Task 3: Sediment Characterization and Flushing Studies - Sawmill Brook Flood Mitigation and Restoration Project

TO: Mary Reilly, Manchester-by-the-Sea Grants Administrator

FROM: Gabrielle Belfit, CFM; Gary Hedman, LSP; David Azinheira, CFM, P.E.

COPY: David A. Murphy, P.E.

DATE: June 18, 2018

1 Introduction

This memorandum describes the field methods, data analysis, and recommendations for sediment management under Task 3 "Sediment Characterization and Sediment Transport for the Sawmill Brook Tide Gate Removal and Restoration Feasibility Study". The memo includes a discussion of the sediment depth profiling, sediment physical and chemical characteristics, sediment sources, sediment transport modeling to evaluate the consequences of the Central Street Bridge tide gate removal, and recommendations for sediment management during the restoration of Central Pond and Lower Sawmill Brook.

Georgeann Keer, Division of Ecological Restoration (DER) and Eric Hutchins, NOAA Restoration Center (NOAA) served as technical advisors for this project. The technical advisors reviewed the field methodology providing helpful suggestions to refine the approach, were onsite during the initial sediment depth profile assessment and reviewed draft and final deliverables.

2 Sediment Characterization

2.1 Sediment Depth Profiling

Sediment profiling was conducted in the Central Pond portion of the project area to develop a baseline assessment of sediment depth. A total of nine sediment depth profiles were completed on November 28, 2017 and January 23, 2018, in the same location as the existing conditions plan surveyed cross sections shown in **Figure 1**. Sediment depths were collected by manually advancing a six-foot-long, half inch diameter steel probe to refusal, and recording the measurement. Sediment depths were profiled every 10 feet across each cross section and are summarized in Appendix A, along with sediment profile cross sections, depicted with the existing conditions survey cross section profile.

The sediment depth profiling of Central Pond indicated that accumulations of fine grained sediment and organic muck range from less than one foot to greater than six feet in depth, with the thickest areas of sediment located at Transect 6 and Transect 10. Sediment thickness along these transects was significantly variable, transitioning from approximately two feet to greater than six feet over the course of one profile interval (10 feet). **Inset 1** shows the sediment profiles for Transect 10, stretching out across the widest point of Central Pond. Deposition of sediment in Central Pond is the result of several contributing factors, most notably the dissipation of flow velocity when the Central Street tide gate is closed, impounding water across the Central Pond area. Sources of sediment include streambank erosion within and upstream of Central Pond, and untreated stormwater runoff from the surrounding areas.

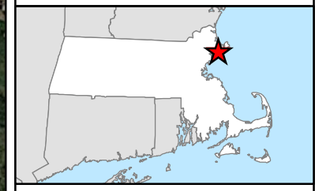
ORTHOPHOTOGRAPH SITE PLAN

LEGEND

Figure 1

Sediment Profiles Transect Locations

LOCUS MAP



N
W E
S

0 50 100
Feet

1 inch equals 75 feet

NOTES

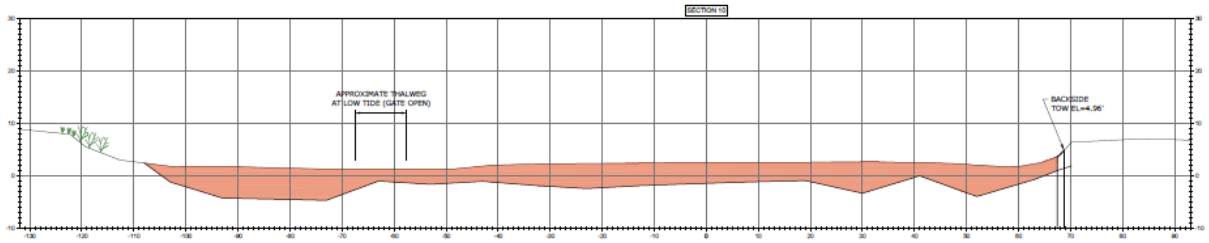
Transect locations are approximate on this figure.

Sawmill Brook Area
Manchester By the Sea, Massachusetts

January 2018

Tighe&Bond
Engineers | Environmental Specialists

G:\GIS\MA\ManchesterMA\avproj\Ortho_SawmillBrook_11x17.mxd Date Saved: 9/29/2017 User: JSM



Inset 1: Sediment Profile at Transect 10

Areas upstream and downstream of Central Pond are subject to higher stream flow velocities, and were observed to have limited areas of finer grained sediment (i.e. coarse sand) deposits. Sediment depth profiling was not conducted in these areas as the stream channel bottoms are comprised primarily of rock, gravel, and cobble that could not be penetrated by the manual probe.

The volume of sediment present in Central Pond was calculated using CAD area geometry provided by the survey elevation of the pond bathymetry and depth profiling, similar to the method used for determining cut and fill volumes. Based on data collected to date, approximately 5,350 cubic yards of sediment are present within the Central Pond portion of the project area, between Transect 4 (downstream) and Transect 13.

Photo 1: Conducting the sediment depth survey at Transect 11 (January 23, 2018).

2.2 Sediment Quality Analysis

Based on the data collected during the sediment depth profiling, visual observations of areas upstream and downstream of Central Pond, and potential restoration alternatives identified by project stakeholders, Tighe & Bond conducted a limited assessment of sediment quality in the Central Pond portion of the project area. Sediment sampling locations were designated based on the premise that the preferred restoration alternative would minimize mechanical dredging of sediment deposits within Central Pond and instead allow for natural transport of sediment through restoration of unimpeded flow conditions.

On January 23, 2018, Tighe & Bond collected three sediment samples from shallow sediment in Central Pond (Upstream, Downstream, and Pond). Samples were collected at low tide with the Central Street tide gate open to allow for access. These conditions also allowed for the identification of the current course of water flow through the Central Pond area at low tide. Two of the sediment samples (Upstream and Downstream) were collected from the center thalweg of the observed course of water flow. The third sediment sample ("Pond") was collected from the area of sediment that has accumulated in the eastern portion of Central Pond that is exposed during low tide when the Central Street tide gate remains open. The stream channel and sediment sampling locations are shown on **Figure 2.**

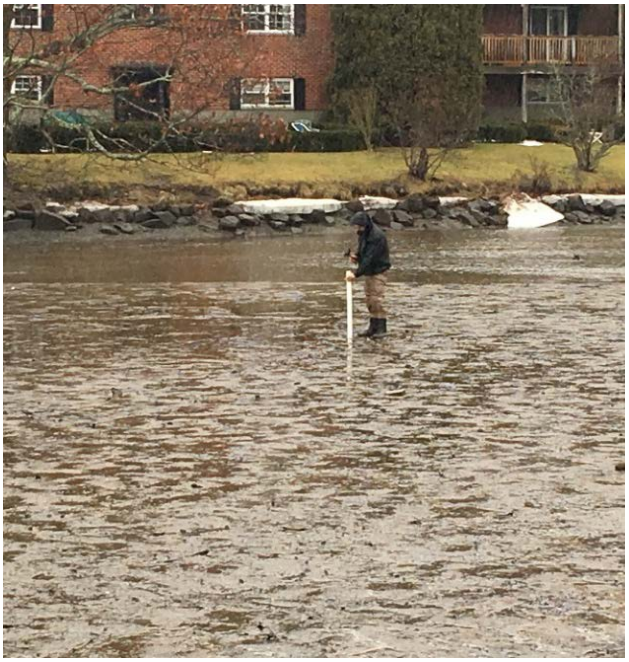


Photo 2: Sediment sample collection at Transect 12 (January 23, 2018).

In each of the sample locations, a dedicated, disposable six-foot length of two-inch diameter PVC tubing was manually advanced approximately three feet into the sediment with a rubber mallet. The top of the core tube was then capped with a rubber expansion plug and extracted, and recovered sediment was collected for compositing / sampling[1]. In order to collect sufficient sample volume, two to three cores were collected at each of the locations.

Sediment samples were placed in appropriate sample containers and submitted to ESS Laboratory, Cranston, Rhode Island for laboratory analysis of chemical constituents required under Massachusetts Department of Environmental Protection (MassDEP) 401 Water Quality Certification (310 CMR 9.07), and MassDEP Policy COMM 94-007, which regulates the reuse of sediment at Massachusetts landfills. The sediment sampling activities conducted during this feasibility evaluation were limited in scope. Additional sediment sampling would be necessary to support a 410 WQC permit application in support of the selected project design / alternative.

[1] US EPA. (2014). *Sediment Sampling Operating Procedures- SESDPROC-200-R3.* USEPA.

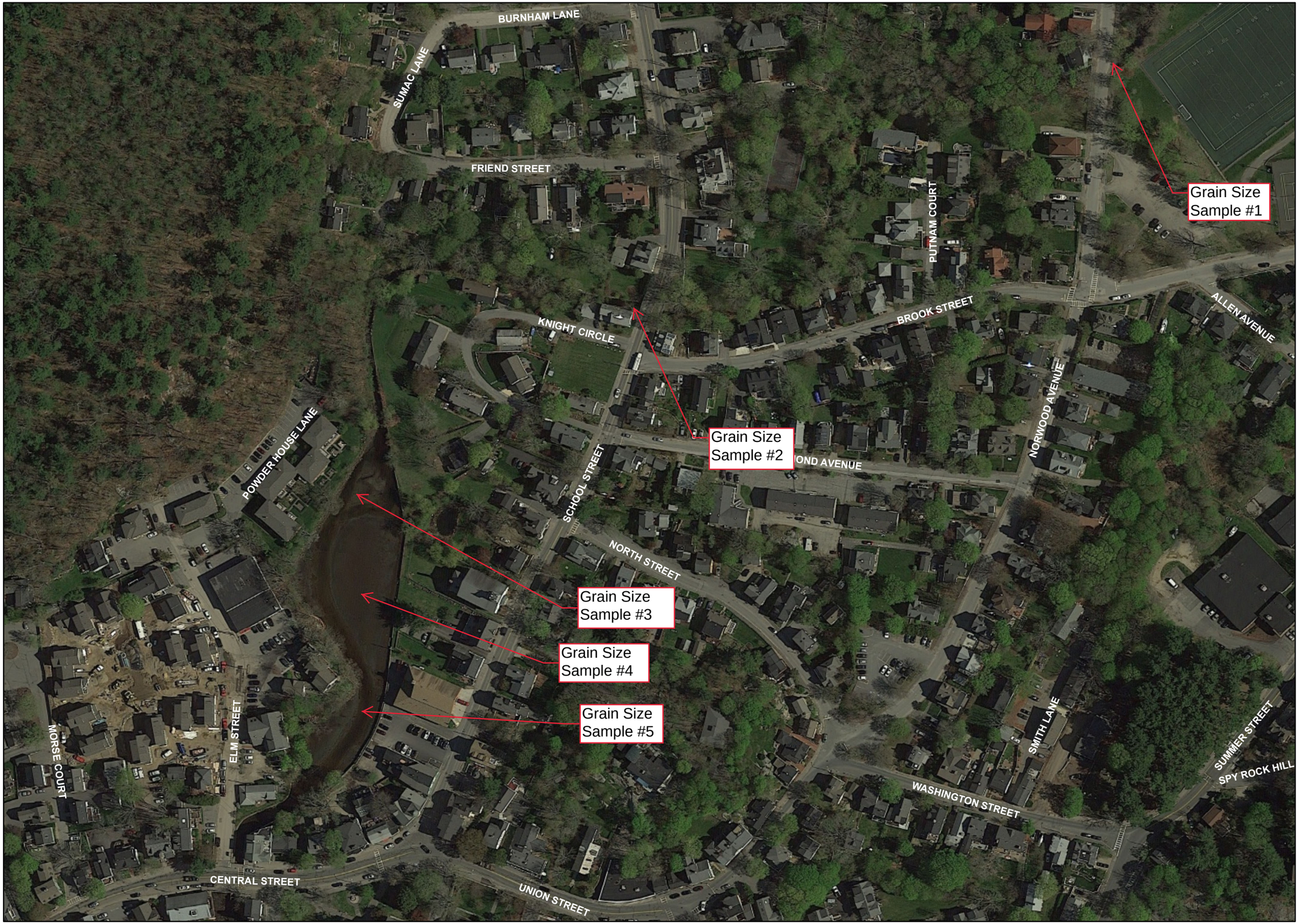


Figure 2

Sediment Sample Locations

LOCUS MAP

N
W E
S

0 50 100
Feet

1 inch equals 150 feet

NOTES

Sawmill Brook Area
Manchester By the Sea,
Massachusetts

January 2018

Tighe&Bond
Engineers | Environmental Specialists

G:\GIS\MA\ManchesterMA\avproj\Ortho_SawmillBrook_11x17.mxd Date Saved: 9/29/2017 User: JSM

Sediment samples were analyzed for:

- Extractable petroleum hydrocarbons (EPH) with polycyclic aromatic hydrocarbons (PAHs);
- Polychlorinated biphenyls (PCBs) – National Oceanic and Atmospheric Administration (NOAA) 18 Congeners;
- Volatile organic compounds (VOCs) by Environmental Protection Agency (EPA) method 8270 SIM;
- Total organic carbon (TOC) by EPA Method 9060;
- Total petroleum hydrocarbons (TPH) by Method 8100 M;
- Resource Conservation and Recovery Act (RCRA) 8 metals
- Percent Moisture / Percent Solids by EPA Method 2540G;
- Grain size distribution by American Society for Testing and Materials (ASTM) D422.

As summarized Table 1, laboratory analysis of the sediment samples indicated the presence of low levels of metals, PAHs, and PCBs.

Table 1 - Sediment Results Summary
Central Pond
Manchester-by-the-Sea, MA

Analytes	No. Samples Detected	MA RCS-1	TECs	Sawmill Brook Maximum Concentration	NAE -2012-322
Metals (mg/kg)					
Arsenic	3 of 3	20	33	13.1	10
Cadmium	3 of 3	70	5	0.67	1.4
Chromium	3 of 3	100	110	15.3	**250**
Copper	3 of 3	1,000	150	23.9	87
Lead	3 of 3	200	130	**167**	110
Mercury	3 of 3	20	0.18	**0.441**	**0.68**
Nickel	3 of 3	600	49	8.5	19
Zinc	3 of 3	1,000	460	129.0	140
Total PCB Congeners (mg/kg)					
PCBs	3 of 3	1	0.06	0.00756	**0.15**
PAHs (mg/kg)					
Benzo(a)anthracene	3 of 3	7	0.110	**2.52**	0.88
Benzo(a)pyrene	3 of 3	2	0.150	**2.10**	0.69
Benzo(b)fluoranthene	3 of 3	7	NE	2.67	0.59
Benzo(g,h,i)perylene	3 of 3	1,000	NE	1.19	0.54
Chrysene	3 of 3	70	0.170	**2.27**	0.62
Fluoranthene	3 of 3	1,000	0.420	**6.23**	1.70
Indeno(1,2,3-cd)pyrene	3 of 3	7	NE	1.44	0.52
Phenanthrene	3 of 3	10	0.200	**1.26**	0.66
Pyrene	3 of 3	1,000	0.200	**4.50**	1.50

Notes:
Mg/kg – milligrams per kilogram
NAE-2012-322 – Bulk Chemical Analysis – Town of Manchester, Manchester Harbor – Tier III Sediment Evaluation
Total PCB congeners equals sum of congener numbers 8, 18, 28, 44, 52, 66, 101, 105, 118, 128, 138, 153, 170, 180, 187, 195, 206, and 206.
Bold font denotes the listed concentration exceeds the MA RCS-1 or TEC criteria.
TEC – Threshold effects concentrations – Guidance for Disposal Site Risk Characterization – In Support of the Massachusetts Contingency Plan (1996).

Sediment sampling results are compared to two criteria in Table 1:

- MassDEP Reportable Concentrations for Soil (RCS-1), as established in 310 CMR 40.000, the Massachusetts Contingency Plan (MCP).
- Threshold Effects Concentrations (TECs), as established in *Revised Sediment Screening Values*, update to Section 9.0 of *Guidance for Disposal Site Risk Characterization – In Support of the Massachusetts Contingency Plan (1996).*

Sediment sampling results are compared to the RCS-1 values to determine if upland reuse of sediment is an alternative, as dredged material, including sediment, placed on or in the land at an upland location is subject to the release notification requirements and thresholds of 310 CMR 40.0300 and 40.1600 for soil, unless such placement is in accordance with the provisions of 310 CMR 40.0317(10) and 314 CMR 9.07 (4), (6), (9), (10), or (11).

With the exception of benzo(a)pyrene (2.10 mg/kg), lead (167 mg/kg) in the Downstream sediment sample, the detected concentrations of metals, PCBS, and PAH concentrations in the sediment samples collected in support of this feasibility evaluation were below the MassDEP Reportable Concentration (RCS-1) values in 310 CMR 40.000.

TECs are sediment screening values used to evaluate the potential risk of harm to the environment from sediment contamination during a Stage I Ecological Risk assessment conducted in accordance with the MCP. If each detected sediment contaminant concentration is equal to or less than the sediment screening criterion for the contaminant, no further evaluation of the risk of harm from the sediment is required. The current screening criteria for metals are based on the TECs that have been developed as consensus-based sediment quality guidelines by MacDonald et al. (2000).

The maximum concentration of total PCBs is below the RCS-1 values and TECs. In sediment samples collected from the Downstream and Pond sediment samples, lead, mercury, and several PAHs were detected at concentrations above the established TEC.

The grain size distribution results indicated that the Central Pond sediment consists of dark brown, silty sand (Sed-1, 2 and 3). Additional samples were taken at School Street and the Norwood Avenue Culvert. Sediment deposits here were limited to areas behind boulders and woody debris. Sediment was defined as poorly graded sand at Norwood Avenue and poorly graded gravel with sand at School Street. The grain size analysis is provided in Appendix C.

The results of the sediment sampling were confirmatory of visual observations. Central Pond is a shallow impounded system, with variable depth fine silt deposits overlaying bedrock (Cape Ann Granite). Sediment analysis identified several metals and PAHs that were above MassDEP the respective RCS-1 and TEC Screening Values.

2.3 Sediment Management Considerations

In accordance with 314 CMR 9.07(9) of the 401 Water Quality Certification regulations, upland placement of dredged material as fill or for other reuse activities is allowable, provided the concentrations of oil and hazardous material in the dredged material are less than the Method 1 S-1 soil standards as specified in 310 CMR 40.0975: *Identification of Applicable Soil Standards in Method 1*. The Method 1 S-1 standards consider the potential risk of harm to humans resulting from direct exposure to contaminants present in soil, and are applicable as the areas where upland reuse of sediment is feasible would be potentially accessible.

314 CMR 9.07(9) places additional criteria for the upland reuse of sediment, requiring that that the subject material is not otherwise a hazardous waste and will not adversely affect an existing public or private potable water supply, provided that:

The material is not reused at a location(s) where:

- The nature of the contaminants (evaluated as chemical families such as metals, PAHs, petroleum hydrocarbons, halogenated volatile organic compounds, halogenated pesticides, PCBs, and dioxin-like compounds) in the dredged material is different than that at the receiving location; and
- the concentration(s) of oil and hazardous materials in the soil at the receiving location are significantly lower than the levels of those oil and hazardous materials present in the material;

In accordance with 314 CMR 9.07(9), it is necessary to demonstrate that the receiving locations do not contain contaminant concentrations that are "significantly lower" than the levels present in the dredge sediment. In the case of Central Pond, since there were detections of benzo(a)pyrene above the MCP Method 1 soil standard in sediment samples collected from the Downstream location, upland reuse of sediment from this area would not be permitted in accordance with 314 CMR 9.07(9). We anticipate that the reuse of sediment from other areas in the project site for salt-marsh restoration would be acceptable, since contaminant levels would potentially be below the Method 1 S1 soil standards, and consistent with the concentrations identified in the "Pond" sample, collected from the area of accumulated sediment in the eastern portion of Central Pond that is exposed during low tide when the Central Street tide gate remains open. Any reuse of sediment in upland areas is subject to review and approval by MassDEP through the 401 Water Quality Certification permitting process.

While dredging and upland reuse of sediment within the project area could be evaluated as a feasible component to the overall project restoration plan. Tighe & Bonds assessment of sediment in the project area was conducted based on the premise that the preferred restoration alternative would minimize mechanical dredging of sediment deposits within Central Pond, and instead allow for natural transport of sediment through restoration of unimpeded flow conditions.

Historically, the flow of water through Central Pond has been restricted by the closed tide gate for significant portions of the year. It is important to note that the tide gate has been routinely opened during the spring to allow for fish passage, and also during the winter and spring seasons to alleviate upstream flooding during periods of peak runoff. During these periods of unrestricted flow conditions, sediment transport is occurring, with the ultimate discharge location in Central Harbor.

In addition to our evaluation of the potential for upland reuse of sediment, Tighe & Bond reviewed analytical data collected by CLE Engineering, of Marion, Massachusetts, in 2012 in support of a harbor dredging project (NAE-2012-322 – Bulk Chemical Analysis – Town of Manchester, Manchester Harbor – Tier III Sediment Evaluation), the results of which are summarized in Table 1. A complete copy of the Tier II Sediment Evaluation laboratory analytical report is included in Appendix B. Our review indicates that, overall, the nature of sediment quality upstream of the Central Street tide gate is not significantly different with regard to the presence of heavy metals, notably lead and mercury. Levels of total PCBs were slightly higher in the Central Harbor sediment samples collected by CLE, while levels of PAHs were slightly higher in samples collected by Tighe & Bond upstream of the Central Street tide gate.

Our visual observations, supported by the sediment analysis, confirm the feasibility of upland reuse of sediment from portions of the project area to create salt marsh areas along the banks

of Sawmill Brook. Our review of data collected to date also indicate that the restoration of natural flow conditions and sediment transport from Sawmill Brook into Central Harbor is unlikely to result in a deterioration of conditions with regard to concentrations of contaminants present in the sediment.

2.4 Bathymetry Development

The survey data was used to develop a bathymetric map of the Central Pond surface (Photo 3). The Pond is relatively flat, with a shallow gradient from ranging from 3 feet NAVD88 where Sawmill Brook enters Central Pond to 0.2 feet at the Central Street culvert inlet. Two main "islands" are present at low tide, one triangular feature at the entrance to the pond, and one kidney shaped feature centrally located. The surveyed bathymetry correlates well with orthophotos, considering the contour resolution is only one foot. At low tide, Sawmill Brook

Photo 3- Survey Bathymetry of Central Pond

flows into the widened section of the Pond, and then meanders over the first triangular rise, slowing the flow and causing sediment to drop out. The flow splits about 90% flows to the west and the rest flows along the western wall.

The three areas of elevated sediment have been consistent over the past 18 years. Looking at historic images of the Pond in Google Earth from 2001 to 2017 (Photo 4) there has been

some increase in the areas of visible deposition, but it has remained relatively consistent over the past 10 years.

Photo 4: Views of Central Pond 2001-2017

To get better visual approximation of the distribution of sediment, the sediment depth profile data from the transects were linked with the bathymetry to develop a map showing the relative sediment depth throughout the pond (**Figure 3**). Three main areas of sediment deposition are noted in the figure. At the lower extent of the pond, there is an area of deposition just off the shallow shelf, where the stream widens up. In the center, there is a notable area on the eastern shore where there is a shallow bank, and stormwater outfall. A third area to the north is less well defined, there are significant gravel deposits in this location, and it is an area where the stream first hits the pond, and sediment can drop out as the velocity slows.

2.5 Stream Bank Survey

On April 18, staff completed a visual stream bank survey from Central Street to Norwood avenue to identify eroded bank reaches along Sawmill Brook. A photo log of the visual survey is provided in Appendix D. A variety of stream bank erosion control matrials are used along the Brook.

Central Pond Structures (Central Street to Knight's Circle)

This area includes the main area known as Central Pond extending from the Central Street Bridge up to Knights Circle. When the tide gate is closed the pond fluctuates an average of 4.25 to 4.90 feet from low to high tide. When the tide gate is open the depth ranges from 1.01 to 5.04 feet from low to high tide. The survey for Central Pond was conducted at low tide, to gain visual access to the toe of wall, and obtain photos from an in-stream perspective.

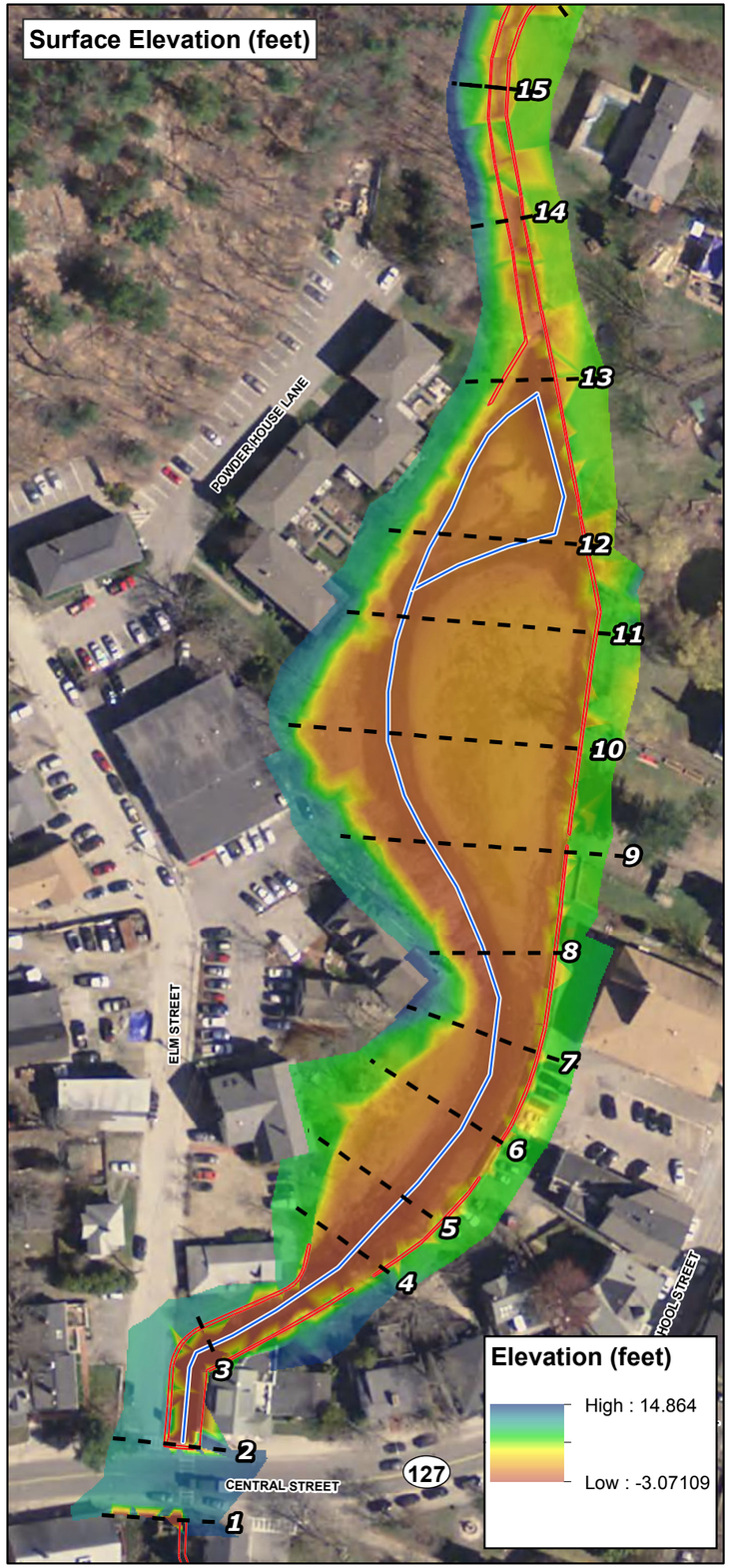
Granite block, poured concrete, brick, field stone and shale revetment and combinations of the above are the dominant structures found around Central Pond. The eastern shoreline is cut sharply into the Pond, with the wall defining the eastern bank boundary. The eastern shoreline was completely lined with wall structures ranging from 3-5 feet in height, with the tallest walls adjacent to Central Street along the channel that paralells Elm Street, and the lowest walls found on the south eastern shoreline, that are predominantly privately owned properties.

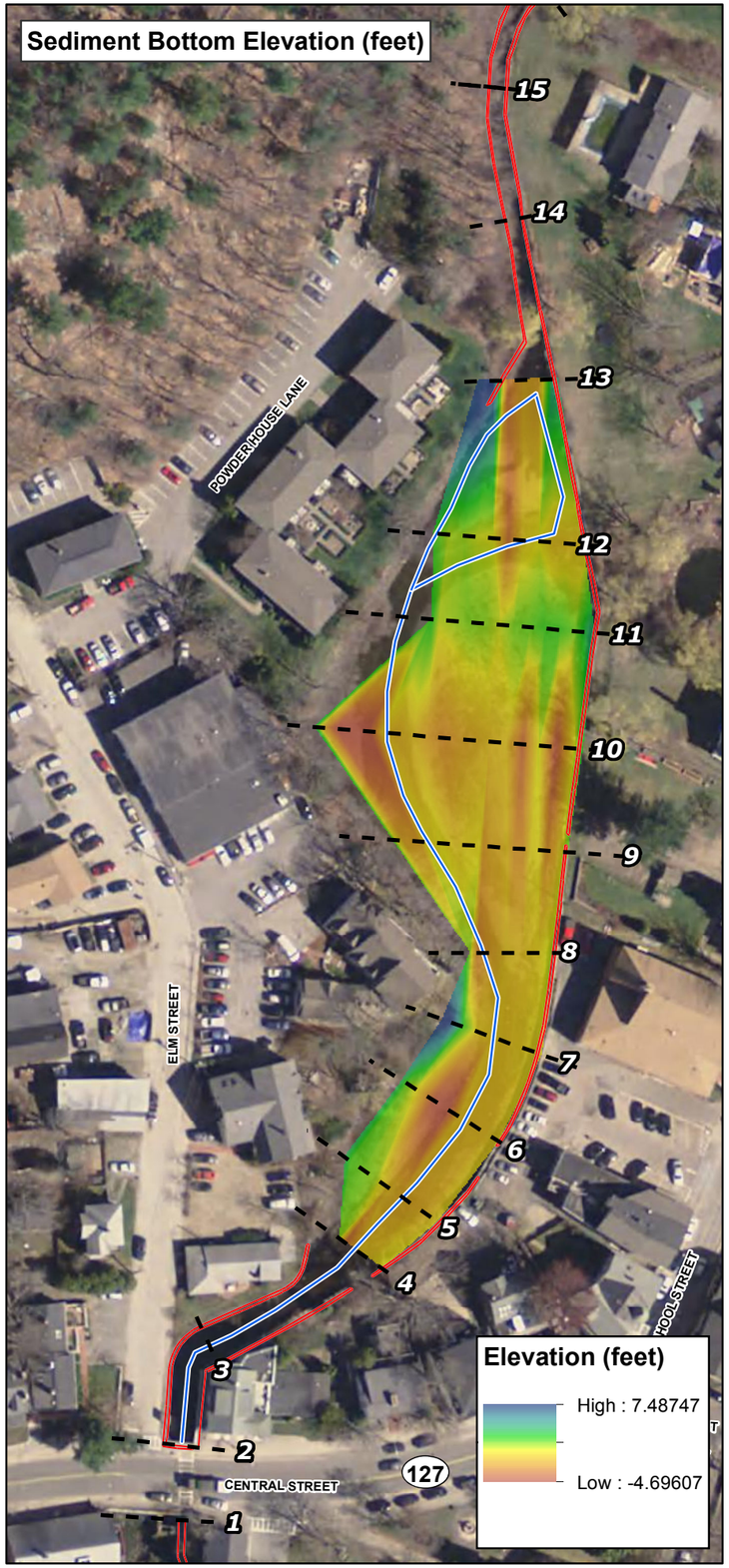
The western shoreline has a more gradual slope, and includes several shoals formed from finer sediments deposited as Sawmill Brook flows under low water flow, gathering in pockets along the shore. Several stormwater discharge outfalls were noted along the western shore that are also a source of sediment. Walls along the western shoreline varied from loose cobbles, revetment, to low fieldstone. The western shoreline is almost entirely under private ownership with the exception of a town-owned parcel on Elm Street .

Appendix D incudes the photos taken during the survey and include a Map Key to show the position and directional orientation of the photo. Photos 1 to 19 depict conditions along Central Pond.

The worst wall conditions were observed in the south-easten section of the Pond (extending from behind 19 Central Street to the Fire Station, where two wall sections have entirely collapsed, and approximately 400 feet is in need of extensive repair. The wall sections above the Fire Station to Knights Circle (approximately 400 feet) have areas that need moderate repairs including replacing cap stones and addressing land subsidence behind the wall.

Sections along the western shore could be improved to prevent continued soil erosion, and could benefit from soft erosion solutions including estabilshing vegetation, contolling public access and potential stormwater outfall improvments. The transition between the wall structure on town owned parcel on Elm Street to the rock rubble on the adjacent privately owned parcel could be improved. This is a high velocity location where the wider channel narrows to the channel above Central Street.





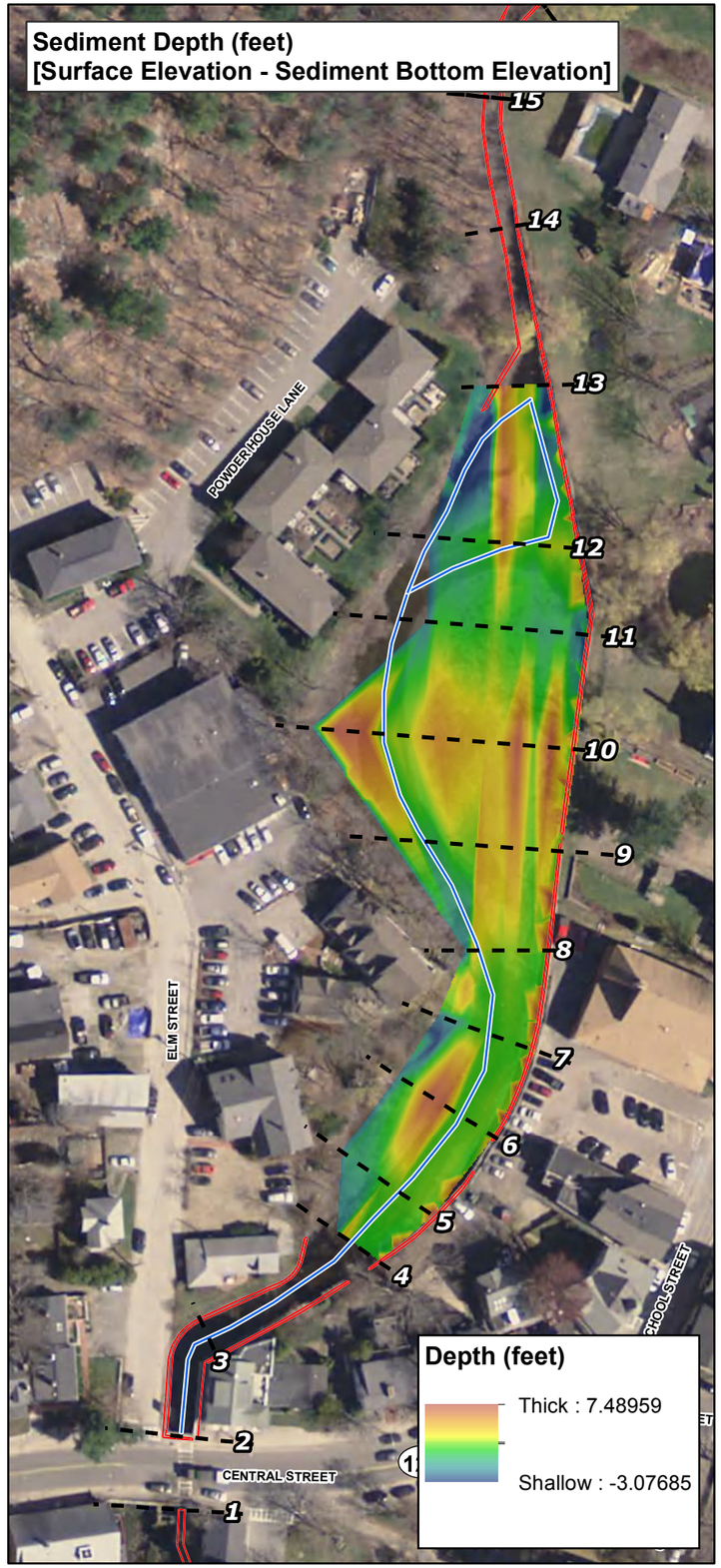


Figure 3
CENTRAL POND BATHYMETRY AND SEDIMENT DISTRIBUTION

LEGEND

- Transects
- Retaining Walls
- Thalwag

LOCUS MAP

N

0 50 100
Feet
1:1,200

NOTES

1. Based on MassGIS Color Orthophotography (2013)

Central Pond and Sawmill Brook
Manchester by the Sea
Massachusetts

April 2018

Tighe&Bond
Engineers | Environmental Specialists

V:\Projects\M\m1476\SawmillBrook_OverviewFigures\SedimentThickness_ManchesterByTheSeaMA_11x17_Final.mxd [Exported By: KJW, 4/17/2018, 5:10:49 PM]

M-1476

Sawmill Brook Structures (Knight's Circle to Norwood Ave)

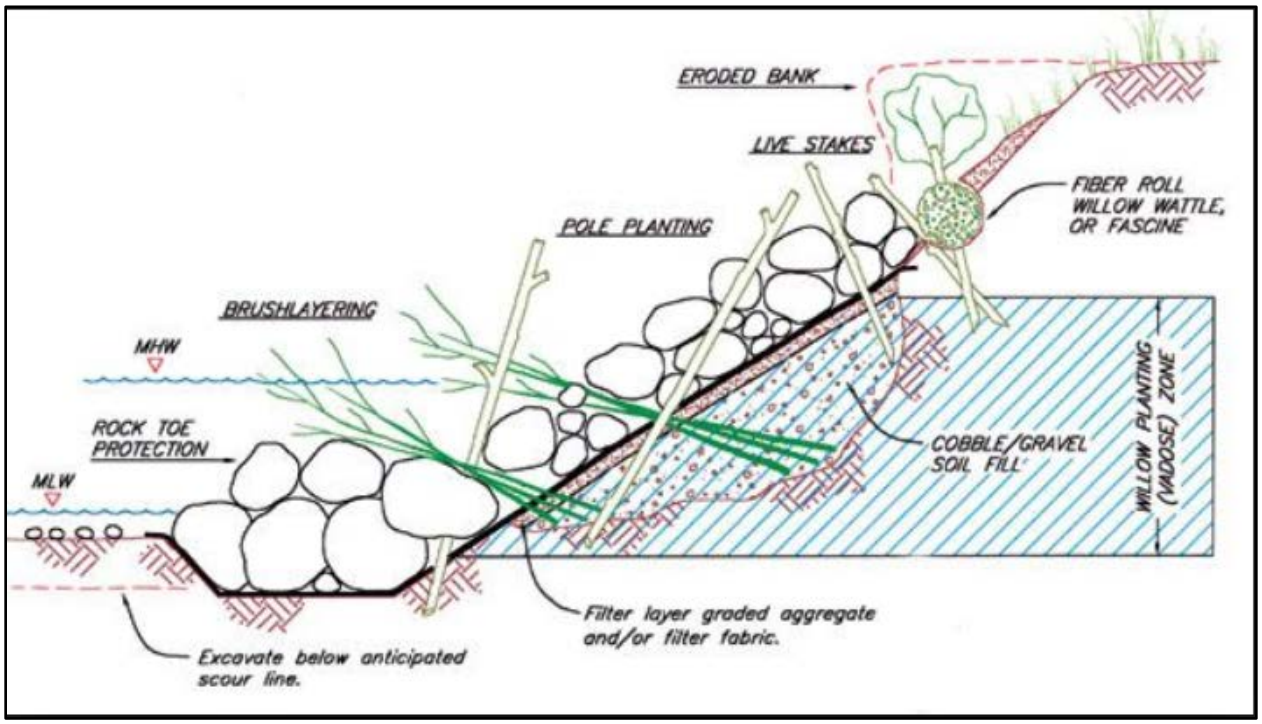
This area includes Sawmill Brook extending from the Knights Circle up to Norwood Avenue. Sawmill Brook is narrow, and predominantly channelized with a variety of stone structures, and occasional areas where wetlands border the stream. The walls vary in height from only a few feet to over 6 feet at Norwood Avenue. The Brook is cobble lined and water depth ranged from less than foot in the fall (typical low flow period) to 3 feet in the spring. The survey was completed under higher water conditions. Wall observations were limited to the upper section.

Granite block, field stone and combinations of the above are the dominant structures found along Sawmill Brook. Poured concrete was used in a few locations.

Appendix D incudes the photos taken during the survey and include a map key to show the position and directional orientation of the photo. Photos 20 to 47 depict conditions along Sawmill Brook.

A number of areas were observed to have deteriorating banks, wall structure collapse and direct outfalls that may contribute to sedimentation issues in Sawmill Brook. Beaver activity was noted at two locations below Norwood Avenue and one location above Norwood Avenue. The impoundment along narrow sections causes upstream water to backup and overtop the banks. In areas where low lying banks were left in a natural vegetated state, there were fewer signs of stream bank erosion. Where property owners had developed and landscaped up to the edge of the streambank, the worst erosion was noted.

Stream bank conditions could be improved with a combination of wall stabilzation repairs, modifying the bank in some locations to lessen the slope and naturalize it with appropriate plantings (Inset 2). Homeowners should be encouraged to plant buffers along the streambank with vegetation that will absorb strormwater runoff from adjacent lawns, and lessen foot traffic along the edge of the bank. Low growing species can be planted to maintain water views.



Inset 2: Bioengineering stream bank erosion control techniques

Source https://www.ernstseed.com/resources/planting-guides/erosion-control-revegetation-planting-guide/

3 Sediment Transport

Tighe & Bond performed a sediment transport analysis of lower Sawmill Brook to characterize sediment transport dynamics and to assess sediment stability within the stream for existing (tide gate open and closed) and proposed conditions.

3.1 Model Development

The analysis was developed using the HEC-RAS hydraulic model developed as part of Task 2: Hydrologic Monitoring and Flushing Studies and described in the Task 2 technical memorandum. The model included the following three geometry scenarios:

1. Existing Conditions with the Tide Gate Closed
2. Existing Conditions with the Tide Gate Open
3. A Proposed Condition with the Tide Gate Removed and Larger Central Street Culvert

The proposed condition improvements include removing the tide gate and replacing the existing Central Street Culvert with an 18-foot wide Conspan arch culvert. The proposed culvert would maintain the existing upstream and downstream invert elevations (-0.2 feet NAVD88, and -4 feet NAVD88, respectively), and provide a constant low chord elevation of 6 feet NAVD88. If the Town decides to replace the Central Street Bridge it is anticipated that the exact geometry of the proposed culvert would vary from the proposed model following a detailed underground utility survey.

The sediment transport analysis was performed using an approximation for the channel-forming discharge, often referred to as the “bankfull flow”. The bankfull flow is on average the 1.5-year frequency storm flow, and was calculated by updating the HEC-HMS model developed as part of the detailed hydrologic analysis performed as part of the February 2016 “Sawmill Brook Culvert and Green Infrastructure Analysis Task 4 Final Report: Evaluation of Locations for Flood Mitigation” prepared by Tighe & Bond. The 24-hour rainfall depth associated with the 1.5-year frequency storm was estimated as 2.99-inch using the Cornell University Northeast Regional Climate Center precipitation data used for the 2016 study. The peak flow computed at Norwood Avenue was 180 cubic feet per second, and the peak flow computed at Central Pond was 200 cubic feet per second.

The HEC-RAS sediment transport analysis tool requires grain size distributions to characterize existing sediment within a stream channel. The sediment sample testing, described in Section 2, included the development of grain size distributions (provided in Appendix C) that were used for HEC-RAS sediment transport modeling. These grain size distributions provide the percent of particles (by weight) that pass various size sampling sieves. The smallest sieve used for this type of analysis is the No. 200 sieve, with 0.075 millimeter openings. The sediment passing the No. 200 sieve are silt and clay sized particles, that are often referred to as “fine-grained sediment” for engineering purposes. The proportion of fine-grained sediment in streams has a substantial impact on degradation (removal of sediment) and aggregation (addition of sediment) because fine-grained sediment mobilizes at lower velocities than larger sediment. The amount of fine-grained soils observed from the sediment samples along Sawmill Brook from Norwood Avenue to Central Avenue are describe below:

- Sediment samples at School Street and Norwood Ave were composed of less than 1% fine-grained sediment.
- Samples in the stream channel upstream of Central Pond were composed of approximately 40% fine-grained sediment.

- Samples within Central Pond were composed of over 50% fine-grained sediment.
- Samples in the stream channel downstream of Central Pond were composed of approximately 25% fine-grained sediment.

The sediment transport analysis was performed using a quasi-unsteady flow, the Ackers-White Transport Function, the Thomas (Ex5) Sorting Method, and the Ruby Fall Velocity Method. Detailed descriptions of these methods are available in the HEC-RAS User's Manual[2]. The analysis was performed for existing conditions with the tide gate closed, existing conditions with the tide gate open, and for proposed conditions. To provide a reasonable range of tailwater conditions the models were run with both Mean Lower Low Water (MLLW) and Mean Higher High Water (MHHW) downstream boundary conditions. The modeled MHHW elevation was 4.77 feet NAVD88 and the MLLW elevation was -5.51 feet NAVD88 based on the NOAA Long Term Tide Water Level Monitoring Station ID: 8443970. Realistically, some variation in tides would be anticipated during a storm event; however, by looking at MHHW and MLLW a range of reasonable outcomes can be considered.

3.2 Evaluation of Sediment Transport Dynamics

The results of the sediment transport analysis for Sawmill Brook are shown in **Figures 4, 5 and 6**. Aggradation (soil deposition) of fine sediments is anticipated within Central Pond if a bankfull event occurred during MHHW for existing conditions (tide gate closed and open) and proposed conditions. This aggradation is caused by a decrease in velocity as water flows from Sawmill Brook upstream of Central Pond to the tidal backwater area at Central Pond during MHHW. For existing conditions when the tide gate is closed, aggradation would also be anticipated if a bankfull event occurred during MLLW, because the tide gate crest elevation would control the minimum water surface elevation within Central Pond. For existing conditions with the tide gate open and for proposed conditions, it is anticipated that degradation (soil loss) would occur if a bankfull event occurred during MLLW toward the downstream limit of Central Pond and the downstream channel. This degradation would remove previously settled fine-grained sediment due to higher velocities associated with flow freely leaving the pond during low tide without tidal backwater.

The process of aggradation of fine particles for a bankfull event during high tide when velocities are backwater limited and degradation of fine particles for a bankfull event during low tides when higher exit velocities are obtained more closely resemble natural sediment dynamics in tidal systems. It is anticipated that actual bankfull flood events would likely either occur during:

1. A range of tides limiting the extent of aggradation and degradation, or,
2. Occur during a storm surge, resulting in a higher probability for aggregation.

The existing tide gate when closed has created a condition where fine sediment settle during large flow events during both low and high tides, instead of allowing sediment to travel downstream during low tides as would have occurred if the tide gate was not in place. The existing system is in disequilibrium while the prevalence of fine-grained sediment within Central Pond is also indicative of a supply of fine sediment within the watershed. The proposed culvert replacement and tide gate removal at Central Street would restore a tidal ebb-and-flow similar to existing conditions observed during periods when the tide gate is left

[2] US Army Corps of Engineers. (2016). *HEC-RAS River Analysis System User's Manual Version 5.0*. Hydrologic Engineering Center.

Figure 4

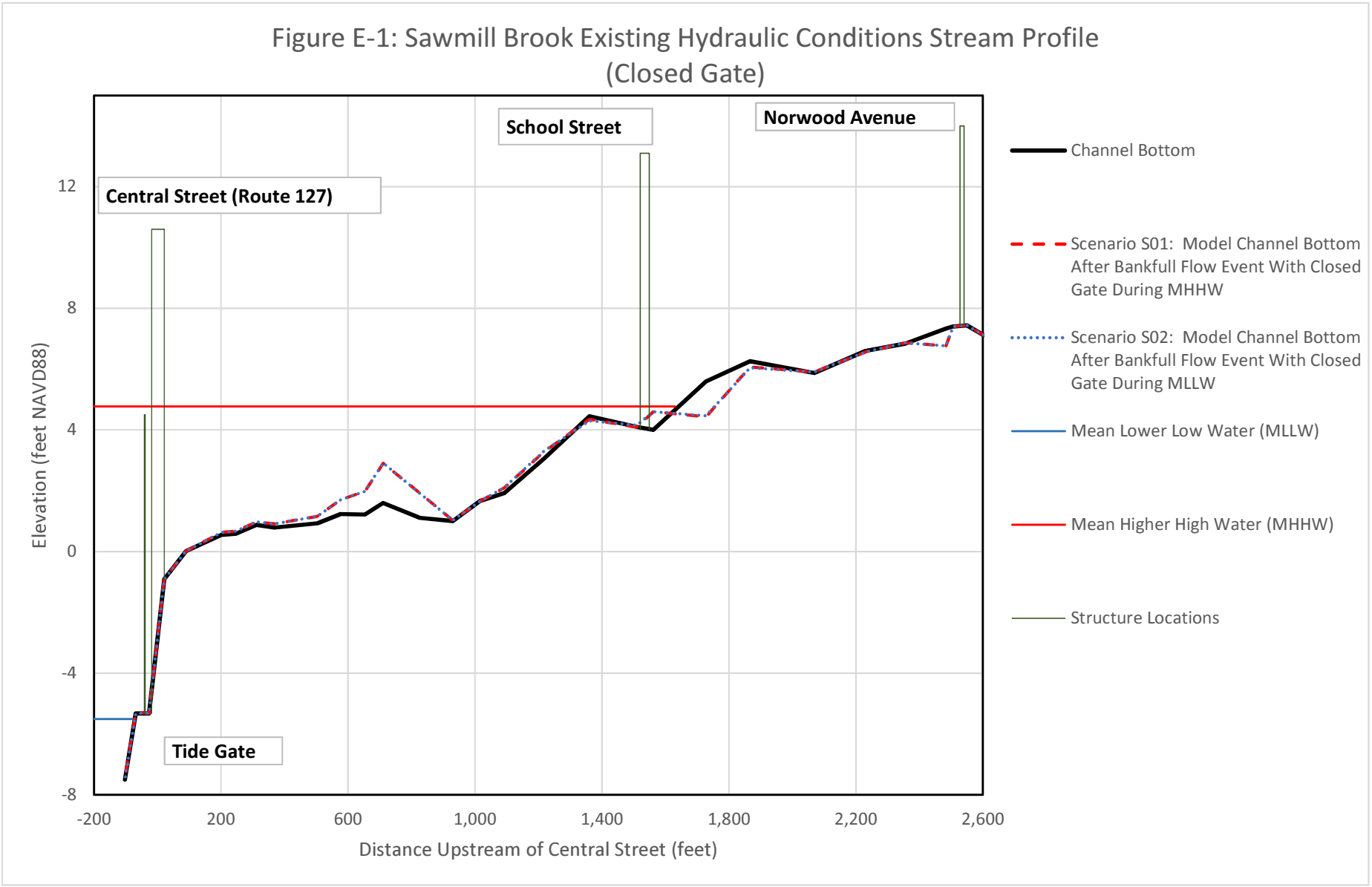


Figure E-1: Sawmill Brook Existing Hydraulic Conditions Stream Profile
(Closed Gate)
School Street
Norwood Avenue
Central Street (Route 127)
Tide Gate
12
8
4
0
-4
-8
Elevation (feet NAVD88)
-200
200
600
1,000
1,400
1,800
2,200
2,600
Distance Upstream of Central Street (feet)
Channel Bottom
Scenario S01: Model Channel Bottom After Bankfull Flow Event With Closed Gate During MHHW
Scenario S02: Model Channel Bottom After Bankfull Flow Event With Closed Gate During MLLW
Mean Lower Low Water (MLLW)
Mean Higher High Water (MHHW)
Structure Locations

Figure 5

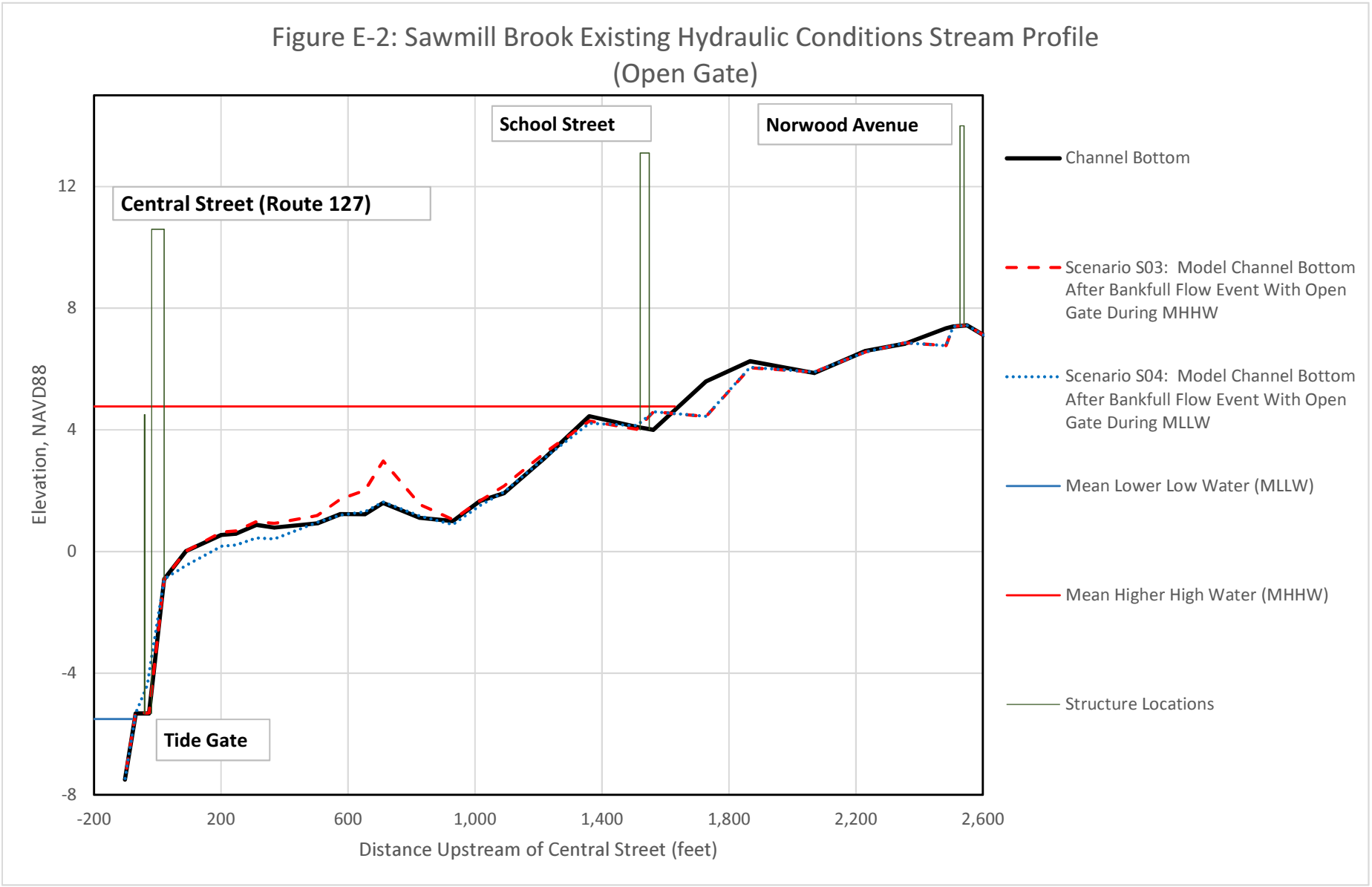


Figure E-2: Sawmill Brook Existing Hydraulic Conditions Stream Profile
(Open Gate)
School Street
Norwood Avenue
Central Street (Route 127)
Tide Gate
12
8
4
0
-4
-8
Elevation, NAVD88
-200
200
600
1,000
1,400
1,800
2,200
2,600
Distance Upstream of Central Street (feet)
Channel Bottom
Scenario S03: Model Channel Bottom After Bankfull Flow Event With Open Gate During MHHW
Scenario S04: Model Channel Bottom After Bankfull Flow Event With Open Gate During MLLW
Mean Lower Low Water (MLLW)
Mean Higher High Water (MHHW)
Structure Locations

Figure 6

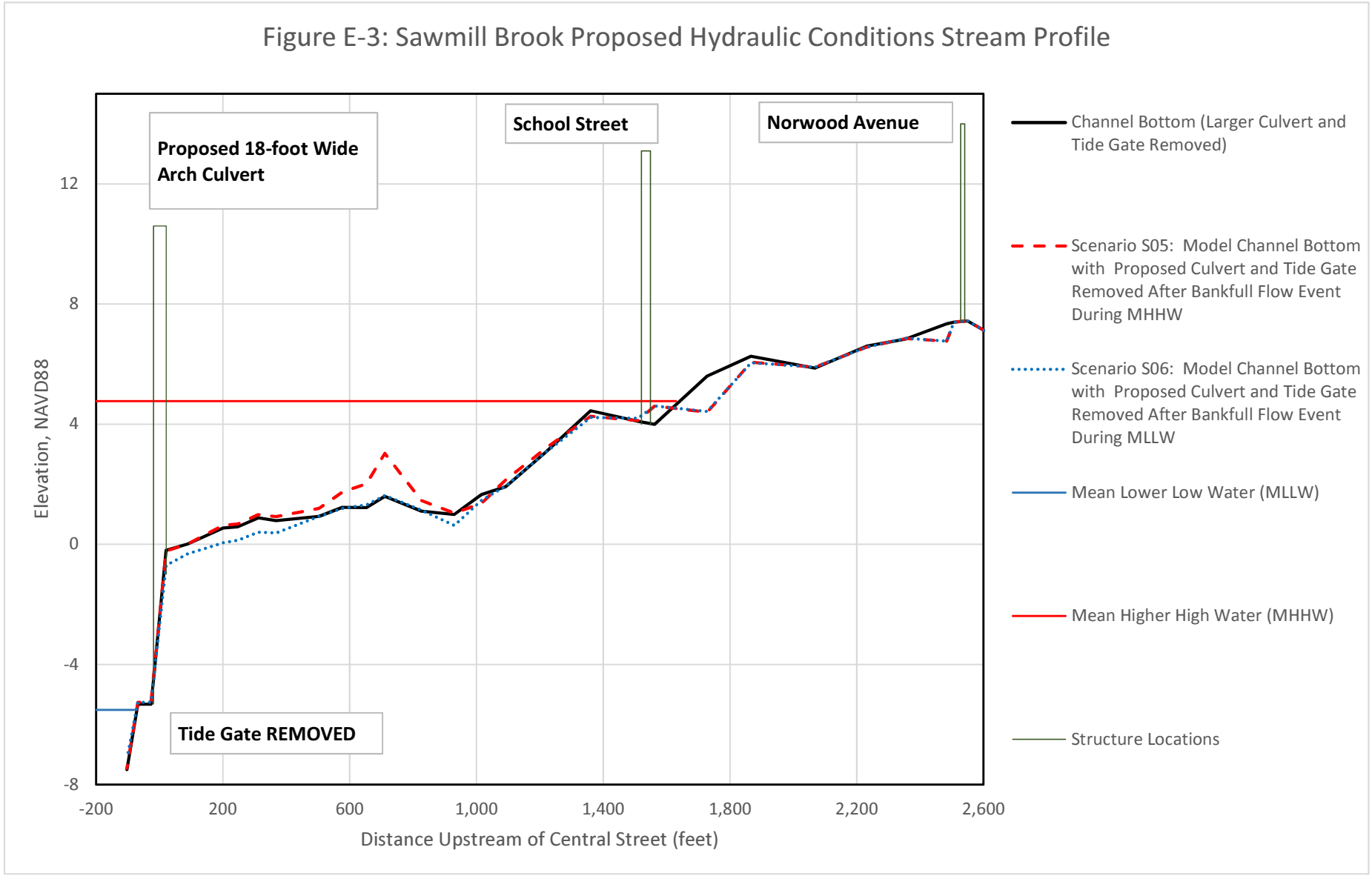


Figure E-3: Sawmill Brook Proposed Hydraulic Conditions Stream Profile
Proposed 18-foot Wide Arch Culvert
School Street
Norwood Avenue
Tide Gate REMOVED
Elevation, NAVD88
12
8
4
0
-4
-8
-200
200
600
1,000
1,400
1,800
2,200
2,600
Distance Upstream of Central Street (feet)
Channel Bottom (Larger Culvert and Tide Gate Removed)
Scenario S05: Model Channel Bottom with Proposed Culvert and Tide Gate Removed After Bankfull Flow Event During MHHW
Scenario S06: Model Channel Bottom with Proposed Culvert and Tide Gate Removed After Bankfull Flow Event During MLLW
Mean Lower Low Water (MLLW)
Mean Higher High Water (MHHW)
Structure Locations

open. While the natural tidal ebb-and flow may help reduce sedimentation within Central Pond, stormwater best management practices (BMPs) should be considered in the watershed to reduce the sediment supply (discussed in Section 4). Reestablishing a tidal ebb-and-flow may increase the probability for degradation of previously settled fine-grained sediment. The potential for degradation when high flows occur during low tides can be reduced by installing channel in-stream controls (e.g., stone features) and/or by removing fine-grained sediment from the channel bottom. Methods to reduce degradation are discussed in in Section 4.

4 Sediment Management for Restoration

Bottom substrate conditions in Sawmill Brook were observed from Central Street to Norwood Avenue, concentrating on characterizing the soft sediments within the Central Pond area. The location of soft sediment in center of the Pond flanked by areas of cobble and gravel above and below the Pond are consistent with the history of dredging and impoundment of Central Pond in the late 19th and early 20th century. Historic accounts have described the area as once being salt marsh. More recently the Pond has been periodically opened to release high flows during storm and seasonal openings to promote fish passage for Rainbow smelt. The following section discusses the sediment management issues at Central Pond and how this frames the selection of restoration alternatives.

4.1 Results of Sediment Characterization

The results of sediment characterization study found that approximately 5,350 cubic yards of sediment are present within the Central Pond area, between Transect 4 and Transect 13. The sediment depth ranged from 1 to over 6 feet in depth (beyond the limit of the probe). Based on the sieve analysis the material was predominantly dark brown silty sand in the pond area. The substrate in Sawmill Brook, from Norwood Avenue to the entrance of the Central Pond, was predominantly cobble, with gravel and sand in lesser amounts. The channel below the Pond, for 100 -200 feet upstream of the Central Street Bridge has a stony bottom, with cobbles, boulders and areas of gravel. The sediment sample taken at the Norwood Avenue culvert was classified as brown poorly graded sand. At the School Street culvert, the sediment sample was classified as brown poorly graded gravel with sand.

Sediment accumulation was noted along the shoreline on the western bank of the Pond and to the north of the Pond. Eroded banks were noted predominantly along the eastern bank of the pond, due to collapse of retaining walls. Sources of erosion on the western shore and further up the pond area likely due to runoff, and direct outfalls entering the Brook and Pond area. Further up Sawmill Brook, deposits of sediment were primarily found upstream of Beaver impoundments or large boulders due to the disruption in stream velocity allowing sediment carried by water to settle out as the velocity slowed down upstream of the isolated impoundment.

The sediment transport evaluation was consistent with observed conditions that fine sediment has settled out in Central Pond during large flow events during both low and high tides, instead of allowing sediment to travel downstream during low tides as would have occurred if the tide gate was not in place.

4.2 Recommendations for Restoration

Currently the restoration of Central Pond is focused on two main goals. The first goal is maintaining the flood storage capacity of the area by repairing and preventing further stream bank erosion. The second goal is to improve the habitat value of the area and promote fish passage, especially for rainbow smelt.

The best restoration element for reducing erosion would be to repair and replace sections of the granite retaining wall along the eastern bank of Central Pond. Areas along the western shore also contribute to sedimentation, particularly the large stormwater outfall. Solutions for reducing erosion range from soft stabilization including bio-engineered planting techniques, controlling public access and a stormwater outfall retrofit to eliminate the direct discharge.

Options for habitat improvements include instream channel modifications and potential instream planting on the raised areas that would further stabilize soft sediments and create habitat. Instream modifications may include dredging, rock veins and other forms of flow augmentation. **Figure 7** presents some of the physical conceptual elements for restoration.

An important component of the mitigation plan is to restore wetland and riparian ecosystems to the stream banks. After hydrologic restoration, freshwater is expected to override a weak saltwater wedge, meaning that freshwater and some minimally brackish-tolerant plants will be incorporated into the wetland restoration. One approach to consider would be to restore the wetland in two phases, the first phase would be populating experimental plots at areas representing variations in sediment size, organic matter content, and salinity. Observations from the plots would be used to populate the entire site in the second phase to improve wetland restoration success.

To establish marsh in this area planting areas may require moderate elevated so plant roots area closer to average high tide elevation. **Photo 5 and 6** provides a plan and cross section view of areas between Transect 6 and 12 and what the elevations would look like with potential salt marsh restoration. The cross sections indicate average high and low water elevations along with potential elevation of substrate to support suitable species.

Planting techniques using nursery grown plants in bio-mats would be ideal for this location, however additional evaluation is needed to support this alternative including obtaining additional salinity measurements, evaluation of suitable species, planting techniques, and maintenance requirements. Most of the planting work would likely be done manually. Substrate augmentation would require a light track vehicle within the pond area and could be mobilized from the shallow slope on the western bank. If desired, limited channel dredging could be accomplished using mechanical dredge to remove soft sediments, allowing the dredge material to settle, dewater and mixing in organic substrate before replacing as augmented soil to raise plating areas. Suitable fill would be covered by biodegradable geotextile material, and nursery plants would be staked on top of the geotextile. **Photo 7 and 8** provides a before and after photo rendering of the potential marsh restoration.

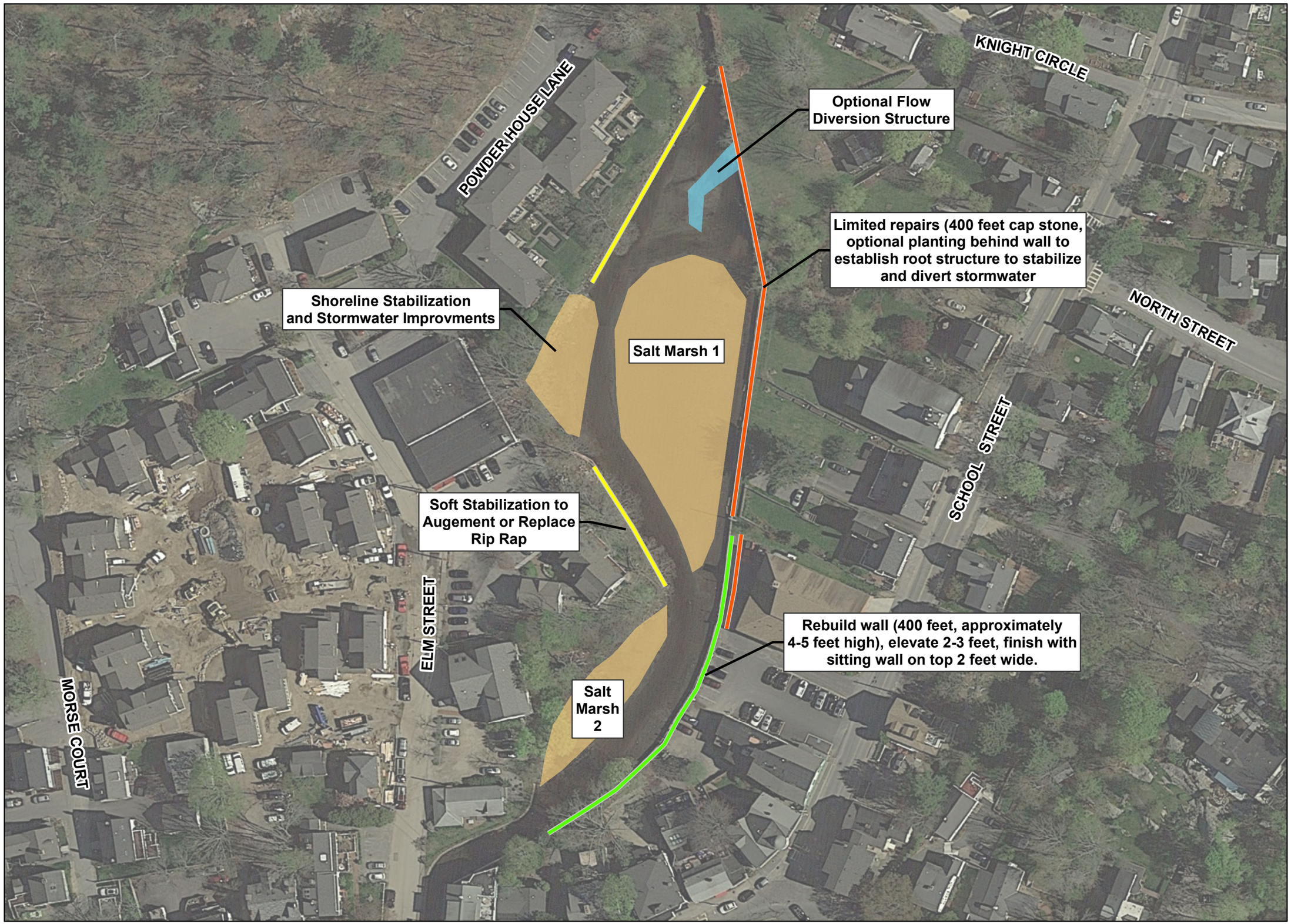
Options to maintain the area as a fresh water system would require a low rock structure downstream of the center of the pond to maintain elevations up to 3 feet upstream. The drawback to this would be continued maintenance to remove sediment that will be trapped behind the structure and limitations placed on fish passage, not unlike the existing tide gate. Rock riffles could be used no matter what option is done, creating additional water movement, aeration and scour pools will improve habitat value. Additional habitat improvements for smelt and Sea Run Brook Trout spawning could be provided further upstream.

The Town should first address the erosion along the stream banks while allowing the stream channel to flush naturally for a period before finalizing the renovation design. Removing sediment deposits and granite blocks from collapsed retaining walls would offset loss of storage resulting from the additional substrate required for salt marsh restoration. The opening of the Central Street Culvert will improve flushing and sediment volumes in the Pond would be expected to diminish over time. Sediment sources from Manchester Harbor on the high tide are expected to be insignificant compared to upstream sources. The Town should continue to investigate and reduce upstream sediment sources as identified in the Stream Bank Survey in Section 2.4 including eliminating direct outfalls, addressing issues caused by beaver dams, and repairing collapsed retaining walls. Providing public education for stream bank stabilization methods will be recommended in the next phase of the Sawmill Brook restoration project.

The alternatives for restoration will be ultimately be decided based on whether dredging is advisable to augment the islands, what type of habitat can be supported in a freshwater predominant estuarine system with up to 7 feet of tidal range and what alternatives can be

Figure 7

CENTRAL POND POTENTIAL RESTORATION ELEMENTS



LEGEND

- High Priority
- Soft Solutions for Bank Stabilization
- Town Owned
- Areas to Restore March in Central Pond
- Optional Flow Diversion Structure

LOCUS MAP

N

0 37.5 75

Feet

1:900

NOTES

Imagery © Google (2016)

Sawmill Brook Area
Manchester By the Sea, Massachusetts

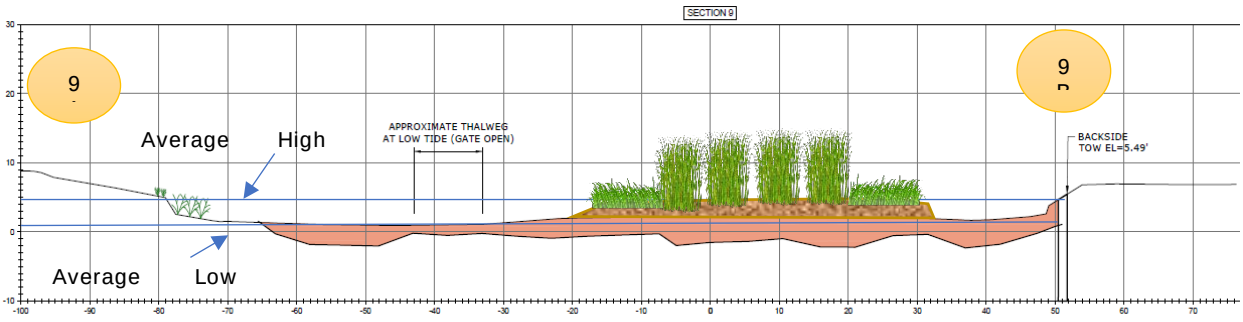
May 2018

Tighe&Bond
Engineers | Environmental Specialists

V:\Projects\M\m1476\SawmillBrook_ManchesterMA_RestorationElements.mxd [Exported By: KJW, 5/2/2018, 4:02:30 PM]

M-1476

permitted and what the restoration costs are. The goals should be aimed at maximizing flood storage and habitat value within the context of what improvements are most acceptable to the abutters. The next steps that are needed to advance the restoration project include addressing the private land ownership issues along eroding stream banks by establishing easements or developing memorandums of agreement for wall improvements, geotechnical studies needed for the wall design, a publicly vetted alternatives analysis and full permitting design of the recommendation alternative.



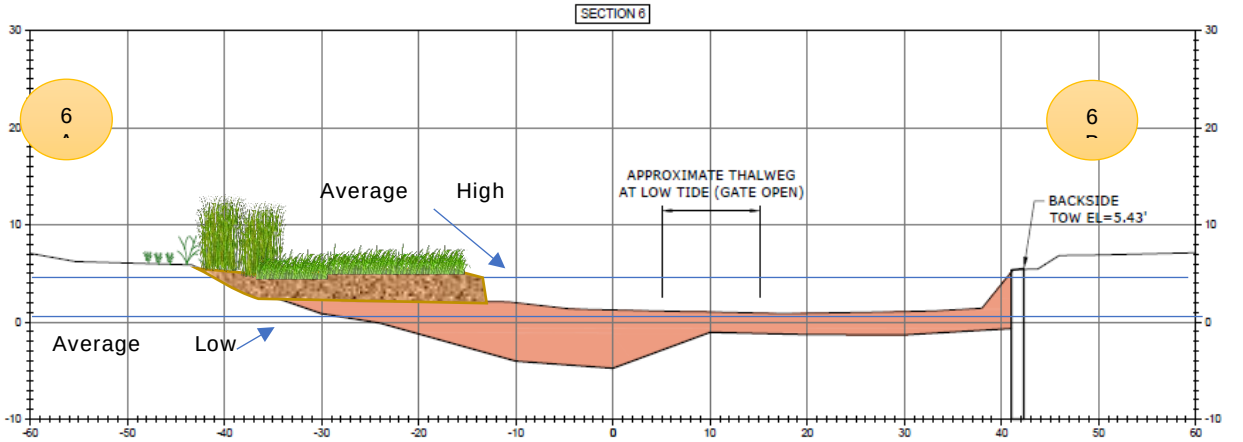


Photo 5
Conceptual Profile for Marsh Restoration- Transect 6 and 9

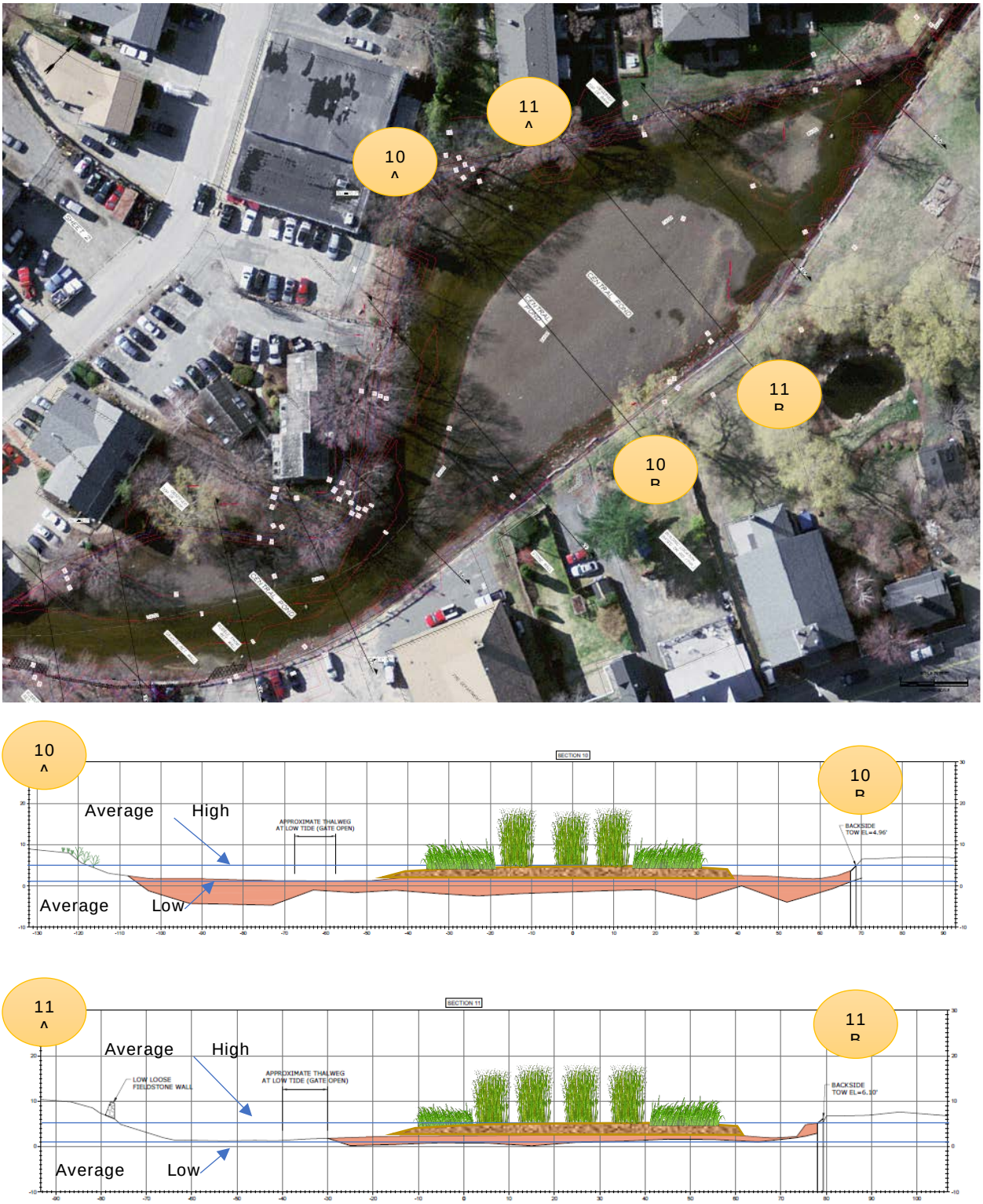


Photo 6
Conceptual Profile for Marsh Restoration- Transect 10 and 11

Photo 7
Before and After Restoration- South View

Photo 8
Before and After Restoration-North View

5 Conclusions

The sediment characterization and sediment transport modeling show and predict that sediment aggregates in Central Pond when the tide gate is closed. The existing tide gate when closed has created a condition where fine sediment settle during large flow events during both low and high tides, instead of allowing sediment to travel downstream during low tides as would have occurred if the tide gate was not in place. This disequilibrium has increased the prevalence of fine-grained sediment within Central Pond and is also indicative of a supply of fine sediment within the watershed.

The proposed culvert replacement and tide gate removal at Central Street would restore a tidal ebb-and-flow similar to existing conditions observed during periods when the tide gate is left open. Channel in-stream controls (e.g., stone features), eliminating sources of stream bank erosion and/or removing fine-grained sediment from the channel bottom can reduce the potential for degradation when high flows occur during low tides after restoration of a tidal ebb-and-flow.

Our visual observations, supported by the sediment analysis, confirm the feasibility of upland reuse of sediment from portions of the project area to create marsh areas along the banks of Sawmill Brook. Our review of data collected to date also indicate that the restoration of natural flow conditions and sediment transport from Sawmill Brook into Central Harbor is unlikely to result in a deterioration of conditions with regard to concentrations of contaminants present in the sediment.

Sediment Management Restoration Recommendations

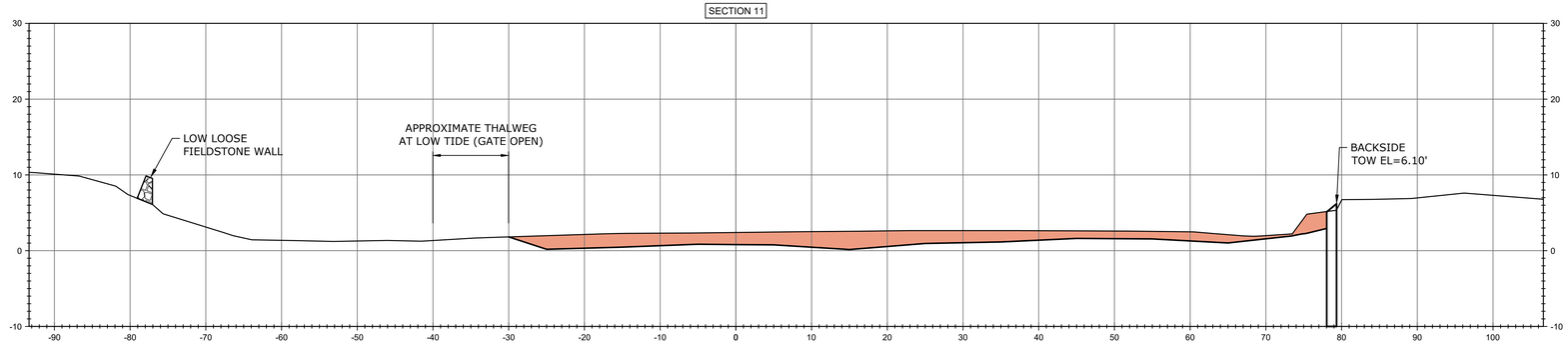
- Develop permit level designs for retaining wall repairs, create additional instream storage by cleaning up wall debris. Remove sources of erosion due to failing retaining walls.
- Let the channel flush for a while before decision on dredging.
- If dredging is recommended, restrict it to instream reuse.

Next Steps

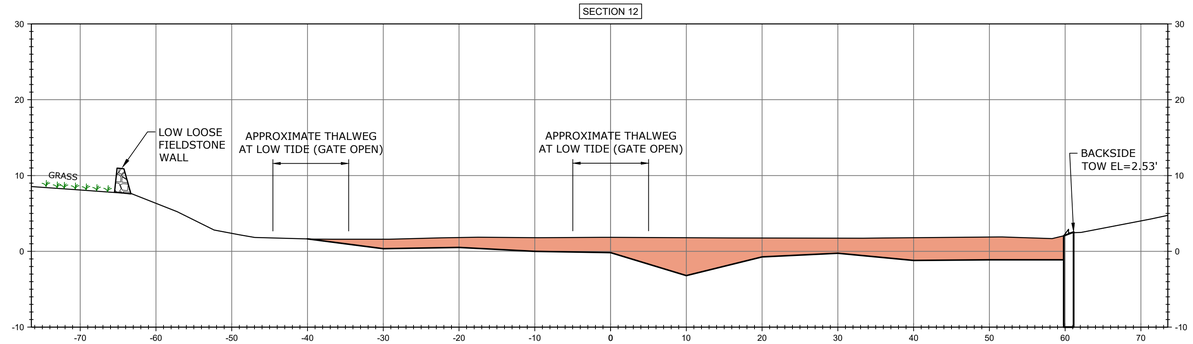
- Establish Memorandum of Understanding with private owner along the southwestern portion of Central Pond to complete Geotech and develop wall repair alternative designs.
- Conduct public outreach on bank stabilization techniques for other private abutters on the western shore of Central Pond and along Sawmill Brook.
- Fully involve the public in the alternatives analysis and selection of a preferred plan to maintain flood storage, address habitat improvements and fish passage.
- Depending on the restoration approach, an implementation plan and schedule will be developed including long-term monitoring efforts.
- Continue to monitor stream levels below and above the pond to documents any changes in elevations.

APPENDIX A

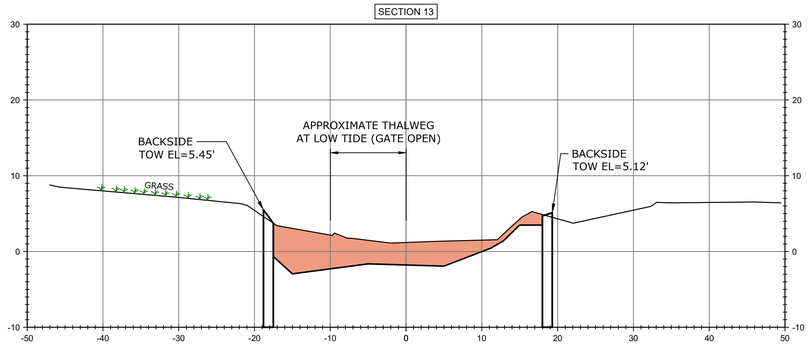
SECTION 11



SECTION 12



SECTION 13



LEGEND:

- GRANITE WALL (DEPTH UNKNOWN)
- VEGETATED EMBANKMENT
- LOW FIELDSTONE WALL (LOOSE)

1 0 10 20

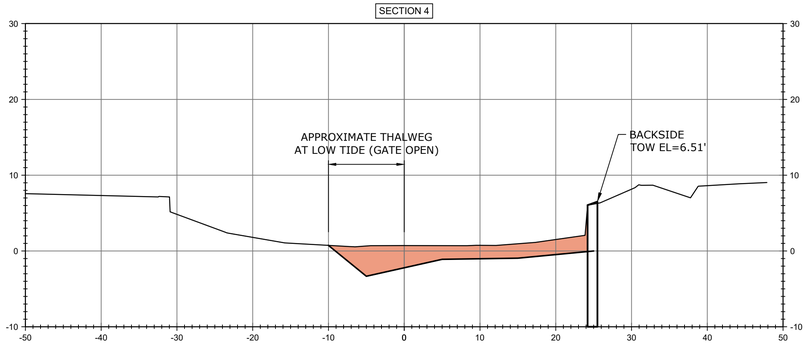
SCALE: 1 INCH = 10FT.

CENTRAL POND
SEDIMENT PROFILES
CROSS SECTION VIEWS
March 2018

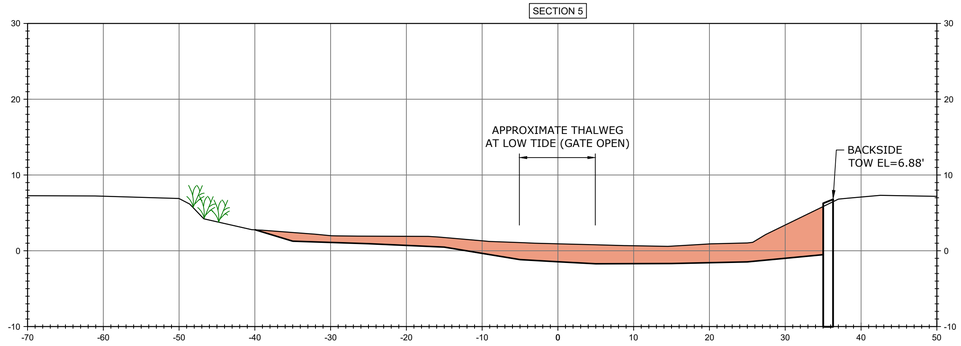
BRIDGE STREET TO NORWOOD AVE.
MANCHESTER-BY-THE-SEA, MASSACHUSETTS

Last Saved: 4/12/2018
Plotted: Oct 24, 2018 - 2:53pm By: CFY
Tighe & Bond: J:\MM1476 Manchester MA Hydro Study\009_MET_Sawmill Feasibility\Drawings_Figures\AutoCAD\Sheet\Sed CrossSects.dwg

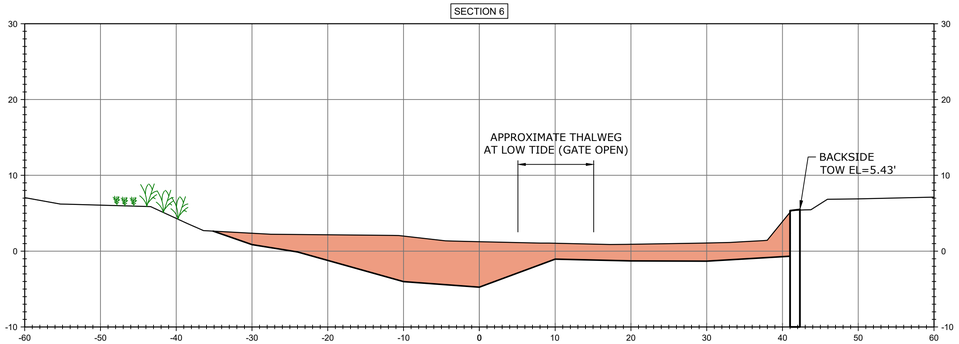
SECTION 4



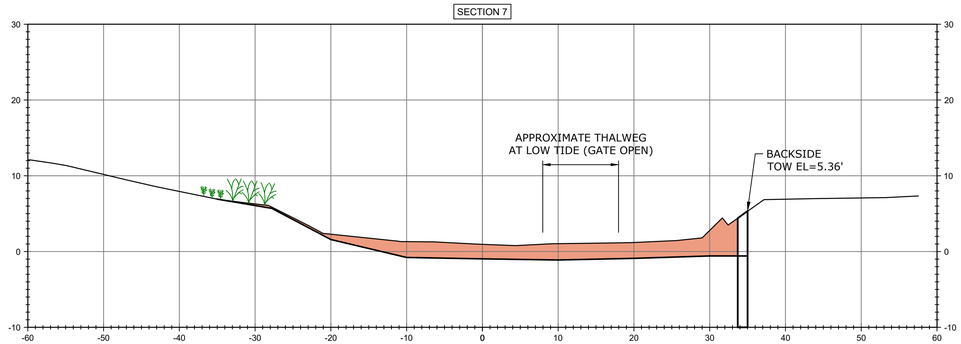
SECTION 5



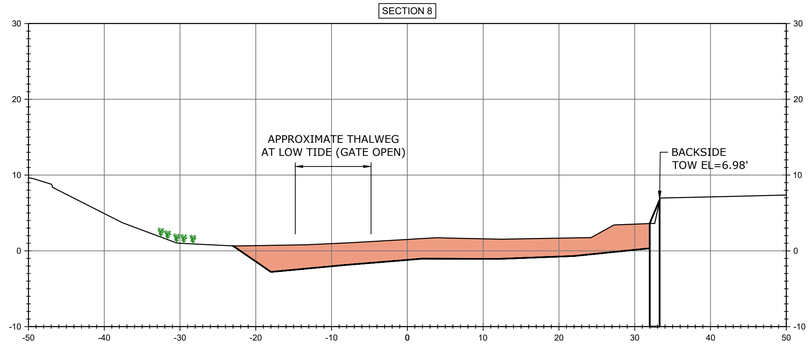
SECTION 6



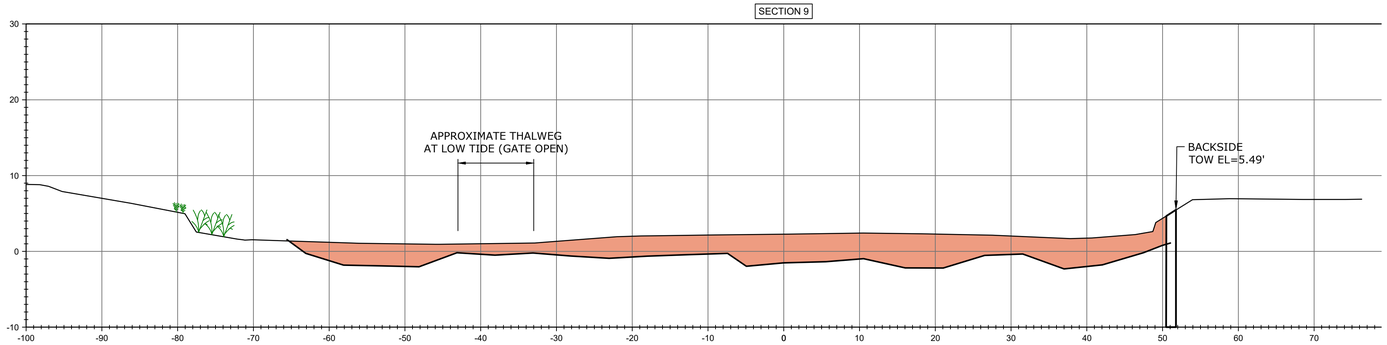
SECTION 7



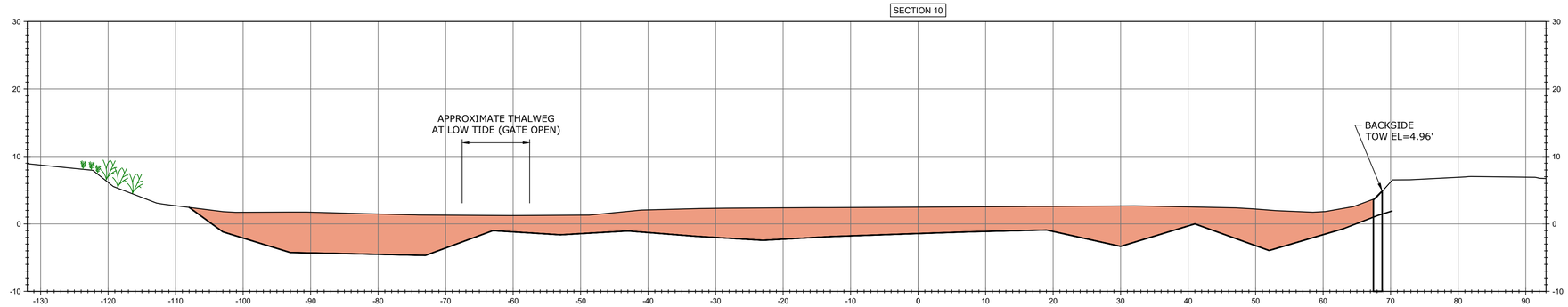
SECTION 8



SECTION 9



SECTION 10



LEGEND:

- GRANITE WALL (DEPTH UNKNOWN)
- VEGETATED EMBANKMENT
- LOW FIELDSTONE WALL (LOOSE)

1 0 10 20

SCALE: 1 INCH = 10FT.

CENTRAL POND
SEDIMENT PROFILES
CROSS SECTION VIEWS
March 2018

BRIDGE STREET TO NORWOOD AVE.
MANCHESTER-BY-THE-SEA, MASSACHUSETTS

Last Saved: 4/12/2018
Plotted: Oct 23, 2018 - 2:53pm By: CFY
Tighe & Bond: J:\M\M1476 Manchester MA Hydro Study\009_MET_Sawmill Feasibility\Drawings_Figures\AutoCAD\Sheet\Sed CrossSects.dwg

Sediment Depth Data

	Transect 4				Transect 5				Transect 6				Transect 7				Transect 8			
Distance from West bank (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)
0	-10	0.7		0	-40	2.8		0	-35	2.6		0	-25	5.7		0	-23	0.6		0
5	-5	0.7	-3.3	>4	-35	2.3	1.3	1	-30	2.4	0.9	1.5	-20	2.3	1.6	0.7	-18	0.7	-2.8	3.5
15	5	0.7	-1.1	1.8	-25	1.9	0.9	1	-20	2.2	-0.1	2.3	-10	1.3	-0.8	2.1	-8	1.1	-1.8	2.9
25	15	0.9	-1.0	1.9	-15	1.7	0.5	1.25	-10	2.0	-4.0	>6	0	0.9	-1.0	1.9	2	1.6	-1.0	2.65
35	25	1.3	0.8	0.5	-5	1.1	-1.2	2.25	0	1.2	-4.8	>6	10	1.0	-1.1	2.15	12	1.5	-1.1	2.6
45	25	6.5	TOW EL	WALL	5	0.8	-1.7	2.5	10	1.0	-1.1	2.1	20	1.2	-0.9	2.1	22	1.7	-0.7	2.4
55					15	0.6	-1.7	2.3	20	0.9	-1.3	2.2	30	1.9	-0.6	2.5	32	2.8	0.3	2.5
65					25	1.0	-1.5	2.5	30	1.1	-1.3	2.4	32	5.4	TOW EL	WALL	35	7.0	TOW EL	WALL
75					35	2.0	-0.5	2.5	38	2.1	-0.7	2.8								
85					35	6.9	TOW EL	WALL	40	5.4	TOW EL	WALL								

	Transect 10				Transect 11				Transect 12				Transect 13			
Distance from West bank (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)	Station	LS Elevation (ft)	Bottom Elevation (ft)	Observed Sediment Depth (ft)
0	-108	2.442		0	-30	1.8		0	-40	1.6		0	-35	7.6		0
5	-103	1.819	-1.181	3	-25	2.0	0.2	1.8	-30	1.6	0.4	1.25	-25	6.6	6.1	0.5
15	-93	1.742	-4.258	6	-15	2.3	0.5	1.8	-20	1.8	0.5	1.3	-15	3.1	-3.0	6
25	-83	1.541	-4.459	6	-5	2.3	0.8	1.5	-10	1.8	0.0	1.8	-5	1.5	-1.6	3.1
35	-73	1.306	-4.694	6	5	2.5	0.8	1.7	0	1.8	-0.2	2	5	1.4	-1.9	3.3
45	-63	1.244	-1.006	2.25	15	2.6	0.2	2.4	10	1.8	-3.2	5	15	4.3	3.5	0.8
55	-53	1.276	-1.624	2.9	25	2.6	0.9	1.7	20	1.8	-0.7	2.5	18	5.1	3.5	WALL
65	-43	1.848	-1.052	2.9	35	2.7	1.2	1.5	30	1.7	-0.3	2				
75	-33	2.254	-1.846	4.1	45	2.6	1.6	1	40	1.8	-1.2	3				
85	-23	2.361	-2.439	4.8	55	2.5	1.5	1	50	1.9	-1.1	3				
95	-13	2.418	-1.882	4.3	65	2.1	1.0	1.1	60	2.5	TOW EL	WALL				
105	-3	2.466	-1.534	4	75	4.2	2.9	1.3								
115	8	2.53	-1.17	3.7	78	6.1	TOW EL	WALL								
125	18	2.601	-0.899	3.5												
135	28	2.663	-3.337	6												
145	38	2.499	-0.001	2.5												
155	48	2.042	-3.958	6												
165	58	2.277	-0.723	3												
175	68	3.93	1.23	2.7												
180	70	4.96	TOW EL	WALL												

APPENDIX B

CERTIFICATE OF ANALYSIS

Gary Hedman
Tighe & Bond
4 Barlows Landing Road, Unit 15
Pocasset, MA 02559

RE: Sawmill Brook - 401WQ (221476)
ESS Laboratory Work Order Number: 1801552

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 11:16 am, Feb 13, 2018

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

Subcontracted Analyses

CTS - Cranston, RI	Grain Size Analysis

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

SAMPLE RECEIPT

The following samples were received on January 30, 2018 for the analyses specified on the enclosed Chain of Custody Record.

Low Level VOA vials were frozen by Client on January 25, 2018 at 10:00.

Lab Number	Sample Name	Matrix	Analysis
1801552-01	Pond	Soil	§, 2540G, 8082, 8260B Low, EPH8270, EPH8270SIM, LK, MADEP-EPH
1801552-02	Stream Up	Soil	§, 2540G, 8082, 8260B Low, EPH8270, EPH8270SIM, LK, MADEP-EPH
1801552-03	Stream Down	Soil	§, 2540G, 8082, 8260B Low, EPH8270, EPH8270SIM, LK, MADEP-EPH
1801552-04	Pond - air dried	Soil	6010C, 7471B
1801552-05	Stream Up - air dried	Soil	6010C, 7471B
1801552-06	Stream Down - air dried	Soil	6010C, 7471B

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

PROJECT NARRATIVE

8082 Polychlorinated Biphenyls (PCB) / Congeners

1801552-01	**Lower value is used due to matrix interferences (LC).**
	BZ#101 , BZ#138 , BZ#170 , BZ#187 , BZ#209 [2C] , BZ#28 [2C] , BZ#52 [2C]
1801552-01	**Percent difference between primary and confirmation results exceeds 40% (P).**
	BZ#101 , BZ#138 , BZ#170 , BZ#187 , BZ#209 [2C] , BZ#28 [2C] , BZ#52 [2C]
1801552-03	**Lower value is used due to matrix interferences (LC).**
	BZ#138 , BZ#170 , BZ#18 , BZ#209 [2C]
1801552-03	**Percent difference between primary and confirmation results exceeds 40% (P).**
	BZ#138 , BZ#170 , BZ#18 , BZ#209 [2C]

No other observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Pond
Date Sampled: 01/23/18 13:00
Percent Solids: 56
Initial Volume: 5.2
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-01
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1,2-Tetrachloroethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,1,1-Trichloroethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,1,2,2-Tetrachloroethane	ND (0.0034)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,1,2-Trichloroethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,1-Dichloroethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,1-Dichloroethene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,1-Dichloropropene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2,3-Trichlorobenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2,3-Trichloropropane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2,4-Trichlorobenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2,4-Trimethylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2-Dibromo-3-Chloropropane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2-Dibromoethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2-Dichlorobenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2-Dichloroethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,2-Dichloropropane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,3,5-Trimethylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,3-Dichlorobenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,3-Dichloropropane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,4-Dichlorobenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
1,4-Dioxane	ND (0.172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
2,2-Dichloropropane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
2-Butanone	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
2-Chlorotoluene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
2-Hexanone	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
4-Chlorotoluene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
4-Isopropyltoluene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
4-Methyl-2-Pentanone	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Acetone	**0.0562** (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Benzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Bromobenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Bromochloromethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Pond
Date Sampled: 01/23/18 13:00
Percent Solids: 56
Initial Volume: 5.2
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-01
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Bromodichloromethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Bromoform	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Bromomethane	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Carbon Disulfide	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Carbon Tetrachloride	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Chlorobenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Chloroethane	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Chloroform	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Chloromethane	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
cis-1,2-Dichloroethene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
cis-1,3-Dichloropropene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Dibromochloromethane	ND (0.0034)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Dibromomethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Dichlorodifluoromethane	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Diethyl Ether	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Di-isopropyl ether	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Ethyl tertiary-butyl ether	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Ethylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Hexachlorobutadiene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Isopropylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Methyl tert-Butyl Ether	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Methylene Chloride	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Naphthalene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
n-Butylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
n-Propylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
sec-Butylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Styrene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
tert-Butylbenzene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Tertiary-amyl methyl ether	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Tetrachloroethene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Tetrahydrofuran	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Toluene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Pond
Date Sampled: 01/23/18 13:00
Percent Solids: 56
Initial Volume: 5.2
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-01
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
trans-1,2-Dichloroethene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
trans-1,3-Dichloropropene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Trichloroethene	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Trichlorofluoromethane	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Vinyl Chloride	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Xylene O	ND (0.0086)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Xylene P,M	ND (0.0172)		8260B Low		1	01/31/18 16:01	C8A0392	CA83109
Xylenes (Total)	ND (0.0172)		8260B Low		1	01/31/18 16:01		[CALC]

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*91 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*91 %*		*70-130*
Surrogate: Dibromofluoromethane	*91 %*		*70-130*
Surrogate: Toluene-d8	*101 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Pond
Date Sampled: 01/23/18 13:00
Percent Solids: 56
Initial Volume: 30.3
Final Volume: 2
Extraction Method: 3540C

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-01
Sample Matrix: Soil
Units: mg/kg dry
Analyst: TJ
Prepared: 1/31/18 16:00

8082 Polychlorinated Biphenyls (PCB) / Congeners

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
BZ#8	ND (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#18	ND (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#28 [2C]	**LC, P 0.00228** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#44	ND (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#52 [2C]	**LC, P 0.00221** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#66	ND (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#101	**LC, P 0.0277** (0.00239)		8082		5	02/08/18 15:05	C8B0071	CA83105
BZ#105	ND (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#118	**0.00440** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#128	**0.00108** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#138	**LC, P 0.00524** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#153	**0.00500** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#170	**LC, P 0.00246** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#180	**0.00435** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#187	**LC, P 0.00286** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#195	ND (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#206 [2C]	**0.00095** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105
BZ#209 [2C]	**LC, P 0.00124** (0.00048)		8082		1	02/07/18 4:06	C8B0071	CA83105

	%Recovery	Qualifier	Limits
Surrogate: Tetrachloro-m-xylene	*77 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*80 %*		*30-150*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Pond
Date Sampled: 01/23/18 13:00

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-01
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								
Percent Moisture	**44** (1)		2540G		1	CCP	01/30/18 18:06	%	CA83028
Total Organic Carbon (Average)	**40300** (92.7)		LK		1	NAR	02/02/18 21:33	mg/kg	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Pond
Date Sampled: 01/23/18 13:00
Percent Solids: 56
Initial Volume: 24.1
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-01
Sample Matrix: Soil
Units: mg/kg dry

Prepared: 2/1/18 15:02

MADEP-EPH Extractable Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
C9-C18 Aliphatics1	ND (22.2)		MADEP-EPH		1	ZLC	02/01/18 19:00	C8B0005	CB80106
C19-C36 Aliphatics1	**26.9** (22.2)		MADEP-EPH		1	ZLC	02/01/18 19:00	C8B0005	CB80106
C11-C22 Unadjusted Aromatics1	**26.6** (22.2)		EPH8270		1	ZLC	02/02/18 3:06	C8B0006	CB80106
C11-C22 Aromatics1,2	ND (22.8)		EPH8270			VSC	02/02/18 17:02		[CALC]
2-Methylnaphthalene	ND (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Acenaphthene	ND (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Naphthalene	**0.039** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Phenanthrene	**0.493** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Acenaphthylene	**0.116** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Anthracene	**0.120** (0.015)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Benzo(a)anthracene	**0.399** (0.015)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Benzo(a)pyrene	**0.465** (0.015)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Benzo(b)fluoranthene	**0.560** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Benzo(g,h,i)perylene	**0.321** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Benzo(k)fluoranthene	**0.176** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Chrysene	**0.456** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Dibenzo(a,h)Anthracene	**0.080** (0.015)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Fluoranthene	**0.986** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Fluorene	**0.036** (0.015)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Indeno(1,2,3-cd)Pyrene	**0.357** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106
Pyrene	**0.808** (0.037)		EPH8270SIM		1	VSC	02/02/18 17:02	C8B0029	CB80106

	%Recovery	Qualifier	Limits
Surrogate: 1-Chlorooctadecane	*75 %*		*40-140*
Surrogate: 2-Bromonaphthalene	*105 %*		*40-140*
Surrogate: 2-Fluorobiphenyl	*93 %*		*40-140*
Surrogate: O-Terphenyl	*80 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Up
Date Sampled: 01/23/18 13:30
Percent Solids: 63
Initial Volume: 5.8
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-02
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1,2-Tetrachloroethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,1,1-Trichloroethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,1,2,2-Tetrachloroethane	ND (0.0027)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,1,2-Trichloroethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,1-Dichloroethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,1-Dichloroethene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,1-Dichloropropene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2,3-Trichlorobenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2,3-Trichloropropane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2,4-Trichlorobenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2,4-Trimethylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2-Dibromo-3-Chloropropane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2-Dibromoethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2-Dichlorobenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2-Dichloroethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,2-Dichloropropane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,3,5-Trimethylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,3-Dichlorobenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,3-Dichloropropane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,4-Dichlorobenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
1,4-Dioxane	ND (0.137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
2,2-Dichloropropane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
2-Butanone	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
2-Chlorotoluene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
2-Hexanone	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
4-Chlorotoluene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
4-Isopropyltoluene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
4-Methyl-2-Pentanone	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Acetone	**0.0233** (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Benzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Bromobenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Bromochloromethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Up
Date Sampled: 01/23/18 13:30
Percent Solids: 63
Initial Volume: 5.8
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-02
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Bromodichloromethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Bromoform	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Bromomethane	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Carbon Disulfide	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Carbon Tetrachloride	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Chlorobenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Chloroethane	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Chloroform	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Chloromethane	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
cis-1,2-Dichloroethene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
cis-1,3-Dichloropropene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Dibromochloromethane	ND (0.0027)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Dibromomethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Dichlorodifluoromethane	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Diethyl Ether	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Di-isopropyl ether	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Ethyl tertiary-butyl ether	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Ethylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Hexachlorobutadiene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Isopropylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Methyl tert-Butyl Ether	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Methylene Chloride	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Naphthalene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
n-Butylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
n-Propylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
sec-Butylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Styrene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
tert-Butylbenzene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Tertiary-amyl methyl ether	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Tetrachloroethene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Tetrahydrofuran	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Toluene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Up
Date Sampled: 01/23/18 13:30
Percent Solids: 63
Initial Volume: 5.8
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-02
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
trans-1,2-Dichloroethene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
trans-1,3-Dichloropropene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Trichloroethene	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Trichlorofluoromethane	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Vinyl Chloride	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Xylene O	ND (0.0069)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Xylene P,M	ND (0.0137)		8260B Low		1	01/31/18 16:26	C8A0392	CA83109
Xylenes (Total)	ND (0.0137)		8260B Low		1	01/31/18 16:26		[CALC]

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*90 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*92 %*		*70-130*
Surrogate: Dibromofluoromethane	*91 %*		*70-130*
Surrogate: Toluene-d8	*101 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Up
Date Sampled: 01/23/18 13:30
Percent Solids: 63
Initial Volume: 30.8
Final Volume: 2
Extraction Method: 3540C

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-02
Sample Matrix: Soil
Units: mg/kg dry
Analyst: TJ
Prepared: 1/31/18 16:00

8082 Polychlorinated Biphenyls (PCB) / Congeners

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
BZ#8	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#18	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#28	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#44	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#52	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#66	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#101	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#105	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#118	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#128	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#138	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#153	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#170	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#180 [2C]	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#187	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#195	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#206	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105
BZ#209	ND (0.00042)		8082		1	02/07/18 4:40	C8B0071	CA83105

	%Recovery	Qualifier	Limits
Surrogate: Tetrachloro-m-xylene	*75 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*78 %*		*30-150*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Up
Date Sampled: 01/23/18 13:30

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-02
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								
Percent Moisture	**37** (1)		2540G		1	CCP	01/30/18 18:06	%	CA83028
Total Organic Carbon (Average)	**32800** (81.4)		LK		1	NAR	02/02/18 22:23	mg/kg	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Up
Date Sampled: 01/23/18 13:30
Percent Solids: 63
Initial Volume: 24.9
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-02
Sample Matrix: Soil
Units: mg/kg dry

Prepared: 2/1/18 15:02

MADEP-EPH Extractable Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
C9-C18 Aliphatics1	ND (24.0)		MADEP-EPH		1	ZLC	02/01/18 19:48	C8B0005	CB80106
C19-C36 Aliphatics1	ND (24.0)		MADEP-EPH		1	ZLC	02/01/18 19:48	C8B0005	CB80106
C11-C22 Unadjusted Aromatics1	ND (24.0)		EPH8270		1	ZLC	02/02/18 3:43	C8B0006	CB80106
C11-C22 Aromatics1,2	ND (24.5)		EPH8270			VSC	02/02/18 17:50		[CALC]
2-Methylnaphthalene	ND (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Acenaphthene	ND (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Naphthalene	ND (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Phenanthrene	**0.062** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Acenaphthylene	ND (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Anthracene	**0.016** (0.013)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Benzo(a)anthracene	**0.112** (0.013)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Benzo(a)pyrene	**0.156** (0.013)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Benzo(b)fluoranthene	**0.205** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Benzo(g,h,i)perylene	**0.111** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Benzo(k)fluoranthene	**0.061** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Chrysene	**0.168** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Dibenzo(a,h)Anthracene	**0.026** (0.013)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Fluoranthene	**0.277** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Fluorene	ND (0.013)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Indeno(1,2,3-cd)Pyrene	**0.134** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106
Pyrene	**0.221** (0.032)		EPH8270SIM		1	VSC	02/02/18 17:50	C8B0029	CB80106

	%Recovery	Qualifier	Limits
Surrogate: 1-Chlorooctadecane	*67 %*		*40-140*
Surrogate: 2-Bromonaphthalene	*113 %*		*40-140*
Surrogate: 2-Fluorobiphenyl	*98 %*		*40-140*
Surrogate: O-Terphenyl	*85 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Down
Date Sampled: 01/23/18 14:00
Percent Solids: 63
Initial Volume: 5.3
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-03
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1,2-Tetrachloroethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,1,1-Trichloroethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,1,2,2-Tetrachloroethane	ND (0.0030)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,1,2-Trichloroethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,1-Dichloroethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,1-Dichloroethene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,1-Dichloropropene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2,3-Trichlorobenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2,3-Trichloropropane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2,4-Trichlorobenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2,4-Trimethylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2-Dibromo-3-Chloropropane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2-Dibromoethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2-Dichlorobenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2-Dichloroethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,2-Dichloropropane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,3,5-Trimethylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,3-Dichlorobenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,3-Dichloropropane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,4-Dichlorobenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
1,4-Dioxane	ND (0.149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
2,2-Dichloropropane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
2-Butanone	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
2-Chlorotoluene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
2-Hexanone	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
4-Chlorotoluene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
4-Isopropyltoluene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
4-Methyl-2-Pentanone	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Acetone	**0.0340** (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Benzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Bromobenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Bromochloromethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Down
Date Sampled: 01/23/18 14:00
Percent Solids: 63
Initial Volume: 5.3
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-03
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Bromodichloromethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Bromoform	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Bromomethane	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Carbon Disulfide	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Carbon Tetrachloride	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Chlorobenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Chloroethane	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Chloroform	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Chloromethane	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
cis-1,2-Dichloroethene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
cis-1,3-Dichloropropene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Dibromochloromethane	ND (0.0030)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Dibromomethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Dichlorodifluoromethane	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Diethyl Ether	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Di-isopropyl ether	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Ethyl tertiary-butyl ether	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Ethylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Hexachlorobutadiene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Isopropylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Methyl tert-Butyl Ether	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Methylene Chloride	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Naphthalene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
n-Butylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
n-Propylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
sec-Butylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Styrene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
tert-Butylbenzene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Tertiary-amyl methyl ether	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Tetrachloroethene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Tetrahydrofuran	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Toluene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Down
Date Sampled: 01/23/18 14:00
Percent Solids: 63
Initial Volume: 5.3
Final Volume: 10
Extraction Method: 5035

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-03
Sample Matrix: Soil
Units: mg/kg dry
Analyst: MEK

5035/8260B Volatile Organic Compounds / Low Level

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
trans-1,2-Dichloroethene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
trans-1,3-Dichloropropene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Trichloroethene	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Trichlorofluoromethane	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Vinyl Chloride	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Xylene O	ND (0.0075)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Xylene P,M	ND (0.0149)		8260B Low		1	01/31/18 16:52	C8A0392	CA83109
Xylenes (Total)	ND (0.0149)		8260B Low		1	01/31/18 16:52		[CALC]

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*95 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*92 %*		*70-130*
Surrogate: Dibromofluoromethane	*93 %*		*70-130*
Surrogate: Toluene-d8	*100 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Down
Date Sampled: 01/23/18 14:00
Percent Solids: 63
Initial Volume: 30.1
Final Volume: 2
Extraction Method: 3540C

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-03
Sample Matrix: Soil
Units: mg/kg dry
Analyst: TJ
Prepared: 1/31/18 16:00

8082 Polychlorinated Biphenyls (PCB) / Congeners

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
BZ#8	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#18	**LC, P 0.00453** (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#28	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#44	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#52	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#66	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#101 [2C]	**0.0101** (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#105	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#118	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#128	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#138	**LC, P 0.00162** (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#153	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#170	**LC, P 0.00283** (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#180	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#187	**0.00084** (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#195	ND (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#206 [2C]	**0.00104** (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105
BZ#209 [2C]	**LC, P 0.00095** (0.00043)		8082		1	02/07/18 5:15	C8B0071	CA83105

	%Recovery	Qualifier	Limits
Surrogate: Tetrachloro-m-xylene	*68 %*		*30-150*
Surrogate: Tetrachloro-m-xylene [2C]	*89 %*		*30-150*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Down
Date Sampled: 01/23/18 14:00

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-03
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Grain Size	**See Attached** (N/A)								
Percent Moisture	**37** (1)		2540G		1	CCP	01/30/18 18:06	%	CA83028
Total Organic Carbon (Average)	**28100** (88.4)		LK		1	NAR	02/02/18 22:39	mg/kg	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Down
Date Sampled: 01/23/18 14:00
Percent Solids: 63
Initial Volume: 24.4
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-03
Sample Matrix: Soil
Units: mg/kg dry

Prepared: 2/1/18 15:02

MADEP-EPH Extractable Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
C9-C18 Aliphatics1	ND (24.3)		MADEP-EPH		1	ZLC	02/01/18 20:35	C8B0005	CB80106
C19-C36 Aliphatics1	**32.1** (24.3)		MADEP-EPH		1	ZLC	02/01/18 20:35	C8B0005	CB80106
C11-C22 Unadjusted Aromatics1	**112** (24.3)		EPH8270		1	ZLC	02/02/18 4:19	C8B0006	CB80106
C11-C22 Aromatics1,2	**85.5** (25.4)		EPH8270			VSC	02/05/18 14:33		[CALC]
2-Methylnaphthalene	**0.058** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Acenaphthene	**0.046** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Naphthalene	**0.095** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Phenanthrene	**1.26** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Acenaphthylene	**0.516** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Anthracene	**0.677** (0.013)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Benzo(a)anthracene	**2.52** (0.013)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Benzo(a)pyrene	**2.10** (0.013)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Benzo(b)fluoranthene	**2.67** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Benzo(g,h,i)perylene	**1.19** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Benzo(k)fluoranthene	**0.735** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Chrysene	**2.27** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Dibenzo(a,h)Anthracene	**0.414** (0.013)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Fluoranthene	**6.23** (0.324)		EPH8270SIM		10	VSC	02/05/18 14:33	C8B0029	CB80106
Fluorene	**0.029** (0.013)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Indeno(1,2,3-cd)Pyrene	**1.44** (0.032)		EPH8270SIM		1	VSC	02/02/18 18:39	C8B0029	CB80106
Pyrene	**4.50** (0.324)		EPH8270SIM		10	VSC	02/05/18 14:33	C8B0029	CB80106

	%Recovery	*Qualifier*	*Limits*
Surrogate: 1-Chlorooctadecane	*70 %*		*40-140*
Surrogate: 2-Bromonaphthalene	*101 %*		*40-140*
Surrogate: 2-Fluorobiphenyl	*91 %*		*40-140*
Surrogate: O-Terphenyl	*82 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Pond - air dried
Date Sampled: 01/23/18 13:00
Percent Solids: 100

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-04
Sample Matrix: Soil
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**13.1** (1.95)		6010C		2	KJK	02/02/18 14:35	5.12	100	CB80131
Cadmium	**0.67** (0.39)		6010C		2	KJK	02/02/18 14:35	5.12	100	CB80131
Chromium	**15.3** (0.78)		6010C		2	KJK	02/02/18 14:35	5.12	100	CB80131
Copper	**23.9** (1.95)		6010C		2	KJK	02/02/18 14:35	5.12	100	CB80131
Lead	**167** (3.91)		6010C		2	KJK	02/02/18 14:35	5.12	100	CB80131
Mercury	**0.441** (0.049)		7471B		5	BJV	02/02/18 14:59	2.01	40	CB80133
Nickel	**8.50** (1.95)		6010C		2	KJK	02/02/18 14:35	5.12	100	CB80131
Zinc	**129** (1.95)		6010C		2	KJK	02/02/18 14:35	5.12	100	CB80131

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Up - air dried
Date Sampled: 01/23/18 13:30
Percent Solids: 100

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-05
Sample Matrix: Soil
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**5.02** (0.98)		6010C		1	KJK	02/02/18 14:27	5.09	100	CB80131
Cadmium	**0.21** (0.20)		6010C		1	KJK	02/02/18 14:27	5.09	100	CB80131
Chromium	**7.92** (0.39)		6010C		1	KJK	02/02/18 14:27	5.09	100	CB80131
Copper	**5.55** (0.98)		6010C		1	KJK	02/02/18 14:27	5.09	100	CB80131
Lead	**29.2** (1.96)		6010C		1	KJK	02/02/18 14:27	5.09	100	CB80131
Mercury	**0.113** (0.008)		7471B		1	BJV	02/02/18 14:24	2.44	40	CB80133
Nickel	**3.64** (0.98)		6010C		1	KJK	02/02/18 14:27	5.09	100	CB80131
Zinc	**39.2** (0.98)		6010C		1	KJK	02/02/18 14:27	5.09	100	CB80131

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ
Client Sample ID: Stream Down - air dried
Date Sampled: 01/23/18 14:00
Percent Solids: 100

ESS Laboratory Work Order: 1801552
ESS Laboratory Sample ID: 1801552-06
Sample Matrix: Soil
Units: mg/kg dry

Extraction Method: 3050B

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Arsenic	**9.17** (1.00)		6010C		1	KJK	02/02/18 14:32	5.02	100	CB80131
Cadmium	**0.35** (0.20)		6010C		1	KJK	02/02/18 14:32	5.02	100	CB80131
Chromium	**8.35** (0.40)		6010C		1	KJK	02/02/18 14:32	5.02	100	CB80131
Copper	**12.2** (1.00)		6010C		1	KJK	02/02/18 14:32	5.02	100	CB80131
Lead	**90.6** (1.99)		6010C		1	KJK	02/02/18 14:32	5.02	100	CB80131
Mercury	**0.262** (0.042)		7471B		5	BJV	02/02/18 15:03	2.37	40	CB80133
Nickel	**3.64** (1.00)		6010C		1	KJK	02/02/18 14:32	5.02	100	CB80131
Zinc	**70.8** (1.00)		6010C		1	KJK	02/02/18 14:32	5.02	100	CB80131

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Total Metals										
Batch CB80131 - 3050B										
Blank										
Arsenic	ND	2.50	mg/kg wet							
Chromium	ND	1.00	mg/kg wet							
Copper	ND	2.50	mg/kg wet							
Lead	ND	5.00	mg/kg wet							
Nickel	ND	2.50	mg/kg wet							
Zinc	ND	2.50	mg/kg wet							
LCS										
Arsenic	106	7.04	mg/kg wet	123.0		86	80-120			
Cadmium	199	1.41	mg/kg wet	224.0		89	80-120			
Chromium	156	2.82	mg/kg wet	179.0		87	80-120			
Copper	69.7	7.04	mg/kg wet	78.90		88	80-120			
Lead	125	14.1	mg/kg wet	145.0		86	80-120			
Nickel	117	7.04	mg/kg wet	143.0		82	80-120			
LCS										
Zinc	202	7.25	mg/kg wet	256.0		79	71-102			
LCS Dup										
Arsenic	114	7.14	mg/kg wet	123.0		93	80-120	8	20	
Cadmium	186	1.43	mg/kg wet	224.0		83	80-120	7	20	
Chromium	164	2.86	mg/kg wet	179.0		92	80-120	5	20	
Copper	74.5	7.14	mg/kg wet	78.90		94	80-120	7	20	
Lead	131	14.3	mg/kg wet	145.0		90	80-120	5	20	
Nickel	123	7.14	mg/kg wet	143.0		86	80-120	5	20	
LCS Dup										
Zinc	197	7.04	mg/kg wet	256.0		77	71-102	3	20	
Batch CB80133 - 7471A										
Blank										
Mercury	ND	0.033	mg/kg wet							
LCS										
Mercury	11.3	1.48	mg/kg wet	18.60		61	41-94			
LCS Dup										
Mercury	11.7	1.55	mg/kg wet	18.60		63	41-94	3	20	
Reference										
Mercury	0.955	0.152	mg/kg wet	1000		0.1	0-200			
5035/8260B Volatile Organic Compounds / Low Level										
Batch CA83109 - 5035										
Blank										
1,1,1,2-Tetrachloroethane	ND	0.0050	mg/kg wet							
1,1,1-Trichloroethane	ND	0.0050	mg/kg wet							
1,1,2,2-Tetrachloroethane	ND	0.0020	mg/kg wet							
1,1,2-Trichloroethane	ND	0.0050	mg/kg wet							

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
5035/8260B Volatile Organic Compounds / Low Level										
Batch CA83109 - 5035										
1,1-Dichloroethane	ND	0.0050	mg/kg wet							
1,1-Dichloroethene	ND	0.0050	mg/kg wet							
1,1-Dichloropropene	ND	0.0050	mg/kg wet							
1,2,3-Trichlorobenzene	ND	0.0050	mg/kg wet							
1,2,3-Trichloropropane	ND	0.0050	mg/kg wet							
1,2,4-Trichlorobenzene	ND	0.0050	mg/kg wet							
1,2,4-Trimethylbenzene	ND	0.0050	mg/kg wet							
1,2-Dibromo-3-Chloropropane	ND	0.0050	mg/kg wet							
1,2-Dibromoethane	ND	0.0050	mg/kg wet							
1,2-Dichlorobenzene	ND	0.0050	mg/kg wet							
1,2-Dichloroethane	ND	0.0050	mg/kg wet							
1,2-Dichloropropane	ND	0.0050	mg/kg wet							
1,3,5-Trimethylbenzene	ND	0.0050	mg/kg wet							
1,3-Dichlorobenzene	ND	0.0050	mg/kg wet							
1,3-Dichloropropane	ND	0.0050	mg/kg wet							
1,4-Dichlorobenzene	ND	0.0050	mg/kg wet							
1,4-Dioxane	ND	0.100	mg/kg wet							
2,2-Dichloropropane	ND	0.0050	mg/kg wet							
2-Butanone	ND	0.0100	mg/kg wet							
2-Chlorotoluene	ND	0.0050	mg/kg wet							
2-Hexanone	ND	0.0100	mg/kg wet							
4-Chlorotoluene	ND	0.0050	mg/kg wet							
4-Isopropyltoluene	ND	0.0050	mg/kg wet							
4-Methyl-2-Pentanone	ND	0.0100	mg/kg wet							
Acetone	ND	0.0100	mg/kg wet							
Benzene	ND	0.0050	mg/kg wet							
Bromobenzene	ND	0.0050	mg/kg wet							
Bromochloromethane	ND	0.0050	mg/kg wet							
Bromodichloromethane	ND	0.0050	mg/kg wet							
Bromoform	ND	0.0050	mg/kg wet							
Bromomethane	ND	0.0100	mg/kg wet							
Carbon Disulfide	ND	0.0050	mg/kg wet							
Carbon Tetrachloride	ND	0.0050	mg/kg wet							
Chlorobenzene	ND	0.0050	mg/kg wet							
Chloroethane	ND	0.0100	mg/kg wet							
Chloroform	ND	0.0050	mg/kg wet							
Chloromethane	ND	0.0100	mg/kg wet							
cis-1,2-Dichloroethene	ND	0.0050	mg/kg wet							
cis-1,3-Dichloropropene	ND	0.0050	mg/kg wet							
Dibromochloromethane	ND	0.0020	mg/kg wet							
Dibromomethane	ND	0.0050	mg/kg wet							
Dichlorodifluoromethane	ND	0.0100	mg/kg wet							
Diethyl Ether	ND	0.0050	mg/kg wet							
Di-isopropyl ether	ND	0.0050	mg/kg wet							
Ethyl tertiary-butyl ether	ND	0.0050	mg/kg wet							

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
5035/8260B Volatile Organic Compounds / Low Level										
Batch CA83109 - 5035										
Ethylbenzene	ND	0.0050	mg/kg wet							
Hexachlorobutadiene	ND	0.0050	mg/kg wet							
Isopropylbenzene	ND	0.0050	mg/kg wet							
Methyl tert-Butyl Ether	ND	0.0050	mg/kg wet							
Methylene Chloride	ND	0.0100	mg/kg wet							
Naphthalene	ND	0.0050	mg/kg wet							
n-Butylbenzene	ND	0.0050	mg/kg wet							
n-Propylbenzene	ND	0.0050	mg/kg wet							
sec-Butylbenzene	ND	0.0050	mg/kg wet							
Styrene	ND	0.0050	mg/kg wet							
tert-Butylbenzene	ND	0.0050	mg/kg wet							
Tertiary-amyl methyl ether	ND	0.0050	mg/kg wet							
Tetrachloroethene	ND	0.0050	mg/kg wet							
Tetrahydrofuran	ND	0.0050	mg/kg wet							
Toluene	ND	0.0050	mg/kg wet							
trans-1,2-Dichloroethene	ND	0.0050	mg/kg wet							
trans-1,3-Dichloropropene	ND	0.0050	mg/kg wet							
Trichloroethene	ND	0.0050	mg/kg wet							
Trichlorofluoromethane	ND	0.0050	mg/kg wet							
Vinyl Chloride	ND	0.0100	mg/kg wet							
Xylene O	ND	0.0050	mg/kg wet							
Xylene P,M	ND	0.0100	mg/kg wet							
Xylenes (Total)	ND	0.0100	mg/kg wet							
Surrogate: 1,2-Dichloroethane-d4	*0.0451*		mg/kg wet	*0.05000*		*90*	*70-130*			
Surrogate: 4-Bromofluorobenzene	*0.0467*		mg/kg wet	*0.05000*		*93*	*70-130*			
Surrogate: Dibromofluoromethane	*0.0452*		mg/kg wet	*0.05000*		*90*	*70-130*			
Surrogate: Toluene-d8	*0.0505*		mg/kg wet	*0.05000*		*101*	*70-130*			
LCS										
1,1,1,2-Tetrachloroethane	0.0494	0.0050	mg/kg wet	0.05000		99	70-130			
1,1,1-Trichloroethane	0.0531	0.0050	mg/kg wet	0.05000		106	70-130			
1,1,2,2-Tetrachloroethane	0.0583	0.0020	mg/kg wet	0.05000		117	70-130			
1,1,2-Trichloroethane	0.0566	0.0050	mg/kg wet	0.05000		113	70-130			
1,1-Dichloroethane	0.0519	0.0050	mg/kg wet	0.05000		104	70-130			
1,1-Dichloroethene	0.0538	0.0050	mg/kg wet	0.05000		108	70-130			
1,1-Dichloropropene	0.0543	0.0050	mg/kg wet	0.05000		109	70-130			
1,2,3-Trichlorobenzene	0.0551	0.0050	mg/kg wet	0.05000		110	70-130			
1,2,3-Trichloropropane	0.0552	0.0050	mg/kg wet	0.05000		110	70-130			
1,2,4-Trichlorobenzene	0.0544	0.0050	mg/kg wet	0.05000		109	70-130			
1,2,4-Trimethylbenzene	0.0550	0.0050	mg/kg wet	0.05000		110	70-130			
1,2-Dibromo-3-Chloropropane	0.0490	0.0050	mg/kg wet	0.05000		98	70-130			
1,2-Dibromoethane	0.0565	0.0050	mg/kg wet	0.05000		113	70-130			
1,2-Dichlorobenzene	0.0539	0.0050	mg/kg wet	0.05000		108	70-130			
1,2-Dichloroethane	0.0549	0.0050	mg/kg wet	0.05000		110	70-130			
1,2-Dichloropropane	0.0551	0.0050	mg/kg wet	0.05000		110	70-130			
1,3,5-Trimethylbenzene	0.0538	0.0050	mg/kg wet	0.05000		108	70-130			

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
5035/8260B Volatile Organic Compounds / Low Level										
Batch CA83109 - 5035										
1,3-Dichlorobenzene	0.0525	0.0050	mg/kg wet	0.05000		105	70-130			
1,3-Dichloropropane	0.0589	0.0050	mg/kg wet	0.05000		118	70-130			
1,4-Dichlorobenzene	0.0539	0.0050	mg/kg wet	0.05000		108	70-130			
1,4-Dioxane	1.02	0.100	mg/kg wet	1.000		102	70-130			
2,2-Dichloropropane	0.0505	0.0050	mg/kg wet	0.05000		101	70-130			
2-Butanone	0.286	0.0100	mg/kg wet	0.2500		114	70-130			
2-Chlorotoluene	0.0534	0.0050	mg/kg wet	0.05000		107	70-130			
2-Hexanone	0.280	0.0100	mg/kg wet	0.2500		112	70-130			
4-Chlorotoluene	0.0536	0.0050	mg/kg wet	0.05000		107	70-130			
4-Isopropyltoluene	0.0528	0.0050	mg/kg wet	0.05000		106	70-130			
4-Methyl-2-Pentanone	0.265	0.0100	mg/kg wet	0.2500		106	70-130			
Acetone	0.274	0.0100	mg/kg wet	0.2500		110	70-130			
Benzene	0.0540	0.0050	mg/kg wet	0.05000		108	70-130			
Bromobenzene	0.0523	0.0050	mg/kg wet	0.05000		105	70-130			
Bromochloromethane	0.0536	0.0050	mg/kg wet	0.05000		107	70-130			
Bromodichloromethane	0.0492	0.0050	mg/kg wet	0.05000		98	70-130			
Bromoform	0.0474	0.0050	mg/kg wet	0.05000		95	70-130			
Bromomethane	0.0544	0.0100	mg/kg wet	0.05000		109	70-130			
Carbon Disulfide	0.0564	0.0050	mg/kg wet	0.05000		113	70-130			
Carbon Tetrachloride	0.0465	0.0050	mg/kg wet	0.05000		93	70-130			
Chlorobenzene	0.0539	0.0050	mg/kg wet	0.05000		108	70-130			
Chloroethane	0.0528	0.0100	mg/kg wet	0.05000		106	70-130			
Chloroform	0.0535	0.0050	mg/kg wet	0.05000		107	70-130			
Chloromethane	0.0557	0.0100	mg/kg wet	0.05000		111	70-130			
cis-1,2-Dichloroethene	0.0535	0.0050	mg/kg wet	0.05000		107	70-130			
cis-1,3-Dichloropropene	0.0486	0.0050	mg/kg wet	0.05000		97	70-130			
Dibromochloromethane	0.0499	0.0020	mg/kg wet	0.05000		100	70-130			
Dibromomethane	0.0544	0.0050	mg/kg wet	0.05000		109	70-130			
Dichlorodifluoromethane	0.0522	0.0100	mg/kg wet	0.05000		104	70-130			
Diethyl Ether	0.0587	0.0050	mg/kg wet	0.05000		117	70-130			
Di-isopropyl ether	0.0557	0.0050	mg/kg wet	0.05000		111	70-130			
Ethyl tertiary-butyl ether	0.0486	0.0050	mg/kg wet	0.05000		97	70-130			
Ethylbenzene	0.0546	0.0050	mg/kg wet	0.05000		109	70-130			
Hexachlorobutadiene	0.0528	0.0050	mg/kg wet	0.05000		106	70-130			
Isopropylbenzene	0.0507	0.0050	mg/kg wet	0.05000		101	70-130			
Methyl tert-Butyl Ether	0.0553	0.0050	mg/kg wet	0.05000		111	70-130			
Methylene Chloride	0.0514	0.0100	mg/kg wet	0.05000		103	70-130			
Naphthalene	0.0500	0.0050	mg/kg wet	0.05000		100	70-130			
n-Butylbenzene	0.0544	0.0050	mg/kg wet	0.05000		109	70-130			
n-Propylbenzene	0.0542	0.0050	mg/kg wet	0.05000		108	70-130			
sec-Butylbenzene	0.0528	0.0050	mg/kg wet	0.05000		106	70-130			
Styrene	0.0499	0.0050	mg/kg wet	0.05000		100	70-130			
tert-Butylbenzene	0.0535	0.0050	mg/kg wet	0.05000		107	70-130			
Tertiary-amyl methyl ether	0.0463	0.0050	mg/kg wet	0.05000		93	70-130			
Tetrachloroethene	0.0506	0.0050	mg/kg wet	0.05000		101	70-130			

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
5035/8260B Volatile Organic Compounds / Low Level										
Batch CA83109 - 5035										
Tetrahydrofuran	0.0516	0.0050	mg/kg wet	0.05000		103	70-130			
Toluene	0.0542	0.0050	mg/kg wet	0.05000		108	70-130			
trans-1,2-Dichloroethene	0.0533	0.0050	mg/kg wet	0.05000		107	70-130			
trans-1,3-Dichloropropene	0.0477	0.0050	mg/kg wet	0.05000		95	70-130			
Trichloroethene	0.0530	0.0050	mg/kg wet	0.05000		106	70-130			
Trichlorofluoromethane	0.0519	0.0050	mg/kg wet	0.05000		104	70-130			
Vinyl Chloride	0.0570	0.0100	mg/kg wet	0.05000		114	70-130			
Xylene O	0.0562	0.0050	mg/kg wet	0.05000		112	70-130			
Xylene P,M	0.111	0.0100	mg/kg wet	0.1000		111	70-130			
Xylenes (Total)	0.168	0.0100	mg/kg wet							
Surrogate: 1,2-Dichloroethane-d4	*0.0491*		mg/kg wet	*0.05000*		*98*	*70-130*			
Surrogate: 4-Bromofluorobenzene	*0.0511*		mg/kg wet	*0.05000*		*102*	*70-130*			
Surrogate: Dibromofluoromethane	*0.0502*		mg/kg wet	*0.05000*		*100*	*70-130*			
Surrogate: Toluene-d8	*0.0512*		mg/kg wet	*0.05000*		*102*	*70-130*			
LCS Dup										
1,1,1,2-Tetrachloroethane	0.0486	0.0050	mg/kg wet	0.05000		97	70-130	2	20	
1,1,1-Trichloroethane	0.0531	0.0050	mg/kg wet	0.05000		106	70-130	0.1	20	
1,1,2,2-Tetrachloroethane	0.0587	0.0020	mg/kg wet	0.05000		117	70-130	0.7	20	
1,1,2-Trichloroethane	0.0554	0.0050	mg/kg wet	0.05000		111	70-130	2	20	
1,1-Dichloroethane	0.0516	0.0050	mg/kg wet	0.05000		103	70-130	0.7	20	
1,1-Dichloroethene	0.0541	0.0050	mg/kg wet	0.05000		108	70-130	0.6	20	
1,1-Dichloropropene	0.0544	0.0050	mg/kg wet	0.05000		109	70-130	0.3	20	
1,2,3-Trichlorobenzene	0.0543	0.0050	mg/kg wet	0.05000		109	70-130	1	20	
1,2,3-Trichloropropane	0.0555	0.0050	mg/kg wet	0.05000		111	70-130	0.6	20	
1,2,4-Trichlorobenzene	0.0533	0.0050	mg/kg wet	0.05000		107	70-130	2	20	
1,2,4-Trimethylbenzene	0.0550	0.0050	mg/kg wet	0.05000		110	70-130	0.1	20	
1,2-Dibromo-3-Chloropropane	0.0500	0.0050	mg/kg wet	0.05000		100	70-130	2	20	
1,2-Dibromoethane	0.0544	0.0050	mg/kg wet	0.05000		109	70-130	4	20	
1,2-Dichlorobenzene	0.0537	0.0050	mg/kg wet	0.05000		107	70-130	0.3	20	
1,2-Dichloroethane	0.0541	0.0050	mg/kg wet	0.05000		108	70-130	1	20	
1,2-Dichloropropane	0.0555	0.0050	mg/kg wet	0.05000		111	70-130	0.7	20	
1,3,5-Trimethylbenzene	0.0542	0.0050	mg/kg wet	0.05000		108	70-130	0.6	20	
1,3-Dichlorobenzene	0.0521	0.0050	mg/kg wet	0.05000		104	70-130	0.8	20	
1,3-Dichloropropane	0.0569	0.0050	mg/kg wet	0.05000		114	70-130	3	20	
1,4-Dichlorobenzene	0.0538	0.0050	mg/kg wet	0.05000		108	70-130	0.3	20	
1,4-Dioxane	1.02	0.100	mg/kg wet	1.000		102	70-130	0.2	20	
2,2-Dichloropropane	0.0503	0.0050	mg/kg wet	0.05000		101	70-130	0.5	20	
2-Butanone	0.284	0.0100	mg/kg wet	0.2500		113	70-130	0.7	20	
2-Chlorotoluene	0.0535	0.0050	mg/kg wet	0.05000		107	70-130	0.3	20	
2-Hexanone	0.271	0.0100	mg/kg wet	0.2500		108	70-130	3	20	
4-Chlorotoluene	0.0539	0.0050	mg/kg wet	0.05000		108	70-130	0.6	20	
4-Isopropyltoluene	0.0526	0.0050	mg/kg wet	0.05000		105	70-130	0.4	20	
4-Methyl-2-Pentanone	0.263	0.0100	mg/kg wet	0.2500		105	70-130	1	20	
Acetone	0.273	0.0100	mg/kg wet	0.2500		109	70-130	0.5	20	
Benzene	0.0535	0.0050	mg/kg wet	0.05000		107	70-130	0.8	20	

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
5035/8260B Volatile Organic Compounds / Low Level										
Batch CA83109 - 5035										
Bromobenzene	0.0531	0.0050	mg/kg wet	0.05000		106	70-130	1	20	
Bromochloromethane	0.0529	0.0050	mg/kg wet	0.05000		106	70-130	1	20	
Bromodichloromethane	0.0487	0.0050	mg/kg wet	0.05000		97	70-130	1	20	
Bromoform	0.0468	0.0050	mg/kg wet	0.05000		94	70-130	1	20	
Bromomethane	0.0532	0.0100	mg/kg wet	0.05000		106	70-130	2	20	
Carbon Disulfide	0.0563	0.0050	mg/kg wet	0.05000		113	70-130	0.2	20	
Carbon Tetrachloride	0.0464	0.0050	mg/kg wet	0.05000		93	70-130	0.2	20	
Chlorobenzene	0.0520	0.0050	mg/kg wet	0.05000		104	70-130	4	20	
Chloroethane	0.0527	0.0100	mg/kg wet	0.05000		105	70-130	0.2	20	
Chloroform	0.0529	0.0050	mg/kg wet	0.05000		106	70-130	1	20	
Chloromethane	0.0542	0.0100	mg/kg wet	0.05000		108	70-130	3	20	
cis-1,2-Dichloroethene	0.0532	0.0050	mg/kg wet	0.05000		106	70-130	0.6	20	
cis-1,3-Dichloropropene	0.0486	0.0050	mg/kg wet	0.05000		97	70-130	0.08	20	
Dibromochloromethane	0.0484	0.0020	mg/kg wet	0.05000		97	70-130	3	20	
Dibromomethane	0.0532	0.0050	mg/kg wet	0.05000		106	70-130	2	20	
Dichlorodifluoromethane	0.0513	0.0100	mg/kg wet	0.05000		103	70-130	2	20	
Diethyl Ether	0.0589	0.0050	mg/kg wet	0.05000		118	70-130	0.4	20	
Di-isopropyl ether	0.0557	0.0050	mg/kg wet	0.05000		111	70-130	0.07	20	
Ethyl tertiary-butyl ether	0.0484	0.0050	mg/kg wet	0.05000		97	70-130	0.6	20	
Ethylbenzene	0.0534	0.0050	mg/kg wet	0.05000		107	70-130	2	20	
Hexachlorobutadiene	0.0514	0.0050	mg/kg wet	0.05000		103	70-130	3	20	
Isopropylbenzene	0.0516	0.0050	mg/kg wet	0.05000		103	70-130	2	20	
Methyl tert-Butyl Ether	0.0552	0.0050	mg/kg wet	0.05000		110	70-130	0.2	20	
Methylene Chloride	0.0509	0.0100	mg/kg wet	0.05000		102	70-130	0.9	20	
Naphthalene	0.0509	0.0050	mg/kg wet	0.05000		102	70-130	2	20	
n-Butylbenzene	0.0541	0.0050	mg/kg wet	0.05000		108	70-130	0.5	20	
n-Propylbenzene	0.0548	0.0050	mg/kg wet	0.05000		110	70-130	1	20	
sec-Butylbenzene	0.0533	0.0050	mg/kg wet	0.05000		107	70-130	1	20	
Styrene	0.0489	0.0050	mg/kg wet	0.05000		98	70-130	2	20	
tert-Butylbenzene	0.0539	0.0050	mg/kg wet	0.05000		108	70-130	0.7	20	
Tertiary-amyl methyl ether	0.0461	0.0050	mg/kg wet	0.05000		92	70-130	0.4	20	
Tetrachloroethene	0.0490	0.0050	mg/kg wet	0.05000		98	70-130	3	20	
Tetrahydrofuran	0.0512	0.0050	mg/kg wet	0.05000		102	70-130	0.8	20	
Toluene	0.0533	0.0050	mg/kg wet	0.05000		107	70-130	2	20	
trans-1,2-Dichloroethene	0.0535	0.0050	mg/kg wet	0.05000		107	70-130	0.4	20	
trans-1,3-Dichloropropene	0.0479	0.0050	mg/kg wet	0.05000		96	70-130	0.5	20	
Trichloroethene	0.0520	0.0050	mg/kg wet	0.05000		104	70-130	2	20	
Trichlorofluoromethane	0.0514	0.0050	mg/kg wet	0.05000		103	70-130	0.9	20	
Vinyl Chloride	0.0554	0.0100	mg/kg wet	0.05000		111	70-130	3	20	
Xylene O	0.0550	0.0050	mg/kg wet	0.05000		110	70-130	2	20	
Xylene P,M	0.108	0.0100	mg/kg wet	0.1000		108	70-130	3	20	
Xylenes (Total)	0.163	0.0100	mg/kg wet							
Surrogate: 1,2-Dichloroethane-d4	*0.0489*		mg/kg wet	*0.05000*		*98*	*70-130*			
Surrogate: 4-Bromofluorobenzene	*0.0493*		mg/kg wet	*0.05000*		*99*	*70-130*			
Surrogate: Dibromofluoromethane	*0.0500*		mg/kg wet	*0.05000*		*100*	*70-130*			

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
5035/8260B Volatile Organic Compounds / Low Level										
Batch CA83109 - 5035										
Surrogate: Toluene-d8	*0.0507*		mg/kg wet	*0.05000*		*101*	*70-130*			
8082 Polychlorinated Biphenyls (PCB) / Congeners										
Batch CA83105 - 3540C										
Blank										
BZ#101	ND	0.00027	mg/kg wet							
BZ#101 [2C]	ND	0.00027	mg/kg wet							
BZ#105	ND	0.00027	mg/kg wet							
BZ#105 [2C]	ND	0.00027	mg/kg wet							
BZ#118	ND	0.00027	mg/kg wet							
BZ#118 [2C]	ND	0.00027	mg/kg wet							
BZ#128	ND	0.00027	mg/kg wet							
BZ#128 [2C]	ND	0.00027	mg/kg wet							
BZ#138	ND	0.00027	mg/kg wet							
BZ#138 [2C]	ND	0.00027	mg/kg wet							
BZ#153	ND	0.00027	mg/kg wet							
BZ#153 [2C]	ND	0.00027	mg/kg wet							
BZ#170	ND	0.00027	mg/kg wet							
BZ#170 [2C]	ND	0.00027	mg/kg wet							
BZ#18	ND	0.00027	mg/kg wet							
BZ#18 [2C]	ND	0.00027	mg/kg wet							
BZ#180	ND	0.00027	mg/kg wet							
BZ#180 [2C]	ND	0.00027	mg/kg wet							
BZ#187	ND	0.00027	mg/kg wet							
BZ#187 [2C]	ND	0.00027	mg/kg wet							
BZ#195	ND	0.00027	mg/kg wet							
BZ#195 [2C]	ND	0.00027	mg/kg wet							
BZ#206	ND	0.00027	mg/kg wet							
BZ#206 [2C]	ND	0.00027	mg/kg wet							
BZ#209	ND	0.00027	mg/kg wet							
BZ#209 [2C]	ND	0.00027	mg/kg wet							
BZ#28	ND	0.00027	mg/kg wet							
BZ#28 [2C]	ND	0.00027	mg/kg wet							
BZ#44	ND	0.00027	mg/kg wet							
BZ#44 [2C]	ND	0.00027	mg/kg wet							
BZ#52	ND	0.00027	mg/kg wet							
BZ#52 [2C]	ND	0.00027	mg/kg wet							
BZ#66	ND	0.00027	mg/kg wet							
BZ#66 [2C]	ND	0.00027	mg/kg wet							
BZ#8	ND	0.00027	mg/kg wet							
BZ#8 [2C]	ND	0.00027	mg/kg wet							
Surrogate: Tetrachloro-m-xylene	*0.00269*		mg/kg wet	*0.003333*		*81*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.00263*		mg/kg wet	*0.003333*		*79*	*30-150*			

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082 Polychlorinated Biphenyls (PCB) / Congeners										
Batch CA83105 - 3540C										
LCS										
BZ#101	0.00314	0.00027	mg/kg wet	0.003333		94	40-140			
BZ#101 [2C]	0.00290	0.00027	mg/kg wet	0.003333		87	40-140			
BZ#105	0.00295	0.00027	mg/kg wet	0.003333		89	40-140			
BZ#105 [2C]	0.00300	0.00027	mg/kg wet	0.003333		90	40-140			
BZ#118	0.00308	0.00027	mg/kg wet	0.003333		93	40-140			
BZ#118 [2C]	0.00286	0.00027	mg/kg wet	0.003333		86	40-140			
BZ#128	0.00326	0.00027	mg/kg wet	0.003333		98	40-140			
BZ#128 [2C]	0.00306	0.00027	mg/kg wet	0.003333		92	40-140			
BZ#138	0.00309	0.00027	mg/kg wet	0.003333		93	40-140			
BZ#138 [2C]	0.00295	0.00027	mg/kg wet	0.003333		89	40-140			
BZ#153	0.00317	0.00027	mg/kg wet	0.003333		95	40-140			
BZ#153 [2C]	0.00291	0.00027	mg/kg wet	0.003333		87	40-140			
BZ#170	0.00317	0.00027	mg/kg wet	0.003333		95	40-140			
BZ#170 [2C]	0.00317	0.00027	mg/kg wet	0.003333		95	40-140			
BZ#18	0.00302	0.00027	mg/kg wet	0.003333		91	40-140			
BZ#18 [2C]	0.00278	0.00027	mg/kg wet	0.003333		83	40-140			
BZ#180	0.00323	0.00027	mg/kg wet	0.003333		97	40-140			
BZ#180 [2C]	0.00318	0.00027	mg/kg wet	0.003333		96	40-140			
BZ#187	0.00313	0.00027	mg/kg wet	0.003333		94	40-140			
BZ#187 [2C]	0.00292	0.00027	mg/kg wet	0.003333		88	40-140			
BZ#195	0.00324	0.00027	mg/kg wet	0.003333		97	40-140			
BZ#195 [2C]	0.00322	0.00027	mg/kg wet	0.003333		97	40-140			
BZ#206	0.00325	0.00027	mg/kg wet	0.003333		98	40-140			
BZ#206 [2C]	0.00314	0.00027	mg/kg wet	0.003333		94	40-140			
BZ#209	0.00323	0.00027	mg/kg wet	0.003333		97	40-140			
BZ#209 [2C]	0.00300	0.00027	mg/kg wet	0.003333		90	40-140			
BZ#28	0.00301	0.00027	mg/kg wet	0.003333		90	40-140			
BZ#28 [2C]	0.00274	0.00027	mg/kg wet	0.003333		82	40-140			
BZ#44	0.00276	0.00027	mg/kg wet	0.003333		83	40-140			
BZ#44 [2C]	0.00286	0.00027	mg/kg wet	0.003333		86	40-140			
BZ#52	0.00278	0.00027	mg/kg wet	0.003333		83	40-140			
BZ#52 [2C]	0.00282	0.00027	mg/kg wet	0.003333		85	40-140			
BZ#66	0.00320	0.00027	mg/kg wet	0.003333		96	40-140			
BZ#66 [2C]	0.00293	0.00027	mg/kg wet	0.003333		88	40-140			
BZ#8	0.00323	0.00027	mg/kg wet	0.003333		97	40-140			
BZ#8 [2C]	0.00337	0.00027	mg/kg wet	0.003333		101	40-140			
Surrogate: Tetrachloro-m-xylene	*0.00269*		mg/kg wet	*0.003333*		*81*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.00265*		mg/kg wet	*0.003333*		*79*	*30-150*			
LCS Dup										
BZ#101	0.00319	0.00027	mg/kg wet	0.003333		96	40-140	1	50	
BZ#101 [2C]	0.00282	0.00027	mg/kg wet	0.003333		84	40-140	3	50	
BZ#105	0.00301	0.00027	mg/kg wet	0.003333		90	40-140	2	50	
BZ#105 [2C]	0.00303	0.00027	mg/kg wet	0.003333		91	40-140	0.9	50	

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8082 Polychlorinated Biphenyls (PCB) / Congeners										
Batch CA83105 - 3540C										
BZ#118	0.00319	0.00027	mg/kg wet	0.003333		96	40-140	3	50	
BZ#118 [2C]	0.00285	0.00027	mg/kg wet	0.003333		85	40-140	0.3	50	
BZ#128	0.00330	0.00027	mg/kg wet	0.003333		99	40-140	1	50	
BZ#128 [2C]	0.00306	0.00027	mg/kg wet	0.003333		92	40-140	0.08	50	
BZ#138	0.00315	0.00027	mg/kg wet	0.003333		94	40-140	2	50	
BZ#138 [2C]	0.00294	0.00027	mg/kg wet	0.003333		88	40-140	0.3	50	
BZ#153	0.00320	0.00027	mg/kg wet	0.003333		96	40-140	0.9	50	
BZ#153 [2C]	0.00290	0.00027	mg/kg wet	0.003333		87	40-140	0.3	50	
BZ#170	0.00324	0.00027	mg/kg wet	0.003333		97	40-140	2	50	
BZ#170 [2C]	0.00320	0.00027	mg/kg wet	0.003333		96	40-140	0.9	50	
BZ#18	0.00302	0.00027	mg/kg wet	0.003333		91	40-140	0.1	50	
BZ#18 [2C]	0.00275	0.00027	mg/kg wet	0.003333		83	40-140	1	50	
BZ#180	0.00330	0.00027	mg/kg wet	0.003333		99	40-140	2	50	
BZ#180 [2C]	0.00318	0.00027	mg/kg wet	0.003333		96	40-140	0.01	50	
BZ#187	0.00321	0.00027	mg/kg wet	0.003333		96	40-140	2	50	
BZ#187 [2C]	0.00291	0.00027	mg/kg wet	0.003333		87	40-140	0.5	50	
BZ#195	0.00326	0.00027	mg/kg wet	0.003333		98	40-140	0.8	50	
BZ#195 [2C]	0.00320	0.00027	mg/kg wet	0.003333		96	40-140	0.6	50	
BZ#206	0.00333	0.00027	mg/kg wet	0.003333		100	40-140	2	50	
BZ#206 [2C]	0.00316	0.00027	mg/kg wet	0.003333		95	40-140	0.7	50	
BZ#209	0.00330	0.00027	mg/kg wet	0.003333		99	40-140	2	50	
BZ#209 [2C]	0.00301	0.00027	mg/kg wet	0.003333		90	40-140	0.3	50	
BZ#28	0.00310	0.00027	mg/kg wet	0.003333		93	40-140	3	50	
BZ#28 [2C]	0.00276	0.00027	mg/kg wet	0.003333		83	40-140	0.7	50	
BZ#44	0.00282	0.00027	mg/kg wet	0.003333		85	40-140	2	50	
BZ#44 [2C]	0.00289	0.00027	mg/kg wet	0.003333		87	40-140	0.9	50	
BZ#52	0.00294	0.00027	mg/kg wet	0.003333		88	40-140	5	50	
BZ#52 [2C]	0.00286	0.00027	mg/kg wet	0.003333		86	40-140	1	50	
BZ#66	0.00328	0.00027	mg/kg wet	0.003333		98	40-140	2	50	
BZ#66 [2C]	0.00294	0.00027	mg/kg wet	0.003333		88	40-140	0.6	50	
BZ#8	0.00326	0.00027	mg/kg wet	0.003333		98	40-140	0.9	50	
BZ#8 [2C]	0.00332	0.00027	mg/kg wet	0.003333		99	40-140	1	50	
Surrogate: Tetrachloro-m-xylene	*0.00265*		mg/kg wet	*0.003333*		*79*	*30-150*			
Surrogate: Tetrachloro-m-xylene [2C]	*0.00256*		mg/kg wet	*0.003333*		*77*	*30-150*			
Classical Chemistry										
Batch CB80218 - General Preparation										
Blank										
Total Organic Carbon (1)	ND	100	mg/kg							
Total Organic Carbon (2)	ND	100	mg/kg							
Total Organic Carbon (Average)	ND	100	mg/kg							
LCS										
Total Organic Carbon (1)	10200	100	mg/kg	10000		102	80-120			
Total Organic Carbon (2)	10300	100	mg/kg	10000		103	80-120			

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CB80218 - [CALC]										
Total Organic Carbon (Average)	10300	100	mg/kg							
LCS Dup										
Total Organic Carbon (1)	9940	100	mg/kg	10000		99	80-120	3	200	
Total Organic Carbon (2)	9660	100	mg/kg	10000		97	80-120	7	200	
Total Organic Carbon (Average)	9800	100	mg/kg							
Reference										
Total Organic Carbon (Average)	1.60		mg/kg							
MADEP-EPH Extractable Petroleum Hydrocarbons										
Batch CB80106 - 3546										
Blank										
C19-C36 Aliphatics1	ND	12.0	mg/kg wet							
C9-C18 Aliphatics1	ND	12.0	mg/kg wet							
Decane (C10)	ND	0.5	mg/kg wet							
Docosane (C22)	ND	0.5	mg/kg wet							
Dodecane (C12)	ND	0.5	mg/kg wet							
Eicosane (C20)	ND	0.5	mg/kg wet							
Hexacosane (C26)	ND	0.5	mg/kg wet							
Hexadecane (C16)	ND	0.5	mg/kg wet							
Hexatriacontane (C36)	ND	0.5	mg/kg wet							
Nonadecane (C19)	ND	0.5	mg/kg wet							
Nonane (C9)	ND	0.5	mg/kg wet							
Octacosane (C28)	ND	0.5	mg/kg wet							
Octadecane (C18)	ND	0.5	mg/kg wet							
Tetracosane (C24)	ND	0.5	mg/kg wet							
Tetradecane (C14)	ND	0.5	mg/kg wet							
Triacontane (C30)	ND	0.5	mg/kg wet							
Surrogate: 1-Chlorooctadecane	*1.49*		mg/kg wet	*2.000*		*74*	*40-140*			
Blank										
C11-C22 Aromatics1,2	ND	12.0	mg/kg wet							
C11-C22 Unadjusted Aromatics1	ND	12.0	mg/kg wet							
Surrogate: 2-Bromonaphthalene	*1.87*		mg/kg wet	*2.000*		*94*	*40-140*			
Surrogate: 2-Fluorobiphenyl	*1.77*		mg/kg wet	*2.000*		*89*	*40-140*			
Surrogate: O-Terphenyl	*1.69*		mg/kg wet	*2.000*		*84*	*40-140*			
Blank										
2-Methylnaphthalene	ND	0.020	mg/kg wet							
Acenaphthene	ND	0.020	mg/kg wet							
Acenaphthylene	ND	0.020	mg/kg wet							
Anthracene	ND	0.008	mg/kg wet							
Benzo(a)anthracene	ND	0.008	mg/kg wet							
Benzo(a)pyrene	ND	0.008	mg/kg wet							
Benzo(b)fluoranthene	ND	0.020	mg/kg wet							

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
MADEP-EPH Extractable Petroleum Hydrocarbons										
Batch CB80106 - 3546										
Benzo(g,h,i)perylene	ND	0.020	mg/kg wet							
Benzo(k)fluoranthene	ND	0.020	mg/kg wet							
C11-C22 Aromatics1,2	ND	0.280	mg/kg wet							
Chrysene	ND	0.020	mg/kg wet							
Dibenzo(a,h)Anthracene	ND	0.008	mg/kg wet							
Fluoranthene	ND	0.020	mg/kg wet							
Fluorene	ND	0.008	mg/kg wet							
Indeno(1,2,3-cd)Pyrene	ND	0.020	mg/kg wet							
Naphthalene	ND	0.020	mg/kg wet							
Phenanthrene	ND	0.020	mg/kg wet							
Pyrene	ND	0.020	mg/kg wet							
LCS										
C19-C36 Aliphatics1	15.9	15.0	mg/kg wet	16.00		100	40-140			
C9-C18 Aliphatics1	9.3	15.0	mg/kg wet	12.00		78	40-140			
Decane (C10)	1.1	0.5	mg/kg wet	2.000		57	40-140			
Docosane (C22)	1.7	0.5	mg/kg wet	2.000		86	40-140			
Dodecane (C12)	1.3	0.5	mg/kg wet	2.000		63	40-140			
Eicosane (C20)	1.7	0.5	mg/kg wet	2.000		85	40-140			
Hexacosane (C26)	1.7	0.5	mg/kg wet	2.000		87	40-140			
Hexadecane (C16)	1.6	0.5	mg/kg wet	2.000		81	40-140			
Hexatriacontane (C36)	1.7	0.5	mg/kg wet	2.000		87	40-140			
Nonadecane (C19)	1.7	0.5	mg/kg wet	2.000		86	40-140			
Nonane (C9)	0.9	0.5	mg/kg wet	2.000		46	30-140			
Octacosane (C28)	1.7	0.5	mg/kg wet	2.000		87	40-140			
Octadecane (C18)	1.6	0.5	mg/kg wet	2.000		82	40-140			
Tetracosane (C24)	1.7	0.5	mg/kg wet	2.000		86	40-140			
Tetradecane (C14)	1.4	0.5	mg/kg wet	2.000		70	40-140			
Triacontane (C30)	1.8	0.5	mg/kg wet	2.000		89	40-140			
Surrogate: 1-Chlorooctadecane	*1.74*		mg/kg wet	*2.000*		*87*	*40-140*			
LCS										
C11-C22 Aromatics1,2	30.7	15.0	mg/kg wet							
C11-C22 Unadjusted Aromatics1	30.7	15.0	mg/kg wet	34.00		90	40-140			
Surrogate: 2-Bromonaphthalene	*2.15*		mg/kg wet	*2.000*		*107*	*40-140*			
Surrogate: 2-Fluorobiphenyl	*1.86*		mg/kg wet	*2.000*		*93*	*40-140*			
Surrogate: O-Terphenyl	*1.83*		mg/kg wet	*2.000*		*91*	*40-140*			
LCS										
2-Methylnaphthalene Breakthrough	0.0		%				0-5			
Naphthalene Breakthrough	0.0		%				0-5			
LCS										
2-Methylnaphthalene	1.52	0.040	mg/kg wet	2.000		76	40-140			
Acenaphthene	1.82	0.040	mg/kg wet	2.000		91	40-140			
Acenaphthylene	1.99	0.040	mg/kg wet	2.000		99	40-140			
Anthracene	1.87	0.016	mg/kg wet	2.000		93	40-140			

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
MADEP-EPH Extractable Petroleum Hydrocarbons										
Batch CB80106 - 3546										
Benzo(a)anthracene	1.79	0.016	mg/kg wet	2.000		89	40-140			
Benzo(a)pyrene	1.85	0.016	mg/kg wet	2.000		93	40-140			
Benzo(b)fluoranthene	1.80	0.040	mg/kg wet	2.000		90	40-140			
Benzo(g,h,i)perylene	1.79	0.040	mg/kg wet	2.000		89	40-140			
Benzo(k)fluoranthene	1.77	0.040	mg/kg wet	2.000		88	40-140			
C11-C22 Aromatics1,2	ND	0.560	mg/kg wet							
Chrysene	1.83	0.040	mg/kg wet	2.000		91	40-140			
Dibenzo(a,h)Anthracene	1.94	0.016	mg/kg wet	2.000		97	40-140			
Fluoranthene	1.87	0.040	mg/kg wet	2.000		93	40-140			
Fluorene	1.92	0.016	mg/kg wet	2.000		96	40-140			
Indeno(1,2,3-cd)Pyrene	2.04	0.040	mg/kg wet	2.000		102	40-140			
Naphthalene	1.57	0.040	mg/kg wet	2.000		79	40-140			
Phenanthrene	1.77	0.040	mg/kg wet	2.000		89	40-140			
Pyrene	1.77	0.040	mg/kg wet	2.000		88	40-140			
LCS Dup										
C19-C36 Aliphatics1	16.1	15.0	mg/kg wet	16.00		101	40-140	1	25	
C9-C18 Aliphatics1	9.3	15.0	mg/kg wet	12.00		77	40-140	0.7	25	
Decane (C10)	1.2	0.5	mg/kg wet	2.000		58	40-140	1	25	
Docosane (C22)	1.8	0.5	mg/kg wet	2.000		89	40-140	3	25	
Dodecane (C12)	1.3	0.5	mg/kg wet	2.000		64	40-140	2	25	
Eicosane (C20)	1.8	0.5	mg/kg wet	2.000		88	40-140	3	25	
Hexacosane (C26)	1.8	0.5	mg/kg wet	2.000		90	40-140	4	25	
Hexadecane (C16)	1.7	0.5	mg/kg wet	2.000		84	40-140	3	25	
Hexatriacontane (C36)	1.8	0.5	mg/kg wet	2.000		90	40-140	4	25	
Nonadecane (C19)	1.8	0.5	mg/kg wet	2.000		89	40-140	3	25	
Nonane (C9)	0.9	0.5	mg/kg wet	2.000		46	30-140	0.9	25	
Octacosane (C28)	1.8	0.5	mg/kg wet	2.000		91	40-140	4	25	
Octadecane (C18)	1.7	0.5	mg/kg wet	2.000		84	40-140	3	25	
Tetracosane (C24)	1.8	0.5	mg/kg wet	2.000		89	40-140	4	25	
Tetradecane (C14)	1.4	0.5	mg/kg wet	2.000		72	40-140	3	25	
Triacontane (C30)	1.9	0.5	mg/kg wet	2.000		93	40-140	4	25	
Surrogate: 1-Chlorooctadecane	*1.79*		mg/kg wet	*2.000*		*89*	*40-140*			
LCS Dup										
C11-C22 Aromatics1,2	29.9	15.0	mg/kg wet							
C11-C22 Unadjusted Aromatics1	29.9	15.0	mg/kg wet	34.00		88	40-140	3	25	
Surrogate: 2-Bromonaphthalene	*1.88*		mg/kg wet	*2.000*		*94*	*40-140*			
Surrogate: 2-Fluorobiphenyl	*1.72*		mg/kg wet	*2.000*		*86*	*40-140*			
Surrogate: O-Terphenyl	*1.81*		mg/kg wet	*2.000*		*90*	*40-140*			
LCS Dup										
2-Methylnaphthalene Breakthrough	0.0		%				0-5		200	
Naphthalene Breakthrough	0.0		%				0-5		200	
LCS Dup										
2-Methylnaphthalene	1.56	0.040	mg/kg wet	2.000		78	40-140	3	30	

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
MADEP-EPH Extractable Petroleum Hydrocarbons										
Batch CB80106 - 3546										
Acenaphthene	1.84	0.040	mg/kg wet	2.000		92	40-140	1	30	
Acenaphthylene	2.01	0.040	mg/kg wet	2.000		101	40-140	1	30	
Anthracene	1.89	0.016	mg/kg wet	2.000		95	40-140	2	30	
Benzo(a)anthracene	1.83	0.016	mg/kg wet	2.000		92	40-140	3	30	
Benzo(a)pyrene	1.88	0.016	mg/kg wet	2.000		94	40-140	1	30	
Benzo(b)fluoranthene	1.88	0.040	mg/kg wet	2.000		94	40-140	4	30	
Benzo(g,h,i)perylene	1.84	0.040	mg/kg wet	2.000		92	40-140	3	30	
Benzo(k)fluoranthene	1.74	0.040	mg/kg wet	2.000		87	40-140	1	30	
C11-C22 Aromatics1,2	ND	0.560	mg/kg wet							
Chrysene	1.86	0.040	mg/kg wet	2.000		93	40-140	2	30	
Dibenzo(a,h)Anthracene	1.92	0.016	mg/kg wet	2.000		96	40-140	0.6	30	
Fluoranthene	1.88	0.040	mg/kg wet	2.000		94	40-140	0.5	30	
Fluorene	1.93	0.016	mg/kg wet	2.000		97	40-140	0.7	30	
Indeno(1,2,3-cd)Pyrene	2.08	0.040	mg/kg wet	2.000		104	40-140	2	30	
Naphthalene	1.63	0.040	mg/kg wet	2.000		81	40-140	3	30	
Phenanthrene	1.79	0.040	mg/kg wet	2.000		90	40-140	1	30	
Pyrene	1.81	0.040	mg/kg wet	2.000		91	40-140	2	30	

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

Notes and Definitions

Z-08	See Attached
U	Analyte included in the analysis, but not detected
P	Percent difference between primary and confirmation results exceeds 40% (P).
LC	Lower value is used due to matrix interferences (LC).
D	Diluted.
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - 401WQ

ESS Laboratory Work Order: 1801552

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

SOILS LABORATORY TESTING ASSIGNMENT SHEET

THIELSCH ENGINEERING
195 Frances Ave., Cranston, RI 02910
401-467-6454

Project Name **Sawmill Brook**
ESS Project No. 1801552
Project Manager Michelle Mirenda
Date Received 1/30/2018 (by)

Client Company Tighe & Bond
Client Email
Site Location
Date Assigned

Collected By
Date Required 2/6/2018

Sample Information				Lab No.	Identification Tests								Permeability		Compaction			Soil Strength			Consol.		Notes
Boring/ Test Pit No.	Sample or depth	Sample date	ESS Sample ID		Water Cont. %	LL & PL %	Org. %	Bulk	Sieve -200 %	Hyd -2μ %	G_s	Tube Density	Sand	Clay	Mod.	Std.	CBR	Un-confined	UU	CIU	Standard	E.O.P.	
					D2216	D4318	D2974		D422		D854		D2434	D5084	D1557	D698	D1883	D2166	D2850	D4767	D2435	D2435	#
Pond		1/23/18	1801552-01						X														**
Stream Up		1/23/18	1801552-02						X														**
Stream Down		1/23/18	1801552-03						X														**

Notes: ** = Sieve # 4,10,40,60,200

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1801552

Turn Time	5	Days
Regulatory State		
Reporting Limits	401 Water Quality	

Is this project for any of the following?: ○CT RCP ◉MA MCP ○RGP

Electonic Deliverables: ☑Data Checker ☑Excel ☐Other (Please Specify →)

Company Name	Project #	Project Name
Tighe & Bond	221476	Sawmill Brook

Contact Person	Address
Gary Hedman	4 Barlows Landing Road

City	State	Zip Code	PO #
Pocasset	MA	02559	

Telephone Number	FAX Number	Email Address
508-304-6357		Ghedman@tighebond.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: *Metals and Percent Water	EPH w/ PAH Low Level	PCB NOAA 18 Congeners	VOC LL	VOC High	TOC - LloydKahn	Grain Size	TPH	MCP 14 Metals (hold)	SVOCs (hold)
01	1/23/18	1300	Composite	Soil	Pond	X	X	X	X	X	X	X	X		
02	1/23/18	1330	Composite	Soil	Stream Up	X	X	X	X	X	X	X	X		
03	1/23/18	1400	Composite	Soil	Stream Down	X	X	X	X	X	X	X	X		
04	1/23/18	1300	C	S	Pond - air dried	X							Per client @ 1/31/18		
05	1/23/18	1330	C	S	Stream Up - air dried	X									
06	1/23/18	1400	C	S	Stream Down - air dried	X									
Container Type:						AG	AG	AG	V	V	AG	O	AG		
Container Volume:						10	10	10	7	7	8	11	10		
Preservation Code:						1	1	1	10	6	1	1	1		
Number of Containers per Sample:						1	1	1	2	1	1	1	1		

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*

Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other*

Laboratory Use Only

Cooler Present: √ ○Drop Off
Seals Intact: — ○Pickup
Cooler Temperature: 1.9 i@ 4

Sampled by : Gary Hedman

Comments: Please specify "Other" preservative and containers types in this space

added air dried samples for metals. mkm 2/5/18

* Metals - As, Cd, Cr, Cu, Pb, Hg, Ni, Zn

LL frozen by G.H. @ 1000 1/25/18 per A.C.

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
1/30/18 13:35	1-30-18 13:35	1-30-18 1430	1/30/18 1515
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1801552

Turn Time	5	Days
Regulatory State		
Reporting Limits	401 Water Quality	
Electonic Deliverables	☑Data Checker ☐Other (Please Specify →)	☑Excel

Is this project for any of the following?: ○CT RCP ◉MA MCP ○RGP

Company Name Tighe & Bond	**Project #** 221476	**Project Name** Sawmill Brook	
Contact Person Gary Hedman	**Address** 4 Barlows Landing Road		
City Pocasset	**State** MA	**Zip Code** 02559	**PO #**
Telephone Number 508-304-6357	**FAX Number**	**Email Address** Ghedman@tighebond.com	

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: *Metals and Percent Water	EPH w/ PAH Low Level	PCB NOAA 18 Congeners	VOC LL	VOC High	TOC - LloydKahn	Grain Size	TPH	MCP 14 Metals (hold)	SVOCs (hold)						
01	1/23/18	1300	Composite	Soil	Pond	X	X	X	X	X	X	X	X								
02	1/23/18	1330	Composite	Soil	Stream Up	X	X	X	X	X	X	X	X								
03	1/23/18	1400	Composite	Soil	Stream Down	X	X	X	X	X	X	X	X								
													Per Client @ 1/24/18								
Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial						AG	AG	AG	V	V	AG	O	AG								
Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*						10	10	10	7	7	8	11	10								
Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other*						1	1	1	10	6	1	1	1								
Number of Containers per Sample:						1	1	1	2	1	1	1	1								

Laboratory Use Only

Cooler Present: √ ○Drop Off
Seals Intact: — ○Pickup
Cooler Temperature: 1.9 i@ 9

Sampled by : Gary Hedman

Comments: Please specify "Other" preservative and containers types in this space

* Metals - As, Cd, Cr, Cu, Pb, Hg, Ni, Zn

LL frozen by G.H. @ 1000 1/25/18 per A.C.

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
1/30/18 13:35	1-30-18 13:35	1-30-18 1430	1/30/18 1515
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

CERTIFICATE OF ANALYSIS

Gary Hedman
Tighe & Bond
4 Barlows Landing Road, Unit 15
Pocasset, MA 02559

RE: Sawmill Brook - MCP (221476)
ESS Laboratory Work Order Number: 1801551

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 2:32 pm, Feb 06, 2018

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

SAMPLE RECEIPT

The following samples were received on January 30, 2018 for the analyses specified on the enclosed Chain of Custody Record.

To achieve CAM compliance for MCP data, ESS Laboratory has reviewed all QA/QC Requirements and Performance Standards listed in each method. Holding times and preservation have also been reviewed. All CAM requirements have been performed and achieved unless noted in the project narrative.

Each method has been set-up in the laboratory to reach required MCP standards. The methods for aqueous VOA and Soil Methanol VOA have known limitations for certain analytes. The regulatory standards may not be achieved due to these limitations. In addition, for all methods, matrix interferences, dilutions, and %Solids may elevate method reporting limits above regulatory standards. ESS Laboratory can provide, upon request, a Limit Checker (regulatory standard comparison spreadsheet) electronic deliverable which will highlight these exceedances.

Question I: All samples for EPH were analyzed for a subset of the required MCP list per the client's request.

Lab Number	Sample Name	Matrix	Analysis
1801551-01	Pond	Soil	8100M
1801551-02	Stream Up	Soil	8100M
1801551-03	Stream Down	Soil	8100M

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

MassDEP Analytical Protocol Certification Form

MADEP RTN: _____

This form provides certification for the following data set: **1801551-01 through 1801551-03**

Matrices: ( ) Ground Water/Surface Water (X) Soil/Sediment ( ) Drinking Water ( ) Air ( ) Other:_____

CAM Protocol (check all that apply below):

( ) 8260 VOC CAM II A	( ) 7470/7471 Hg CAM III B	( ) MassDEP VPH (GC/PID/FID) CAM IV A	( ) 8082 PCB CAM V A	( ) 9014 Total Cyanide/PAC CAM VI A	( ) 6860 Perchlorate CAM VIII B
( ) 8270 SVOC CAM II B	( ) 7010 Metals CAM III C	( ) MassDEP VPH (GC/MS) CAM IV B	( ) 8081 Pesticides CAM V C	( ) 7196 Hex Cr CAM VI B	( ) MassDEP APH CAM IX A
( ) 6010 Metals CAM III A	( ) 6020 Metals CAM III D	(X) MassDEP EPH CAM IV B	( ) 8151 Herbicides CAM V C	( ) Explosives CAM VIII A	( ) TO-15 VOC CAM IX B

Affirmative responses to questions A through F are 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 (X) No ( )
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	Yes (X) No ( )
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 (X) No ( )
D	Does the laboratory report comply with all the reporting requirements specified in the CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	Yes (X) No ( )
E	VPH, EPH, APH and TO-15 only: a. Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications).	Yes (X) No ( )
	b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes ( ) No ( )
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	Yes (X) No ( )

Responses to Questions G, H and I below are required for '"Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocols(s)?	Yes (X) No ( )*
	***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 performance standards specified in the CAM protocol(s) achieved?	Yes (X) No ( )*
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	Yes ( ) No (X)*

****All negative responses must be addressed in an attached laboratory 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: Laurel Stoddard

Date: February 06, 2018

Printed Name: Laurel Stoddard

Position: Laboratory Director

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP
Client Sample ID: Pond
Date Sampled: 01/23/18 13:00
Percent Solids: 60
Initial Volume: 19
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 1801551
ESS Laboratory Sample ID: 1801551-01
Sample Matrix: Soil
Units: mg/kg dry
Analyst: SMR
Prepared: 1/31/18 9:45

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	**93.7** (17.5)		8100M		1	02/02/18 19:46	C8B0040	CA83007

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*97 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP
Client Sample ID: Stream Up
Date Sampled: 01/23/18 13:30
Percent Solids: 66
Initial Volume: 20.6
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 1801551
ESS Laboratory Sample ID: 1801551-02
Sample Matrix: Soil
Units: mg/kg dry
Analyst: SMR
Prepared: 1/31/18 9:45

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	**24.1** (14.7)		8100M		1	02/02/18 20:24	C8B0040	CA83007

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*104 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP
Client Sample ID: Stream Down
Date Sampled: 01/23/18 14:00
Percent Solids: 76
Initial Volume: 19.2
Final Volume: 1
Extraction Method: 3546

ESS Laboratory Work Order: 1801551
ESS Laboratory Sample ID: 1801551-03
Sample Matrix: Soil
Units: mg/kg dry
Analyst: SMR
Prepared: 1/31/18 9:45

8100M Total Petroleum Hydrocarbons

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Total Petroleum Hydrocarbons	**222** (13.7)		8100M		1	02/02/18 21:03	C8B0040	CA83007

	%Recovery	Qualifier	Limits
Surrogate: O-Terphenyl	*105 %*		*40-140*

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch CA83007 - 3546										
Blank										
Decane (C10)	ND	0.2	mg/kg wet							
Docosane (C22)	ND	0.2	mg/kg wet							
Dodecane (C12)	ND	0.2	mg/kg wet							
Eicosane (C20)	ND	0.2	mg/kg wet							
Hexacosane (C26)	ND	0.2	mg/kg wet							
Hexadecane (C16)	ND	0.2	mg/kg wet							
Hexatriacontane (C36)	ND	0.2	mg/kg wet							
Nonadecane (C19)	ND	0.2	mg/kg wet							
Nonane (C9)	ND	0.2	mg/kg wet							
Octacosane (C28)	ND	0.2	mg/kg wet							
Octadecane (C18)	ND	0.2	mg/kg wet							
Tetracosane (C24)	ND	0.2	mg/kg wet							
Tetradecane (C14)	ND	0.2	mg/kg wet							
Total Petroleum Hydrocarbons	ND	10.0	mg/kg wet							
Triacontane (C30)	ND	0.2	mg/kg wet							
Surrogate: O-Terphenyl	*5.82*		mg/kg wet	*5.000*		*116*	*40-140*			
LCS										
Decane (C10)	2.4	0.2	mg/kg wet	2.500		95	40-140			
Docosane (C22)	2.6	0.2	mg/kg wet	2.500		105	40-140			
Dodecane (C12)	2.6	0.2	mg/kg wet	2.500		104	40-140			
Eicosane (C20)	2.6	0.2	mg/kg wet	2.500		104	40-140			
Hexacosane (C26)	2.6	0.2	mg/kg wet	2.500		104	40-140			
Hexadecane (C16)	2.6	0.2	mg/kg wet	2.500		103	40-140			
Hexatriacontane (C36)	2.6	0.2	mg/kg wet	2.500		106	40-140			
Nonadecane (C19)	2.6	0.2	mg/kg wet	2.500		104	40-140			
Nonane (C9)	2.0	0.2	mg/kg wet	2.500		80	30-140			
Octacosane (C28)	2.6	0.2	mg/kg wet	2.500		104	40-140			
Octadecane (C18)	2.5	0.2	mg/kg wet	2.500		102	40-140			
Tetracosane (C24)	2.6	0.2	mg/kg wet	2.500		105	40-140			
Tetradecane (C14)	2.6	0.2	mg/kg wet	2.500		103	40-140			
Total Petroleum Hydrocarbons	36.3	10.0	mg/kg wet	35.00		104	40-140			
Triacontane (C30)	2.6	0.2	mg/kg wet	2.500		104	40-140			
Surrogate: O-Terphenyl	*6.10*		mg/kg wet	*5.000*		*122*	*40-140*			
LCS Dup										
Decane (C10)	2.4	0.2	mg/kg wet	2.500		96	40-140	0.7	25	
Docosane (C22)	2.6	0.2	mg/kg wet	2.500		104	40-140	1	25	
Dodecane (C12)	2.6	0.2	mg/kg wet	2.500		103	40-140	0.8	25	
Eicosane (C20)	2.6	0.2	mg/kg wet	2.500		103	40-140	1	25	
Hexacosane (C26)	2.6	0.2	mg/kg wet	2.500		103	40-140	1	25	
Hexadecane (C16)	2.5	0.2	mg/kg wet	2.500		102	40-140	1	25	
Hexatriacontane (C36)	2.7	0.2	mg/kg wet	2.500		107	40-140	2	25	
Nonadecane (C19)	2.6	0.2	mg/kg wet	2.500		103	40-140	1	25	

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8100M Total Petroleum Hydrocarbons										
Batch CA83007 - 3546										
Nonane (C9)	2.0	0.2	mg/kg wet	2.500		82	30-140	1	25	
Octacosane (C28)	2.6	0.2	mg/kg wet	2.500		103	40-140	0.7	25	
Octadecane (C18)	2.5	0.2	mg/kg wet	2.500		100	40-140	1	25	
Tetracosane (C24)	2.6	0.2	mg/kg wet	2.500		104	40-140	0.9	25	
Tetradecane (C14)	2.5	0.2	mg/kg wet	2.500		102	40-140	1	25	
Total Petroleum Hydrocarbons	35.6	10.0	mg/kg wet	35.00		102	40-140	2	25	
Triacontane (C30)	2.6	0.2	mg/kg wet	2.500		103	40-140	0.7	25	
Surrogate: O-Terphenyl	*5.90*		mg/kg wet	*5.000*		*118*	*40-140*			

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

Notes and Definitions

U	Analyte included in the analysis, but not detected
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit

CERTIFICATE OF ANALYSIS

Client Name: Tighe & Bond
Client Project ID: Sawmill Brook - MCP

ESS Laboratory Work Order: 1801551

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory Sample and Cooler Receipt Checklist

Client: Tighe & Bond - KPB/TB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1801551
Date Received: 1/30/2018
Project Due Date: 2/6/2018
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 1.9 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** Yes / No / (NA)
10. Were any analyses received outside of hold time? Yes / (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? Yes / (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	198995	Yes	NA	Yes	8 oz. Jar - Unpres	NP	
02	198994	Yes	NA	Yes	8 oz. Jar - Unpres	NP	
03	198993	Yes	NA	Yes	8 oz. Jar - Unpres	NP	

2nd Review
Are barcode labels on correct containers? (Yes) / No

Completed By: Date & Time: 1/30/18 1542
Reviewed By: Date & Time: 1/30/18 1603
Delivered By: 1/30/18 1603

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 180155 1

Turn Time	5	Days
Regulatory State		
Reporting Limits	401 Water Quality	
Electonic Deliverables	☑Data Checker ☐Other (Please Specify →)	☑Excel

Is this project for any of the following?: ○CT RCP ◉MA MCP ○RGP

Company Name	Project #	Project Name
Tighe & Bond	221476	Sawmill Brook
Contact Person	**Address**	
Gary Hedman	4 Barlows Landing Road	
City	**State**	**Zip Code** / **PO #**
Pocasset	MA	02559
Telephone Number	**FAX Number**	**Email Address**
508-304-6357		Ghedman@tighebond.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: *Metals and Percent Water	EPH w/ PAH Low Level	PCB NOAA 18 Congeners	VOC LL	VOC High	TOC - LloydKahn	Grain Size	TPH	MCP 14 Metals (hold)	SVOCs (hold)						
01	1/23/18	1300	Composite	Soil	Pond	X	X	X	X	X	X	X	X	X	X						
02	1/23/18	1330	Composite	Soil	Stream Up	X	X	X	X	X	X	X	X	X	X						
03	1/23/18	1400	Composite	Soil	Stream Down	X	X	X	X	X	X	X	X	X	X						
																per client					
																EL 1/24/18					

Container Type:	AC-Air Cassette	AG-Amber Glass	B-BOD Bottle	C-Cubitainer	J-Jar	O-Other	P-Poly	S-Sterile	V-Vial	AG	AG	AG	V	V	AG	O	AG					
Container Volume:	1-100 mL	2-2.5 gal	3-250 mL	4-300 mL	5-500 mL	6-1L	7-VOA	8-2 oz	9-4 oz	10-8 oz	11-Other*	10	10	10	7	7	8	11	10			
Preservation Code:	1-Non Preserved	2-HCl	3-H2SO4	4-HNO3	5-NaOH	6-Methanol	7-Na2S2O3	8-ZnAce, NaOH	9-NH4Cl	10-DI H2O	11-Other*	1	1	1	10	6	1	1	1			
											Number of Containers per Sample:	1	1	1	2	1	1	1	1			

Laboratory Use Only

Cooler Present: √ ○Drop Off
Seals Intact: — ○Pickup
Cooler Temperature: 1.9 iced

Sampled by : Gary Hedman

Comments: **Please specify "Other" preservative and containers types in this space**

* Metals - As, Cd, Cr, Cu, Pb, Hg, Ni, Zn

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
1/30/18 13:35	1-30-18 13:35	1-30-18 1430	1/30/18 1515
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

APPENDIX C

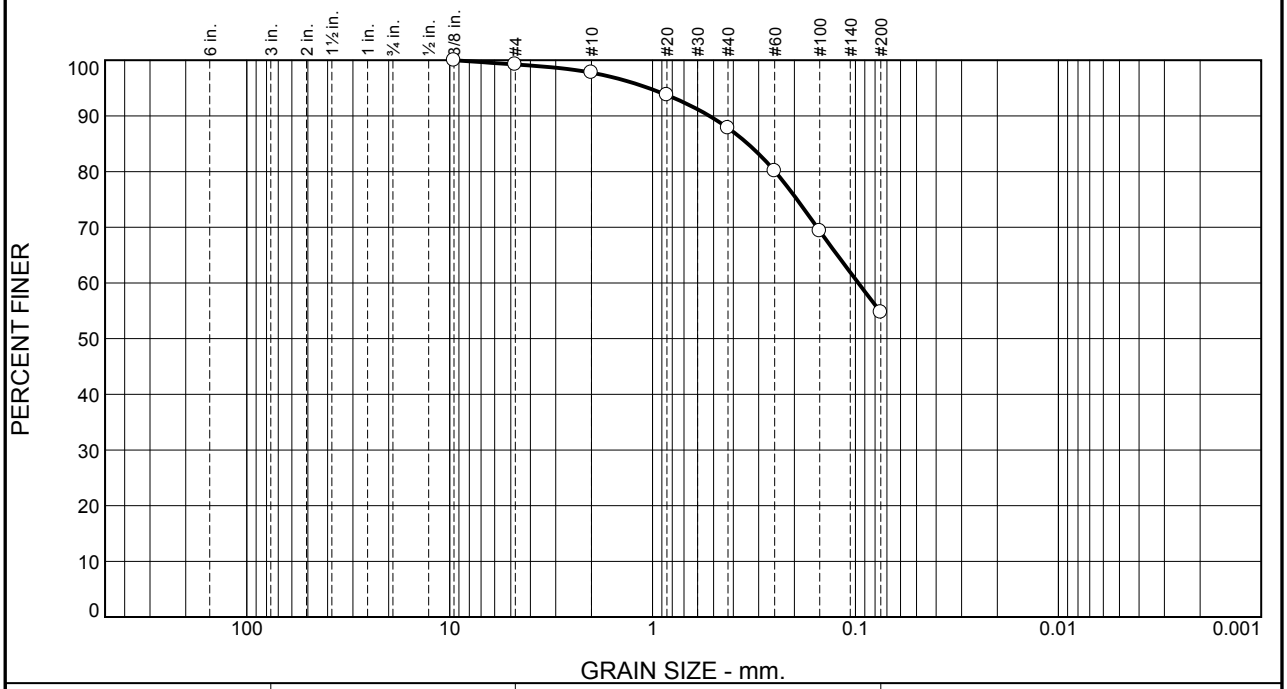
THIELSCH ENGINEERING	195 Frances Avenue Cranston RI, 02910 Phone: (401)-467-6454 Fax: (401)-467-2398 http://www.thielsch.com	Client Information: ESS / Tighe & Bond Cranston, RI PM: Michelle Mirenda Assigned By: M. Mirenda	Laboratory Information Project Name: **Sawmill Brook** ESS Project Number: 1801552 Report Date: 02.02.18

LABORATORY TESTING DATA SHEET

Material ID	ESS Sample No.	Sample Date	CTS Laboratory No.	Identification Tests							Density		Strength Tests				
				Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) Corrected	CBR Setup as % of Proctor	CBR Dry unit wt. pcf	CBR Water Content %	CBR @ 0.1" @ 0.2"	Laboratory Log and Soil Description
Pond	1801552-01	01.23.18	18-S-098				0.8	44.5	54.7								Dark Brown sandy silt
Stream Up	1801552-02	01.23.18	18-S-099				8.1	53.4	38.5								Dark Brown sandy silt
Stream Down	1801552-03	01.23.18	18-S-100				3.2	72.0	24.8								Dark Brown silty sand

Reviewed By _____ Date Reviewed: 02.06.18

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	1.4	10.0	33.1	54.7	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375"	100.0		
#4	99.2		
#10	97.8		
#20	93.7		
#40	87.8		
#60	80.1		
#100	69.3		
#200	54.7		

* (no specification provided)

Material Description

Dark Brown sandy silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 0.5246 D_{85}= 0.3392 D_{60}= 0.0968
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Material was visually checked for plasticity and rolled to 1/8th inch.

Date Received: 1.31.18 **Date Tested:** 2.2.18

Tested By: JF

Checked By: Matthew Colman P.E.

Title: Laboratory Manager

Source of Sample: Exploratory Samples **Date Sampled:** 01.23.18

Sample Number: Pond

Thielsch Engineering Inc.

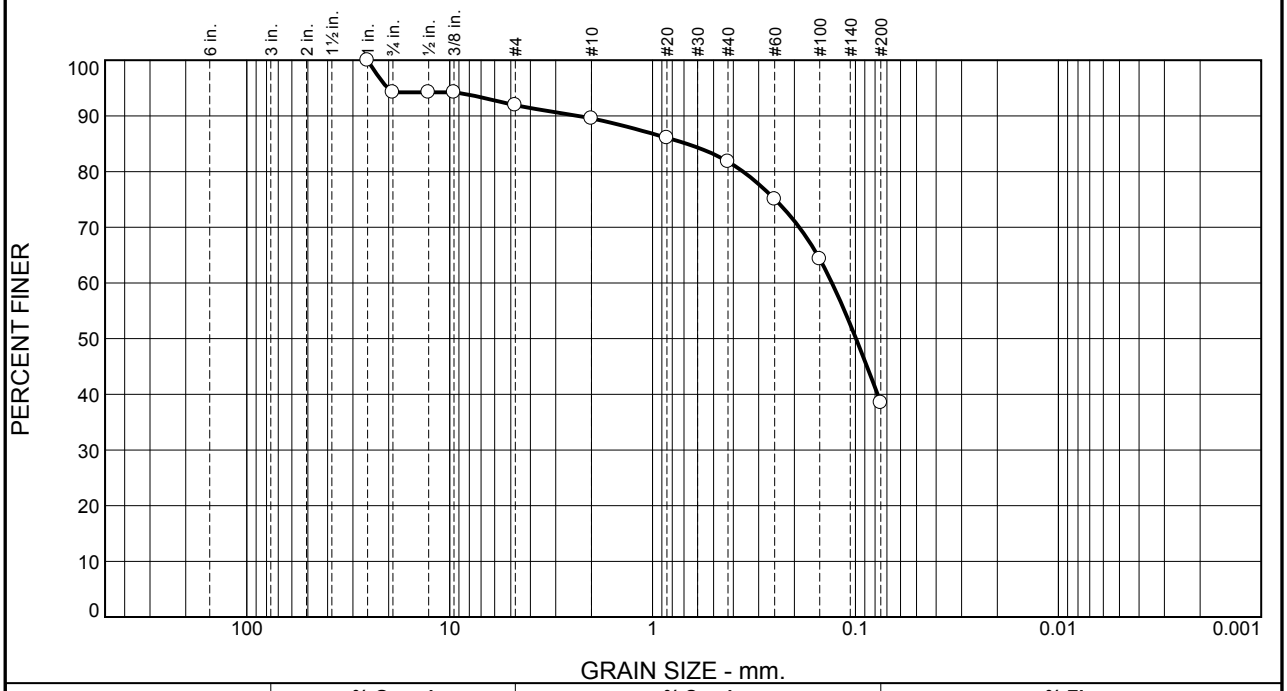
Cranston, RI

Client: ESS / Tighe & Bond

Project: Sawmill Brook

Project No: 1801552 **Figure** 1801552-01

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.8	2.3	2.4	7.7	43.3	38.5	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	94.2		
0.5"	94.2		
0.375"	94.2		
#4	91.9		
#10	89.5		
#20	86.1		
#40	81.8		
#60	75.0		
#100	64.3		
#200	38.5		

* (no specification provided)

Material Description

Dark Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 2.3329 D_{85}= 0.6792 D_{60}= 0.1305
D_{50}= 0.0994 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Material was visually checked for plasticity and rolled to 1/8th inch.

Date Received: 1.31.18 **Date Tested:** 2.2.18

Tested By: JF

Checked By: Matthew Colman P.E.

Title: Laboratory Manager

Source of Sample: Exploratory Samples **Date Sampled:** 01.23.18

Sample Number: Stream Up

Thielsch Engineering Inc.

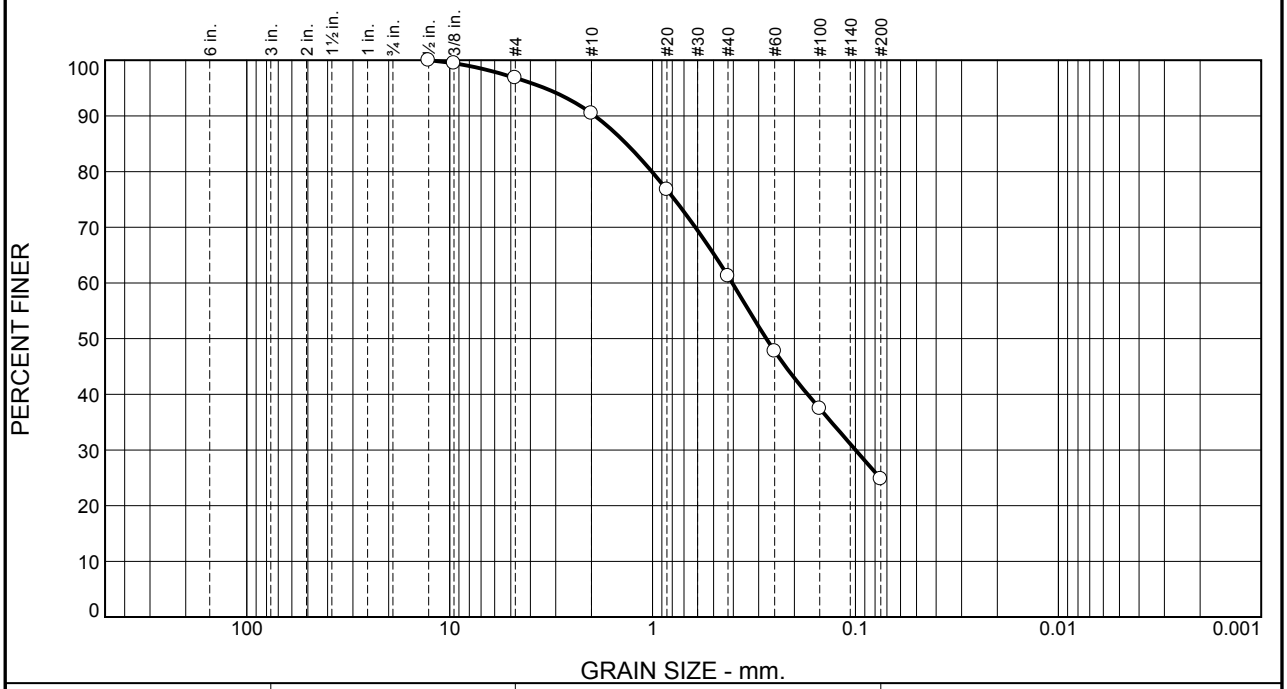
Cranston, RI

Client: ESS / Tighe & Bond

Project: Sawmill Brook

Project No: 1801552 **Figure** 1801552-02

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.2	6.3	29.3	36.4	24.8	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	99.5		
#4	96.8		
#10	90.5		
#20	76.7		
#40	61.2		
#60	47.7		
#100	37.4		
#200	24.8		

* (no specification provided)

Material Description

Dark Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 1.9234 D_{85}= 1.3463 D_{60}= 0.4048
D_{50}= 0.2750 D_{30}= 0.0999 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 1.31.18 **Date Tested:** 2.2.18

Tested By: JF

Checked By: Matthew Colman P.E.

Title: Laboratory Manager

Source of Sample: Exploratory Samples **Date Sampled:** 01.23.18
Sample Number: Stream Down

Thielsch Engineering Inc.

Cranston, RI

Client: ESS / Tighe & Bond
Project: Sawmill Brook

Project No: 1801552 **Figure** 1801552-03

SOILS LABORATORY TESTING ASSIGNMENT SHEET

THIELSCH ENGINEERING
195 Frances Ave., Cranston, RI 02910
401-467-6454

Project Name **Sawmill Brook**
ESS Project No. 1801552
Project Manager Michelle Mirenda
Date Received 1/30/2018 (by)

Client Company Tighe & Bond
Client Email
Site Location
Date Assigned

Collected By
Date Required 2/6/2018

Sample Information				Lab No.	Identification Tests								Permeability		Compaction			Soil Strength			Consol.		Notes
Boring/ Test Pit No.	Sample or depth	Sample date	ESS Sample ID		Water Cont. %	LL & PL %	Org. %	Bulk	Sieve -200 %	Hyd -2μ %	G_s	Tube Density	Sand	Clay	Mod.	Std.	CBR	Un-confined	UU	CIU	Standard	E.O.P.	
					D2216	D4318	D2974		D422		D854		D2434	D5084	D1557	D698	D1883	D2166	D2850	D4767	D2435	D2435	#
Pond		1/23/18	1801552-01						X														**
Stream Up		1/23/18	1801552-02						X														**
Stream Down		1/23/18	1801552-03						X														**

Notes: ** = Sieve # 4,10,40,60,200

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1801552

Turn Time	5	Days
Regulatory State		
Reporting Limits	401 Water Quality	

Is this project for any of the following?: ○CT RCP ◉MA MCP ○RGP

Electonic Deliverables: ☑Data Checker ☑Excel ☐Other (Please Specify →)

Company Name	Project #	Project Name
Tighe & Bond	221476	Sawmill Brook

Contact Person	Address
Gary Hedman	4 Barlows Landing Road

City	State	Zip Code	PO #
Pocasset	MA	02559	

Telephone Number	FAX Number	Email Address
508-304-6357		Ghedman@tighebond.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: *Metals and Percent Water	EPH w/ PAH Low Level	PCB NOAA 18 Congeners	VOC LL	VOC High	TOC - LloydKahn	Grain Size	TPH	MCP 14 Metals (hold)	SVOCs (hold)
01	1/23/18	1300	Composite	Soil	Pond	X	X	X	X	X	X	X	X		
02	1/23/18	1330	Composite	Soil	Stream Up	X	X	X	X	X	X	X	X		
03	1/23/18	1400	Composite	Soil	Stream Down	X	X	X	X	X	X	X	X		
04	1/23/18	1300	C	S	Pond - air dried	X							Per client @ 1/31/18		
05	1/23/18	1330	C	S	Stream Up - air dried	X									
06	1/23/18	1400	C	S	Stream Down - air dried	X									
Container Type:						AG	AG	AG	V	V	AG	O	AG		
Container Volume:						10	10	10	7	7	8	11	10		
Preservation Code:						1	1	1	10	6	1	1	1		
Number of Containers per Sample:						1	1	1	2	1	1	1	1		

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*

Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other*

Laboratory Use Only

Cooler Present: √ ○Drop Off
Seals Intact: — ○Pickup
Cooler Temperature: 1.9 i@ 4

Sampled by : Gary Hedman

Comments: Please specify "Other" preservative and containers types in this space

added air dried samples for metals. mkm 2/5/18

* Metals - As, Cd, Cr, Cu, Pb, Hg, Ni, Zn

LL frozen by G.H. @ 1000 1/25/18 per A.C.

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
1/30/18 13:35	1-30-18 13:35	1-30-18 1430	1/30/18 1515
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1801552

Turn Time	5	Days
Regulatory State		
Reporting Limits	401 Water Quality	
Electonic Deliverables	☑Data Checker ☐Other (Please Specify →)	☑Excel

Is this project for any of the following?: ○CT RCP ◉MA MCP ○RGP

Company Name Tighe & Bond	**Project #** 221476	**Project Name** Sawmill Brook	
Contact Person Gary Hedman	**Address** 4 Barlows Landing Road		
City Pocasset	**State** MA	**Zip Code** 02559	**PO #**
Telephone Number 508-304-6357	**FAX Number**	**Email Address** Ghedman@tighebond.com	

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: *Metals and Percent Water	EPH w/ PAH Low Level	PCB NOAA 18 Congeners	VOC LL	VOC High	TOC - LloydKahn	Grain Size	TPH	MCP 14 Metals (hold)	SVOCs (hold)						
01	1/23/18	1300	Composite	Soil	Pond	X	X	X	X	X	X	X	X								
02	1/23/18	1330	Composite	Soil	Stream Up	X	X	X	X	X	X	X	X								
03	1/23/18	1400	Composite	Soil	Stream Down	X	X	X	X	X	X	X	X								
													Per Client @ 1/24/18								
Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer J-Jar O-Other P-Poly S-Sterile V-Vial						AG	AG	AG	V	V	AG	O	AG								
Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*						10	10	10	7	7	8	11	10								
Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other*						1	1	1	10	6	1	1	1								
Number of Containers per Sample:						1	1	1	2	1	1	1	1								

Laboratory Use Only

Cooler Present: √ ○Drop Off
Seals Intact: — ○Pickup
Cooler Temperature: 1.9 i@ 9

Sampled by : Gary Hedman

Comments: Please specify "Other" preservative and containers types in this space

* Metals - As, Cd, Cr, Cu, Pb, Hg, Ni, Zn

LL frozen by G.H. @ 1000 1/25/18 per A.C.

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
1/30/18 13:35	1-30-18 13:35	1-30-18 1430	1/30/18 1515
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

THIELSCH ENGINEERING

195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
http://www.thielsch.com
Let's Build a Solid Foundation

Client Information:
Tighe & Bond
Worcester, MA
PM: Gary Hedman
Assigned By: Gary Hedman
Tighe & Bond Number: M-1476-0

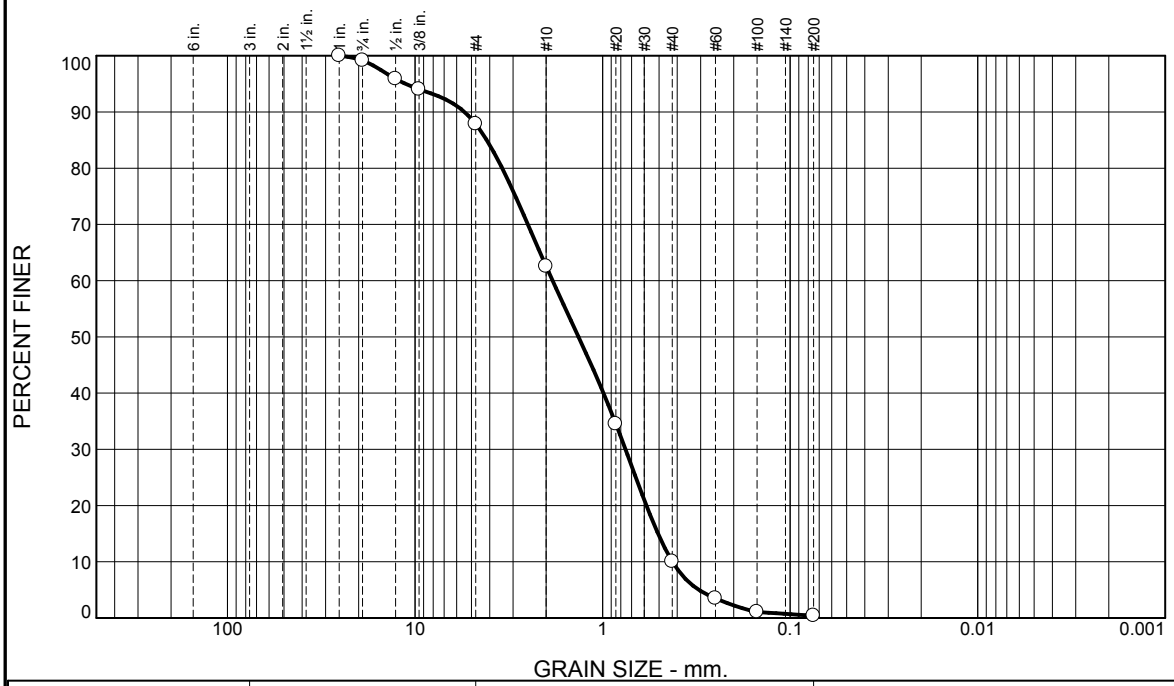
Project Information:
Sawmill Brook / Norwood Ave.
Manchester-by-the-Sea, MA
TEI Project Number: 74-18-0002.104
Summary Page: 1 of 1
Report Date: 03.08.18

LABORATORY TESTING DATA SHEET

Source	Material	Depth (ft)	Laboratory No.	Identification Tests						Corrosivity Tests								Laboratory Log and Soil Description
				Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	pH	Sulfate (mg/kg)	Chloride (mg/kg)	Sulfide (mg/kg)	Redox Potential (mv)	Electrical Resist. As Received Ohm-cm	Electrial Resist. Saturated Ohm-cm	Other	
Norwood Ave	Sed B	0-2	18-S-228				12.1	87.5	0.4									Brown poorly graded sand (SP)
School St	Sed A	0-2	18-S-229				55.0	44.9	0.1									Brown poorly graded gravel with sand (GP)

Reviewed By _____ Date Reviewed 03.09.2018

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.8	11.3	25.3	52.6	9.6	0.4	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	99.2		
0.5"	95.9		
0.375"	94.0		
#4	87.9		
#10	62.6		
#20	34.5		
#40	10.0		
#60	3.5		
#100	1.1		
#200	0.4		

* (no specification provided)

Material Description

Brown poorly graded sand (SP)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 5.4497 D_{85}= 4.1436 D_{60}= 1.8477
D_{50}= 1.3432 D_{30}= 0.7555 D_{15}= 0.5061
D_{10}= 0.4242 C_u= 4.36 C_c= 0.73

Remarks

Sample contained leaf litter.

Date Received: 03.07.18 **Date Tested:** 03.08.18

Tested By: MN

Checked By: Matthew Colman P.E.

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 0-2' **Date Sampled:**
Sample Number: Norwood Ave Sed B

Thielsch Engineering Inc.

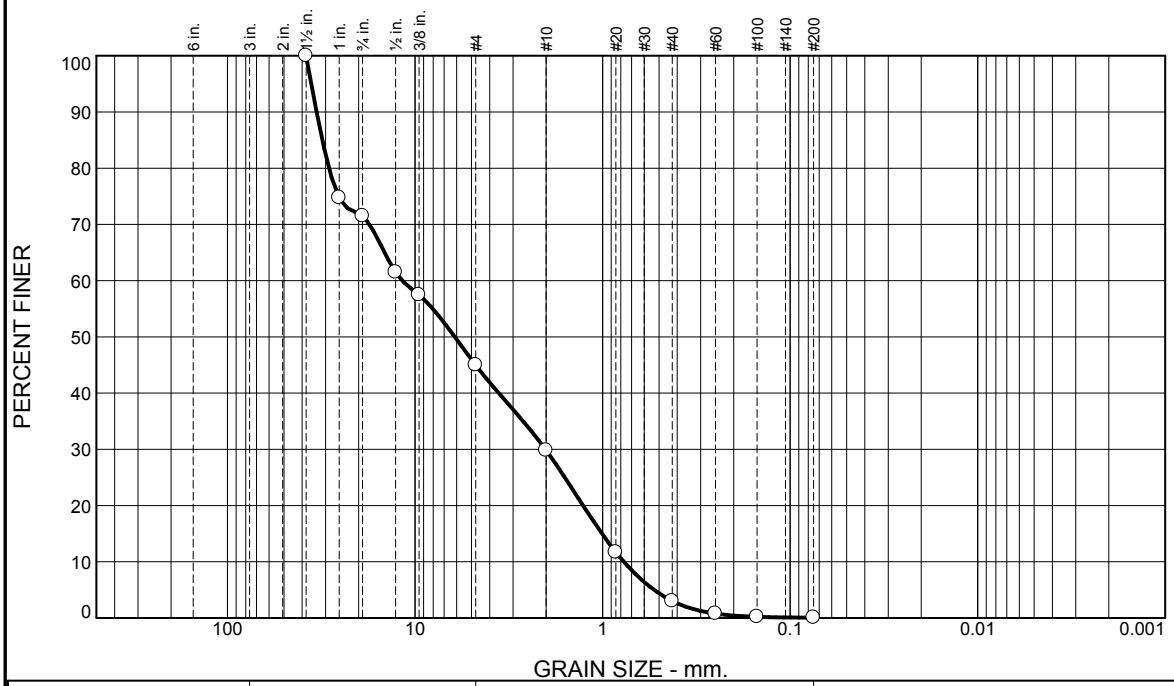
Cranston, RI

Client: Tighe & Bond

Project: Sawmill Brook / Norwood Ave
Manchester-by-the-Sea, MA

Project No: M-1476-9 **Figure** 18-S-228

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	28.5	26.5	15.2	26.8	2.9	0.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	74.8		
0.75"	71.5		
0.5"	61.5		
0.375"	57.5		
#4	45.0		
#10	29.8		
#20	11.7		
#40	3.0		
#60	0.8		
#100	0.2		
#200	0.1		

* (no specification provided)

Material Description

Brown poorly graded gravel with sand (GP)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 33.4811 D_{85}= 31.1932 D_{60}= 11.7020
D_{50}= 6.1380 D_{30}= 2.0177 D_{15}= 1.0071
D_{10}= 0.7706 C_u= 15.19 C_c= 0.45

Remarks

Sample contained leaf litter.

Date Received: 03.07.18 **Date Tested:** 03.08.18

Tested By: MN

Checked By: Matthew Colman P.E.

Title: Laboratory Manager

Source of Sample: Borings **Depth:** 0-2' **Date Sampled:**
Sample Number: School St. Sed A

Thielsch Engineering Inc.

Cranston, RI

Client: Tighe & Bond

Project: Sawmill Brook / Norwood Ave
Manchester-by-the-Sea, MA

Project No: M-1476-9 **Figure** 18-S-229

APPENDIX D

Central Pond Wall Survey Photo Log Locations

LEGEND

LOCUS MAP

N
W E
S

0 50 100
Feet

1 inch equals 75 feet

NOTES

Sawmill Brook Area
Manchester By the Sea,
Massachusetts

April 2018

Tighe&Bond
Engineers | Environmental Specialists

G:\GIS\MA\ManchesterMA\avproj\Ortho_SawmillBrook_11x17.mxd Date Saved: 9/29/2017 User: JSM

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
1	4/18/2018

Direction Photo Taken:
South

Description:
Walls adjacent to the Central Street Bridge.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
2	3/28/2018

Direction Photo Taken:
North

Description:
Eastern wall segment, concrete overlay on granite blocks.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
3	6/11/2015

Direction Photo Taken:
North

Description:
View with tide gate open in 2015 towards Fire station.

Wall collapse evident only behind 7 Central Street.

Town owned granite/ concrete wall on the left

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
4	12/3/2017

Direction Photo Taken:
East

Description:
Wall collapse behind 7 Central Street.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
5	3/11/2017

Direction Photo Taken:
Northeast

Description:
New section of wall collapse behind 6 School Street.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
6	12/3/2017

Direction Photo Taken:
Northeast

Description:
Snow piles on top of wall collapse at 6 School Street. Degraded curb stops in foreground.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
7	3/11/2017

Direction Photo Taken:
Northwest

Description: Collapse behind Fire Station and 16 School Street. Drainage issues and land subsidence evident.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
8	4/18/2018

Direction Photo Taken:
Southwest

Description:
Wall cap collapse behind 16 School Street.

Tighe&Bond

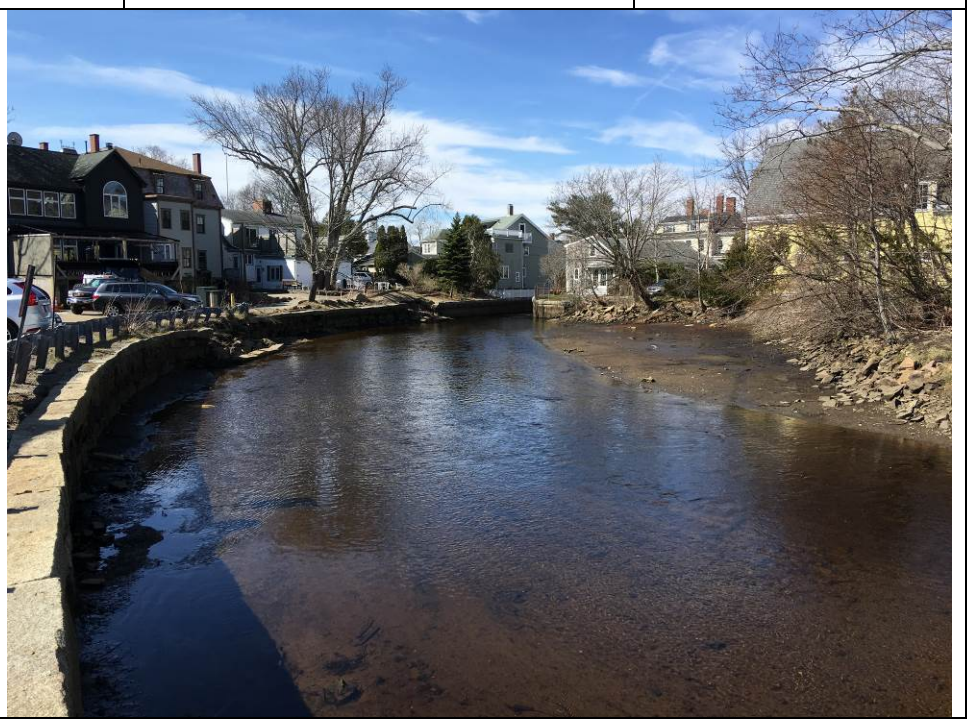
PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
9	4/18/2018

Direction Photo Taken:
South

Description:
Sections of wall collapse on eastern bank of Central Pond Wall. Over 300 feet of the wall is in poor condition. Western bank includes rock revetment and mud flat behind 5 Elm Street, exposed at low tide.



Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
10	5/12/2015

Direction Photo Taken:
South

Description:
View across Central Pond to end of western wall section at 1 Elm Street.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
11	4/18/2018

Direction Photo Taken:
Northeast

Description:
Gravel and rubble western bank in lower Central Pond. Shoreline has a gentle slope.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
12	4/18/2018

Direction Photo Taken:
Southeast

Description:
Western shore of Lower Central Pond. Rock revetment intended to stabilize shoreline just before the Town owned granite wall.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
13	4/18/2018

Direction Photo Taken:
Northeast

Description:
Western shore towards 3 Powderhouse Lane. Gently sloping shoreline stabilized by revetment. The l channel shown in the photos is maintained during low flow/ low tide.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
14	4/18/2018

Direction Photo Taken:
West

Description:
Stormwater outfall behind 17 Elm Street on the western shore, mid-section of Central Pond. The bank is stabilized by revetment, and Sawmill Brook flow channel is maintained at low tide. The mud flat in the foreground is exposed at low tide.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
15	4/18/2018

Direction Photo Taken:
Southwest

Description:
Looking south from the top of Central Pond on the western bank at low tide. Flow is maintained in the western channel. The bottom of the Channel is gravely in this location. Revetment and grass stabilize the bank.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
16	4/18/2018

Direction Photo Taken:
West

Description:
View of the western shore and main channel at low tide. The gravel substrate is carried over to the edge of the bank. The elevated mudflat is shown toward the right.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
17	4/18/2018

Direction Photo Taken:
Northwest

Description:
Loose revetment along banks, 3 Powder House Lane.

Tighe&Bond

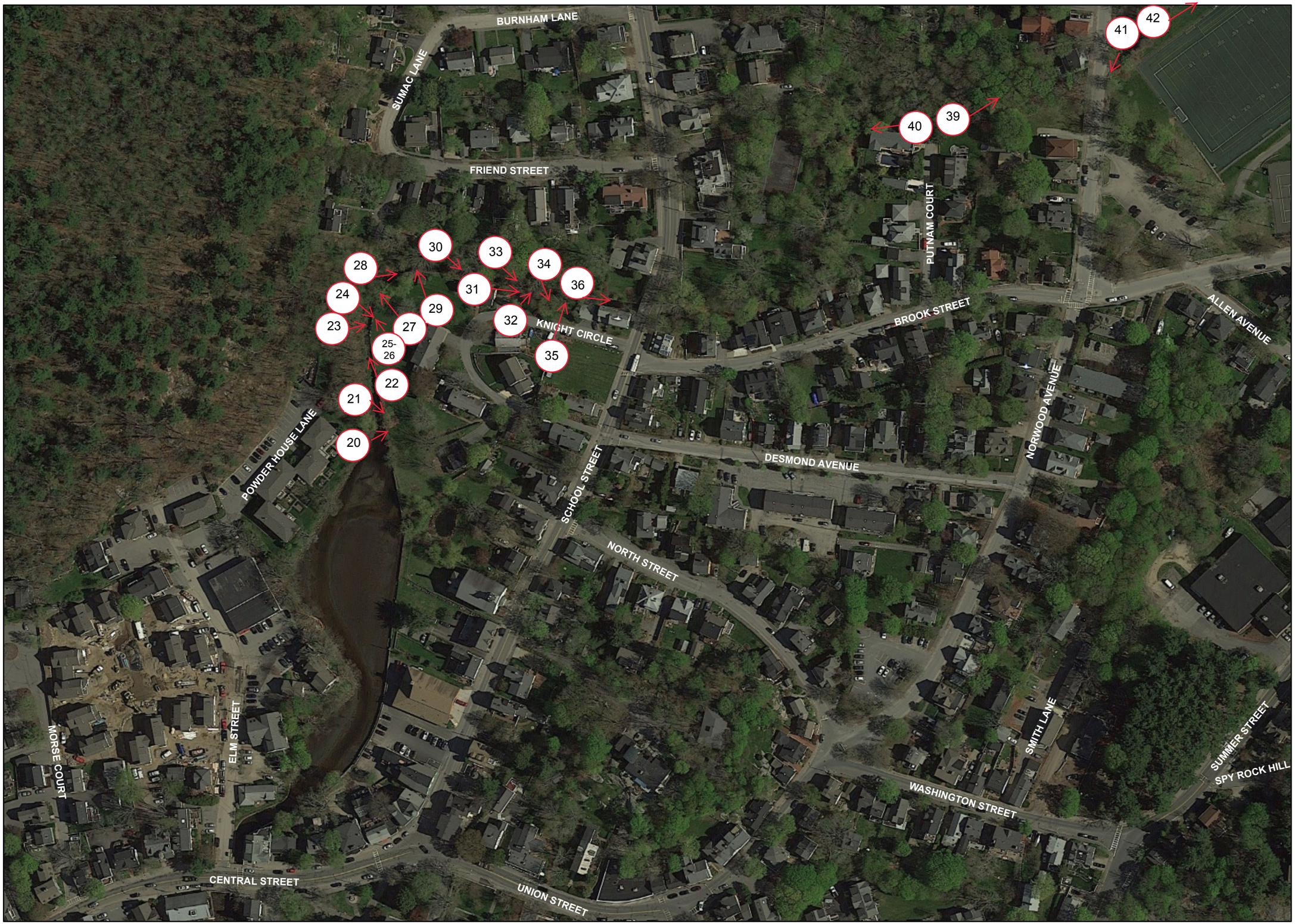
PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
18	4/18/2018

Direction Photo Taken:
Northwest

Description:
Loose revetment along banks, 3 Powder House Lane. A more structured wall is located at the northern edge, just prior to the entrance of the Sawmill Brook channel



Sawmill Brook Wall Survey Photo Log Locations

LEGEND

LOCUS MAP

N
W E
S

0 50 100
Feet

1 inch equals 150 feet

NOTES

Sawmill Brook Area
Manchester By the Sea,
Massachusetts

April 2018

Tighe&Bond
Engineers | Environmental Specialists

G:\GIS\MA\ManchesterMA\avproj\Ortho_SawmillBrook_11x17.mxd Date Saved: 9/29/2017 User: JSM

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
19	4/18/2018

Direction Photo Taken:
East

Description:
Sections of wall collapse behind 20 Summer Street.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
20	4/18/2018

Direction Photo Taken:
East

Description:
Wall collapse behind 8 Knights Circle.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
21	4/18/2018

Direction Photo Taken:
Southeast

Description:
Wall collapse behind 8 Knights Circle.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
22	4/18/2018

Direction Photo Taken:
North

Description:
Wall collapse behind 8 Knights Circle.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
23	4/18/2018

Direction Photo Taken:
Northeast

Description:
Beaver Dam

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
24	4/18/2018

Direction Photo Taken:
East

Description:
Land subsidence and wall collapse 8 Knights Circle.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
25	4/18/2018

Direction Photo Taken:
West

Description:
Land subsidence, wall collapse and drainage issues Knights Circle.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
26	4/18/2018

Direction Photo Taken:
East

Description:
Land subsidence, wall collapse and drainage issues Knights Circle.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
27	4/18/2018

Direction Photo Taken:
North

Description:
High flows are near the top of bank behind Knights Circle. Northern bank granite walls are build up higher.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
28	4/18/2018

Direction Photo Taken:
Northeast

Description:
Land subsidence, wall collapse on south bank Knights Circle. North bank wall is built up higher.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
29	4/18/2018

Direction Photo Taken:

Description:
In-stream rock riffle. Debris and vegetation restricting flow.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
30	4/18/2018

Direction Photo Taken:

Description:
Bend in the Sawmill Brook. Wall is maintained on the south bank and a jumble of granite blocks on the north.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
31	4/18/2018

Direction Photo Taken:
East

Description:
Rock bank on either side. Evidence of bank overtopping on the east.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
32	4/18/2018

Direction Photo Taken:
Northeast

Description:
Loose rocky bank, and invasive covering the shore.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
33	4/18/2018

Direction Photo Taken:
South

Description:
Section of native fieldstone wall behind Knights Circle.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
34	4/18/2018

Direction Photo Taken:
Southeast

Description:
Native fieldstone wall behind Knights Circle.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
35	4/18/2018

Direction Photo Taken:
West

Description:
Native fieldstone wall behind 10 Knights Circle.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
36	4/18/2018

Direction Photo Taken:
West

Description:
Native fieldstone walls behind 10 Knights Circle.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
37	4/18/2018

Direction Photo Taken:
North

Description:
Collapsed granite wall section behind Friend Street.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	Date:
38	4/18/2018

Direction Photo Taken:
Northeast

Description:
Granite walls behind 6 Friend Street.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
39	4/18/2018

Direction Photo Taken:
East

Description:
Looking towards Norwood Ave, the Brook widens out overtopping wetland banks on the north.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
40	4/18/2018

Direction Photo Taken:
West

Description:
Poured concrete wall with cap behind 6 Putnam Court.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
41	4/18/2018

Direction Photo Taken:
Southwest

Description:
View towards Coach Fields Park and Norwood Avenue Bridge. Granite and fieldstone walls along the western bank. Remains of beaver dam in center.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.:**
Manchester-by-the-Sea, MA	Central Pond	M-1476-009

Photo No.	**Date:**
42	4/18/2018

Direction Photo Taken:
Northeast

Description:
View towards Elementary School. Evidence of west bank overtopping. Beaver activity evident in the foreground.