/30/19**)

i. **Task 1** – Resiliency Evaluation Report
   - FINAL Climate Change Scenario Memo – delivered to City & EEA on January 26, 2019.
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   - FINAL DRAFT Resiliency Evaluation Report – delivered to City & EEA March 29, 2019.

ii. **Task 2 & 4** - Engineering Evaluation & Wall Alternatives and Permitting Strategy Report
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   - FINAL DRAFT Alternative Evaluation Report – delivered to City & EEA on March 1, 2019.
   - FINAL Alternative Evaluation Report – delivered to City & EEA on March 29, 2019.

iii. **Task 6** - Community Outreach
   - Public Meeting scheduled for May 30, 2019 to present conceptual 25% Riverwalk design options and gather feedback from public on conceptual Riverwalk design. Plans are not anticipated to be updated following meeting – feedback will be considered during future design phases.

iv. **Task 3** - FINAL South Wall 25% Preliminary Design Plans
   - DRAFT South Wall 25% Design Plans ~ April 30, 2019
   - Two-week review period. City provided comment to W&S ~ May 10, 2019.
   - FINAL South Wall 25% Design Plans ~ May 28, 2019.

Task 5 - Riverwalk Preliminary Design Plans
   - DRAFT Riverwalk 25% Design Plans~ April 30, 2019
   - Two-week review period. City provided comments to W&S ~ May 10, 2019.
   - FINAL Riverwalk 25% Design Plans ~ May 28, 2019.

v. **FINAL REPORT**
   - Draft FINAL REPORT ~ June 7, 2019
   - 2-week review period. City & EEA comments due to W&S by ~ June 14, 2019
   - FINAL REPORT ~ June 28, 2019 (grant deadline 6/30/19)

TASK	DESCRIPTION	GRANT AMOUNT	MATCH AMOUNT	TOTAL	INVOICED TO DATE	GRANT SPENT	MATCH SPENT	TOTAL SPENT	GRANT BALANCE	MATCH BALANCE	TOTAL BALANCE	WS Contract Amounts	MVP/WS Difference	MVP Contract Adjustment
A	RESLIENCY EVALUATION	$31,717.00	$10,572.00	**$42,289.00**	$44,597.50	$33,448.12	$11,149.38	**$44,597.50**	-$1,731.12	-$577.38	**-$2,308.50**	$44,750.00	-$2,461.00	$42,289.00
B	PRELIMINARY ENGINEERING & ALTERNATIVES	$94,453.00	$31,485.00	**$125,938.00**	$107,497.59	$80,623.19	$26,874.40	**$107,497.59**	$13,829.81	$4,610.60	**$18,440.41**	$114,075.00	$11,863.00	$125,938.00
C	WALL PRELIMINARY DESIGN	$33,933.00	$11,310.00	**$45,243.00**	$0.00	$0.00	$0.00	**$0.00**	$33,933.00	$11,310.00	**$45,243.00**	$48,635.00	-$3,392.00	$45,243.00
D	WALK PRELIMINARY DESIGN	$34,867.00	$11,622.00	**$46,489.00**	$2,605.00	$1,953.75	$651.25	**$2,605.00**	$32,913.25	$10,970.75	**$43,884.00**	$44,740.00	$1,749.00	$46,489.00
E	PERMITTING STRATEGY	$10,858.00	$3,620.00	**$14,478.00**	$9,840.00	$7,380.00	$2,460.00	**$9,840.00**	$3,478.00	$1,160.00	**$4,638.00**	$9,840.00	$4,638.00	$14,478.00
F	COMMUNITY ENGAGEMENT	$10,983.00	$3,661.00	**$14,644.00**	$0.00	$0.00	$0.00	**$0.00**	$10,983.00	$0.00	**$14,644.00**	$6,715.00	$7,929.00	$14,644.00
G	PROGRAM MANAGEMENT & FINAL REPORT	$7,405.00	$2,469.00	**$9,874.00**	$8,272.50	$6,204.39	$2,068.11	**$8,272.50**	$1,200.61	$400.89	**$1,601.50**	$30,200.00	-$20,326.00	$9,874.00
TOTAL		$224,216.00	$74,739.00	**$298,955.00**	$172,812.59	$129,609.45	$43,203.14	**$172,812.59**	$94,606.55	$31,535.86	**$126,142.41**	$298,955.00	$0.00	$298,955.00

Weston & Sampson

5 Centennial Drive, Peabody, MA 01960 (HQ)
Tel: 978.532.1900

MEMORANDUM

TO:	Brendan Callahan, Assistant Director of Planning – City of Peabody Massachusetts Margot Mansfield - Executive Office of Energy & Environmental Affairs (MassEEA)
FROM:	Sarah DeStefano, Senior Project Manager – Weston & Sampson
DATE:	6/4/19
SUBJECT:	Monthly Progress Report Reporting Period of May 1, 2019 – May 31, 2019 Report Number No. 8 2018 MVP Action Grant - Peabody North River Canal Resilient Wall, Riverwalk and Park

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Weston & Sampson is pleased to provide this summary of the status of engineering and design services related to the execution of the City of Peabody's North River Canal Resilient Wall, Riverwalk and Park Grant Project, which is funded by the Massachusetts Executive Office of Energy & Environmental Affairs (MassEEA) through its Municipal Vulnerability Preparedness (MVP) Action Grant Program.

TASK 1. PRELIMINARY RESILIENCE EVALUATION

- This task was completed on March 29, 2019, when the Resiliency Team formally addressed EEA/CZM's comments and finalize the river resilience report and submitted it to the City and EEA.

TASK 2. PRELIMINARY ENGINEERING SERVICES AND ALTERNATIVES ANALYSIS

- Weston & Sampson evaluated preliminary conceptual stormwater management and/or flood storage options as part of the proposed alternative that could be included in the preliminary 25% designs.

- Drone photos and videos were obtained from the project area on 5/23/19.

- Activities and findings associated with Task 2 were incorporated into the draft and final power point presentation for the Public Meeting, which was held on Thursday, May 30th at 6pm at Peabody City Hall.

- Weston & Sampson and the City had a conference call to discuss the draft power point presentation for the Public Meeting on Tuesday, May 21, 2019.

TASK 3. SOUTH WALL PRELIMINARY DESIGN

- Using the results of the alternatives analysis conducted in Task 2, Weston & Sampson prepared a preliminary design of the preferred North River Canal's south wall option - Alternative C – Sheet Pile Option 2 with Sloped Bank. Weston & Sampson generated Draft 25% plans for the design for the City's review and comment on April 30, 2019. The 25% plans are a preliminary presentation of the overall concept of the proposed structures and/or the proposed rehabilitation. It will allow the designer and the client to agree on the principal components of the structure types and/or the rehabilitation schemes to be pursued in the final design phase since the 25% plans will show the major features to be incorporated into the construction drawings. The City provided comments on the 25% design on May 10, 2019 and May 13, 2019.

- The Structural Team incorporated details associated with Task 2 and Task 3 into the draft and final power point presentation for the Public Meeting, which was held on Thursday, May 30th at 6pm at Peabody City Hall.

- Weston & Sampson and the City had a conference call to discuss the comments and applicable revisions to the 25% design plans and the draft power point presentation for the public meeting on Tuesday, May 21, 2019.

- The lead structural engineer for the project presented at the Public Meeting on 5/30/19.

- Final Draft 25% south wall design plans were submitted to the City for review on June 4, 2019.

TASK 4. RIVERWALK PRELIMNARY DESIGN

- The Landscape Architectural (LA) team submitted a DRAFT 25% Preliminary Design to the City for review and comments on April 30, 2019 which included: one (1) plan drawing showing design intent of pedestrian circulation, bicycle circulation, site lighting placement, seating, signage and planting; and grading design intent; up to two (2) site cross sections; precedent images to convey design intent; and one (1) cost estimate. The City provided comments on the 25% design on May 10, 2019 and May 13, 2019.

- The LA Team incorporated details associated with Task 3 into the draft and final power point presentation for the Public Meeting, which was held on Thursday, May 30th at 6pm at Peabody City Hall. The LA Team also created interactive community feedback boards, including a dot survey regarding Riverwalk features and a comment and suggestion board.

- Weston & Sampson and the City had a conference call to discuss the comments and applicable revisions to the 25% preliminary design plans and the draft power point presentation for the public meeting on Tuesday, May 21, 2019.

- The lead Landscape Architect for the project presented at the Public Meeting on 5/30/19.

- Final Draft 25% Riverwalk preliminary design plans were submitted to the City for review on May 29, 2019.

TASK 5. PERMITTING STRATEGY

- This task was completed on March 29, 2019, when the Geotechnical, Structural, Permitting and Environmental Teams formally addressed EEA/CZM's comments and finalize the Alternative Analysis report and submitted it to the City and EEA.

TASK 6. COMMUNITY ENGAGEMENT

- The draft power point presentation was sent to the City on 5/20/19. Weston & Sampson and the City had a conference call to discuss the draft power point presentation on Tuesday, May 21, 2019. The City and Weston & Sampson worked to finalize the power point presentation between May 21 and May 28, 2019. The presentation was finalized on May 29, 2019.

- A public meeting was held on Thursday, May 30th at 6pm at City Hall. The City presented the following information at the meeting:
  - Project Summary - City of Peabody
  - Introduction to Weston & Sampson – Weston & Sampson (W&S)
  - Resiliency Report - W&S
  - Wall Analysis & Repair Alternatives – W&S
  - Conceptual Riverwalk Plan – W&S
  - Next Steps – City of Peabody
  - Questions & Answers

- A copy of the sign-in sheet and power point presentation are attached. In addition, pictures of the interactive public feedback boards, including a dot survey regarding Riverwalk features and a comment and suggestion board, are also provided.

- Approximately thirty (30) people attended the public meeting. General comments / responses from the public included the following:
  - A request was made for the City to post the presentation on the City's website.
    - The City agreed to the request.
  - Will a subcommittee or community group be created to provide input regarding the Public?
    - The City will consider the request and will reach out if such group(s) will be formed.
  - What is the water quality of the river?
    - All surface water bodies in the City are classified as Category 5 (impaired, and requiring one or more Total Maximum Daily Loads (TMDLs)
  - Graffiti and vandalism are problems in the City of Peabody. This needs to be taken into consideration when designing the proposed Riverwalk.
    - The City concurred with this comment.
  - Cameras should be installed along the proposed Riverwalk for safety and security reasons.
    - The City agreed to consider this recommendation.
  - The Salem Sound Coast Watch (SSCW) noted that they are doing work in the area of Howley Street to increase the habitat for smelt. The SSCW asked if ecological impacts have been considered as part of the proposed design.

- The City noted that ecological type considerations and potential impacts are generally evaluated and performed as part of the regulatory permitting process, which will occur during the next phase of the project.

- Will the Riverwalk be designed for bicycles and pedestrians?
  - Due to existing structural constraints in certain locations along the proposed Riverwalk, there is not enough space to meet the minimum requirements for a multi-modal path for the entire extent of the proposed Riverwalk with the existing proposed easements, etc. However, the City anticipates that users of the Riverwalk will include bicyclists.
- A representative from the Azorean Brothers, a private property owner located along the proposed Riverwalk, expressed their support for the project and their excitement in seeing the proposed Riverwalk plans move forward. The Azorean Brothers requested that considerations be included in the design that protect children from falling into the river.
  - The City concurred that railings and/or deterrent vegetation will be considered as part of the design process to deter children from directly accessing the river.
- Will there be any improvements to Strongwater Brook?
  - The City confirmed that improvements will be limited to the crossing of Strongwater Brook and no improvements will be completed upstream of that location.
- An upstream resident noted that flooding that occurs in the area and the impacts it has on his and the neighboring community's properties. The resident questioned if stormwater storage option areas have been considered and whether widening or dredging of the river would occur as part of the proposed project.
  - The City explained that the existing wall would be removed as part of the proposed conceptual design plan which would increase flood storage in the area, however river widening, and dredging will not be conducted as part of the proposed project. In addition, it is the City's intent to design the Riverwalk to flood and to evaluate additional potential storage options on the 24 Caller Street property. Any additional storage generated as part of the project would be a benefit to the community.
- What is the timeline of the proposed project?
  - The City expressed that they are aggressively seeking funding opportunities to move the project forward and expects to hear on the next round of EEA MVP and EPA Brownfields grant funding within the month. Furthermore, the City described the next step would be to bring the project to 75% design and permitting.
- What are the anticipated costs?
  - The City agreed to provide a copy of the preliminary cost estimates and associated assumptions provided in the alternative analysis report.

TASK 7. PROGRAM MANAGEMENT

- Weston & Sampson's Teams coordinated and prepared presentation materials for the public meeting. Project Management Team members participated in the conference call with the City on Tuesday, May 21, 2019 to discuss the comments and applicable revisions to the 25% design plans for the Canal Wall and Riverwalk and the draft power point presentation for the public meeting on scheduled for May 30, 2019 at 6pm. The City and Weston & Sampson's Project Management team worked to finalize the power point presentation between May 21 and May 28, 2019. The presentation was finalized on May 29, 2019.

- Weston & Sampson performed general project management activities including work plan implementation; correspondence and coordination with appropriate Site contacts and subcontractors, the laboratory, and the City; project staffing oversight; schedule, budget tracking and control; invoice preparation and submittal; monthly progress reports and status calls to discuss progress and findings, and/or other miscellaneous project management activities.

SCOPE & BUDGET

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TOTAL		$224,216.00	$74,739.00	**$298,955.00**	$196,172.59	$147,129.46	$49,043.13	**$196,172.59**	$77,086.54	$25,695.87	**$102,782.41**	$298,955.00	$0.00	$298,955.00