Tighe&Bond

Manchester-by-the-Sea, Massachusetts

Stream Crossing Evaluation, Sawmill Brook Watershed

Prepared For:

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

July 30, 2015

CONTENTS

Stream Crossing Evaluation in Sawmill Brook Watershed

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

FROM: Gabrielle C. Belfit, Janet Moonan; Tighe & Bond

COPY: M. Gregory Federspiel, Town Administrator

David A. Murphy, P.E. Vice President, Tighe & Bond

DATE: July 28, 2015

The Sawmill Brook and associated tributaries provides drainage for the central portion of the Town of Manchester-by-the-Sea (Town). Stream crossing infrastructure along the Brook and tributaries includes the Central Street tidal dam, culverts and bridges. These structures, many of which are over 100 years old, include arches, bridges, and pipes, constructed from a wide variety of materials including granite block, stone, aluminum, iron, and concrete.

The Town Department of Public Works (DPW) and Highway Department crews report dozens of culverts that appear to be undersized, in poor condition, or impacted by beaver dams. Deterioration, blocked culverts, and undersized structures frequently create flood water that backs up onto roadways and adjacent land, resulting in roadway closure and property damage. Culverts that have collapsed in the recent past due to flooding include two locations on School Street (one at Brook Street and one near Route 128) and the culvert at Atwater Ave.

Task 2 of the Sawmill Brook Culvert Evaluation Coastal Zone Management (CZM) grant project provides an in-depth evaluation of all municipally owned stream crossing structures in the Sawmill Brook Watershed. The information obtained as part of Task 2 provides baseline observations of current conditions and information for setting up the watershed model in Task 4. The model will be used to evaluate the culvert capacity under future climate change conditions including flood storage projects that may be implemented at various locations within the watershed. This memo summarizes the culvert evaluation protocol, data collection, culvert evaluation results, and the tide gate evaluation.

1) Development of Stream Crossing Evaluation Protocol

A standardized stream crossing evaluation protocol, modified after the *Oyster River Culvert Analysis EPA Pilot Projec*t (University of New Hampshire, 2010), was used to evaluate all municipally owned stream crossing structures (i.e. culverts and bridges) including the Central Street tidal dam (seawall and tide gate). The protocol includes obtaining photo documentation of the exposed and above water portions of the structure both upstream and downstream, field measurements of critical dimensions, and observations on physical and environmental attributes.

A draft field evaluation form was reviewed by the Town, Manchester Coastal Stream Team (Stream Team) coordinator, and Tighe & Bond's flood plain specialist. The forms were simplified from the original Oyster River templates to tailor data collection for the essential fields needing hydraulic evaluation and modeling input. Diagrams were added to the forms to provide a consistent reference on where to collect measurements.

Maps were developed to identify all culvert locations and the culverts were numbered sequentially, generally proceeding from the top to the bottom of the watershed. Detailed site maps were also prepared, showing orthography and hydrography to assist with the field work effort. The final field evaluation form and maps are included in Appendix A.

2) Stream Crossing Data Collection

The stream crossing data collection involved three separate components. Volunteers were recruited to assist with a one-day field data collection event on May 30, 2015. A separate culvert evaluation was completed on June 11, 2015 for the Central Street tide gate and associated structures by Tighe & Bond's coastal engineer, as discussed in Section 4. Finally, a survey crew was deployed the week of July 20, 2015 to obtain culvert inlet/outlet elevations at specific locations along Sawmill and Cat Books. Utilizing different levels of expertise to gather the stream crossing evaluation data resulted in efficient use of resources and budget savings.

a) Volunteer Field Team Data Collection Event

On May 30, 2015, sixteen volunteers assisted Town staff and Tighe & Bond engineers and scientists with a field effort to photograph and collect vital statistics on the culverts and stream crossings throughout town. The volunteers were recruited from regional and local groups including Salem Sound Coast Watch, Stream Team, high-school environmental organizations, and Town committees including Conservation and Open Space. The Town Grants Administrator and Stream Team Chair took the lead in recruiting and coordinating the volunteer field team and Tighe & Bond assisted with pre-planning logistics, such as equipment lists and developing a site safety plan.

Tighe & Bond provided training for the volunteer field team and team coordinators on how to complete the stream crossing evaluation using the protocol and field data forms. Team members met at Town Hall for the initial briefing to coordinate the 12 team groups, provide culvert assignments, distribute paper work and equipment, and review the site safety plan. This was followed by an on-site demonstration at a centrally located culvert on how to observe and record the data and provide identifiable photographs. The field teams then departed to complete team data collection assignments. Tighe & Bond staff were in phone contact with all teams and provided spot checks to make sure that protocol was being followed. At the conclusion of the data collection, the teams returned equipment and completed data forms to Town Hall, and provided digital photos through email or drop box websites. To publicize this public participation event, candid photographs from the field event were collected in a scrapbook format and published on the Town's website, as shown in Appendix B. The completed data forms and photo diaries from the field event are included in Appendix C.

b) Culvert Elevation Surveys

Accurate culvert inlet and outlet elevations are a critical component for the Sawmill Brook Watershed Modeling effort that will be completed as part of Task 4 of this project. Existing culvert information from the a 2007 field survey completed to support the February 2008 Hydrologic Study for Millets Brook and Sawmill Brook Watersheds was provided by the Town for a dozen culvert locations within the Sawmill Brook. A copy of the survey results from this report are included in Appendix D. Field survey was conducted in July 2015 to capture twelve additional key culvert locations and to verify results from two of the 2007 survey locations along the primary stream segment of Sawmill and Cat Brook and select locations in the tide gate (Culvert ID 25) not previously surveyed. The figures in Appendix D indicate the locations for the 2007 and 2015 surveys. The results of the survey are also included in Appendix D. The *Sawmill Brook Culvert Evaluation Results May 30th Volunteer Field Effort* summary table in Appendix D provides a summary of all culvert dimensions, elevations, survey source, culvert type and general conditions. In some cases, volunteers were not able to access one or more of the locations needed to gather data. Missing data were supplemented with results from previous surveys, as shown in the summary table.

3) Culvert Evaluation Results

Twenty four (24) culverts were inventoried in June 2015. Culverts 1 and 14 were unable to be located in the field and are believed not to exist. The majority were open bottom arch construction, and about half of the culverts were observed to have condition issues. The majority of the culvert locations had sediment buildup upstream and about half of the locations also had sediment buildup downstream. Blockages that might impede flow included concrete pipe, detritus, woody vegetation, metal, and beaver dams.

Table 1 provides a descriptive summary of the observed culvert construction and observed issues. Measured stream crossing and structural dimensions are summarized in Table 2. All measurements were made following the established protocol described in the field forms. In three locations, the data obtained by the 2015 stream volunteers varied from the 2008 survey. Based on knowledge of the field volunteer's equipment, training and experience, the 2015 data was retained, and the variations attributed to changing culvert conditions over a span of 7 years.

TABLE 1

Summary of culvert observations

Culvert	Location	Construction and Other Features	Observed Issue
1	Conservation	N/A	Does not exist or was unable to be located
2	School St	Old, dry stone box culvert construction, beaver deceiver	Beavers
3	School St	New, metal open bottom arch construction	None
4	Atwater Ave	Old, metal open bottom arch construction	Upstream erosion and beaver dam
5	Conservation	Metal open bottom arch construction	Rust, upstream scour
6	School St	New concrete round culvert	
7	Forest Ln	Old, stone open bottom arch construction	Collapsing, upstream backup and sediment buildup, downstream erosion
8	Loading Place Road	New, plastic round culverts (3)	Sediment buildup up and downstream, beaver dam upstream
9	Pine St	Old, metal round culverts (2)	Upstream sediment buildup, downstream clogged with sand
10	Rockwood Hts	Old, concrete and stone embedded round culverts (2)	Up and downstream sediment buildup, downstream clogged with mud
11	Mill St	Concrete open bottom arch construction	Up and downstream sediment buildup
12	Millet Ln	Metal embedded elliptical culvert	Rusty outlet, organic debris, up and downstream sediment buildup, erosion along headwall
13	The Plains	New, metal open bottom arch construction	Up and downstream sediment buildup
14	Old Essex Rd	N/A	Does not exist or was unable to be located
15	Blue Heron Ln	New, concrete open bottom arch construction	Up and downstream sediment buildup, downstream erosion and headwall needs patching

Culvert	Location	Construction and Other Features	Observed Issue
16	Golf Course	Metal bridge with stone abutments	Natural gravel and stone bottom. *
17	Lincoln St	Old, stone open bottom arch construction	Up and downstream bank erosion, downstream sediment buildup
18	Lincoln St	Old, stone open bottom arch construction	Branches blocking outlet
19	School St-Golf	Old, metal open bottom arch construction	Wood debris blocking inlet, sediment buildup and detritus downgradient
20	Summer St	Old, metal open bottom arch construction	Concrete channel
21	Summer St	Old, concrete box culvert construction	Upstream sediment buildup and obstructions
22	Norwood Ave	Old, metal/stone bridge with abutments	Upstream erosion sediment buildup, downstream erosion, metal falling off
23	School St	Old, concrete/stone open bottom arch construction with 2 culverts	Upstream sediment buildup
24	Summer St	Old, concrete/plastic culverts underneath bridge with abutments	Rusted and upstream sediment buildup
25	Central St	Old, stone/concrete open bottom arch construction	Erosion, collapsing support walls, overlay repair
27	Mill St	Old, stone open bottom arch construction	Branches blocking outlet

***Culvert observations from the Metcalf and Eddy 2008 Sawmill Brook Watershed report**

TABLE 2

Summary of stream crossing dimensions

Culvert #	Stream	Street	Inlet Dimensions (ft)		Outlet Dimensions (ft)		Length (ft)	Crossing #s
			Width	Height	Width	Height		
1	Sawmill Brook	Conservation	None					
2	Cedar Swamp	School Street	2.67	2.67	3.33	2.83	45.0	1
3	Sawmill Brook	School Street	15.35	6.58	15.35	6.58	58.0	1
4	Sawmill Brook	Atwater Avenue	14.70	8.30	14.70	8.30	42.0	1
5	Sawmill Brook	Conservation	9.00	5.58	9.00	5.67	38.0	1
6	Sawmill Brook	School Street	1.10	1.10	1.10	1.10	28.0	1
7	Cat Brook	Forest Ln	11.6	2.9	11.6	2.9	20.2	1
8	Cat Brook	Load Place	2.00	2.00	2.00	2.00	30.7	3
9	Sawmill Brook	Pine Street	2.92	2.92	2.92	2.92	42.0	2
10	Sawmill Brook	Rockwood Heights	1.83	1.58	1.83	1.25	25.0	2
11	Cat Brook	Mill Street	12.50	3.70	12.00	5.58	20.1	1

12	Sawmill Brook	Millet Lane	5.00	5.00	2.50	2.50	35.0	1
13	Sawmill Brook	The Plains	5.00	2.00	5.00	2.75	40.0	1
14	Sawmill Brook	Old Essex Road	None					
15	Sawmill Brook	Blue Heron Lane	2.50	2.50	2.50	2.50	28.0	1
16	Sawmill Brook	Golf Course	12.0	9.52	11.50	9.58	20.0	
17	Sawmill Brook	Lincoln Street	12.00	6.00	12.00	6.00	50.0	1
18	Causeway Brook	Lincoln Street	14.50	3.67	13.00	3.67	60.0	1
19	Causeway Brook	School Street-Golf	8.33	4.50	7.75	4.08	41.2	1
20	Causeway Brook	Summer Street	8.17	4.25	10.25	4.92	15.0	1
21	Causeway Brook	Summer Street	5.42	3.10	5.42	3.10	59.2	1
22	Sawmill Brook	Norwood Avenue	14.25	5.50	13.00	5.42	42.0	1
23	Sawmill Brook	School Street	8.76	4.67	8.92	4.83	36.0	2
24	Causeway Brook	Summer Street	3.58	2.10	1.58	1.58	60.1	1
25	Sawmill Brook	Central Street	16.00	6.67	14.00	8.25	42.0	1
27	Sawmill Brook	Mill Street	7.10	7.10	6.80	6.80	47.0	1

4) Tide Gate/Culvert/Dam Evaluation

On June 11, 2015, a site visit was held in conjunction with the Massachusetts Division of Marine Fisheries (DMF), Tighe & Bond staff, and the Manchester-by-the-Sea Grants Administrator. The purpose of the visit was to discuss concerns with present tide gate fish passage restrictions and related issues with the project coastal engineer prior to his completing the on-site tide gate evaluation. A memorandum summarizing the DMF site visit is included in Appendix E. Following the DMF site visit, the Town DPW director authorized the opening of the tide gate to lower the impoundment surface water level and provide full access to observe the tide gate/culvert/dam structures. Observations by the project coastal engineer of immediate structural safety concerns were summarized in a June 18, 2015 memo to the Town DPW director and Town Administrator. A copy of the memo and the full tide gate/culvert/dam evaluation is included in Appendix E.

References

University of New Hampshire. (2010). *The Oyster River Culvert Analysis*. Environmental Protection Agency Climate Ready Estuary Pilot Project.

\\SRV\Projects\M\M1476 Manchester MA Hydro Study\Task 2-Stream Crossing Survey\Stream Crossing Eval Memo.docx

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APPENDIX A

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID:

Nearest Address:

Stream Name:

Observer Names:

Date: Time:

Flow Conditions: ☐ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☐ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☐ Paved	☐ Unpaved		
Road Type	☐ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☐ No		
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☐ New	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: _____

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
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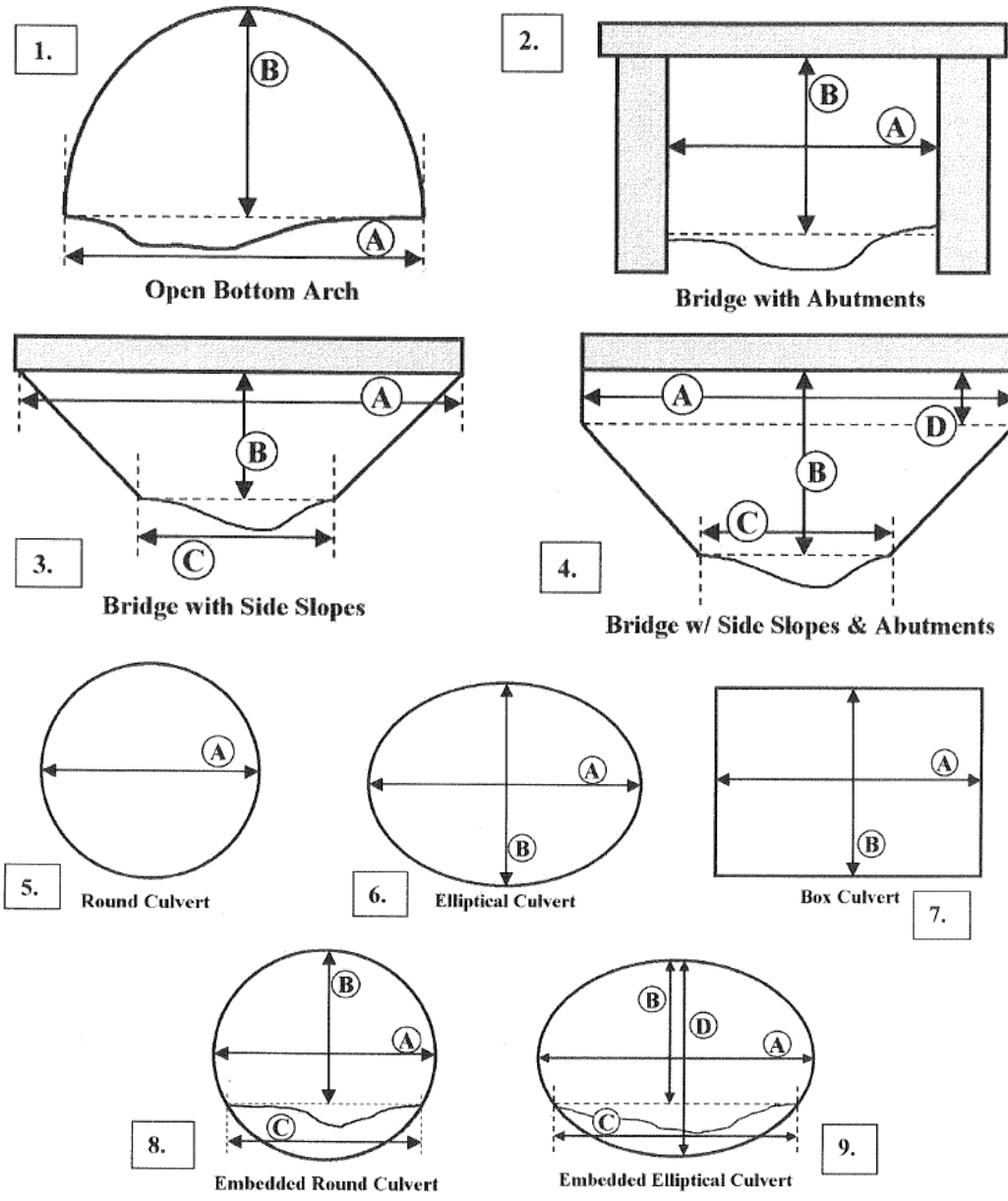
Crossing Type and Dimensions



Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Downstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Structure ID: _____

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
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Upstream

Headwall Material: ☐ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by:	☐ Wood	☐ Sediment	☐ Wood and Sediment	☐ Culvert Deformed	☐ None
Angle of stream flow approaching structure:	☐ Sharp Bend	☐ Mild Bend	☐ Naturally Straight	☐ Channelized Straight	
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☐ Erosion	☐ Sediment Buildup	☐ None		
Culvert inlet:	☐ At Grade	☐ Cascade	☐ Free Fall		
Upstream bankfull widths (see page 4): _____ feet					

Downstream

Water depth in culvert (at outlet): _____ feet				
Culvert outlet:	☐ At Grade	☐ Cascade	☐ Free Fall	☐ Backwatered _____ feet
Outlet drop (invert to water surface): _____ feet				
Pool present immediately downstream of structure:	☐ Yes	☐ No		
Pool depth at point of streamflow entry: _____ feet				
Maximum pool depth: _____ feet				
Evidence of streambed erosion or sediment buildup immediately downstream of culvert:	☐ Erosion	☐ Sediment Buildup	☐ None	
Downstream bankfull widths (see page 4): _____ feet				

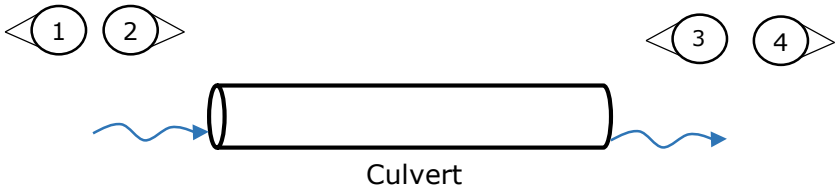
	Upstream	*In Structure*	*Downstream*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK			
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: ☐ Yes ☐ No Distance from structure to dam: _____ feet	☐ Yes ☐ No _____ feet	☐ Yes ☐ No _____ feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls

Structure ID: _____

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Photograph Instructions

Take at least four (4) photographs of the culvert and surrounding area. These photographs must be taken for every culvert that is visited. Additional photographs are also acceptable.



Culvert

Photograph 1:	Upstream from culvert inlet
Photograph 2:	Culvert inlet
Photograph 3:	Culvert outlet
Photograph 4:	Downstream from culvert outlet
Photograph 5 and on:	Miscellaneous photographs

A number with the **structure ID** and **description of what you are photographing** must be visible and clear in EVERY photograph that is taken. For the description of what you are photographing, the following codes can be used: "UPSTREAM," "INLET," "OUTLET," or "DOWNSTREAM." For example:

Structure ID

Downstream

If additional photographs are taken, please include the structure ID and description of the photograph. For example:

Structure ID

Sediment buildup in culvert

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
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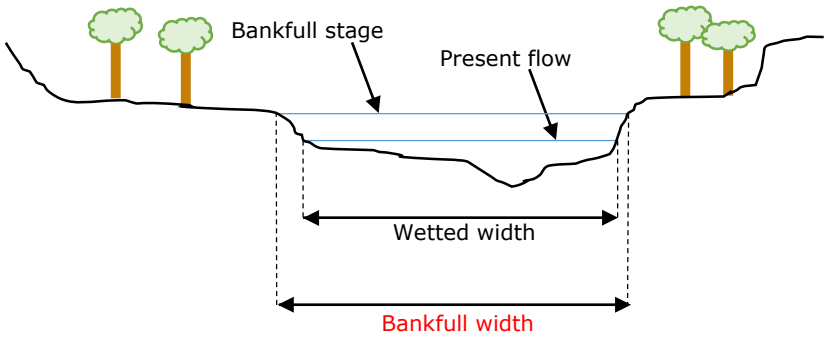
Bankfull Width

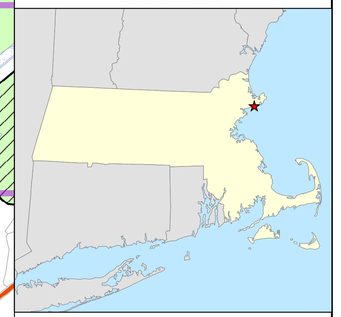


STREAM CROSSING LOCATIONS

LEGEND

- Sawmill Brook Watershed
- Town Boundary
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Town Owned Property
- Parcels
- MassDOT Culvert
- Culvert
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Open Space

LOCUS MAP



0 250 500 1,000 Feet

1 " = 500 '

NOTES

Data sources: Town of Manchester-by-the-Sea, Office of Geographic and EnvironmentalInformation (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Sawmill Brook Culvert & Green Infrastructure Analysis
Manchester-by-the-Sea, MA

Tighe&Bond
June 2015

FIGURE 1

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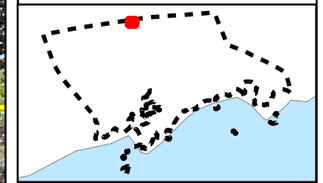
Field Map: **1**

Culvert ID: **2619**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



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Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

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X-XXXX

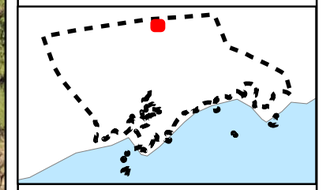
Field Map: **2**

Culvert ID: **2622**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



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Feet

1 inch equals 50 feet

NOTES

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Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

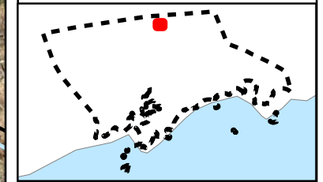
Field Map: **3**

Culvert ID: **2631**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



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Feet

1 inch equals 50 feet

NOTES

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Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

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X-XXXX

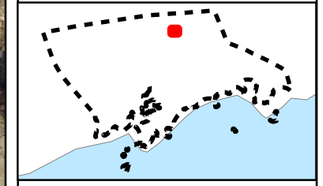
Field Map: **4**

Culvert ID: **2639**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



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Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

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Environmental Specialists

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X-XXXX

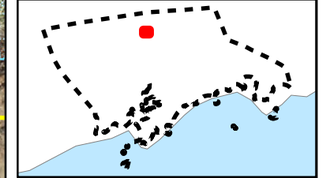
Field Map: **5**

Culvert ID: **2641**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



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Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

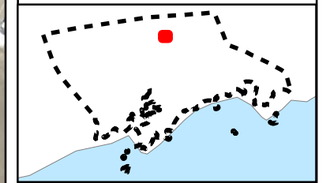
Field Map: **6**

Culvert ID: **2653**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

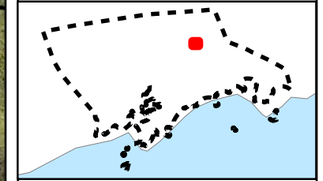
Field Map: **7**

Culvert ID: **2656**

Stream: **EAST BRANCH CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

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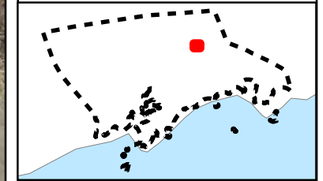
Field Map: **8**

Culvert ID: **2658**

Stream: **EAST BRANCH CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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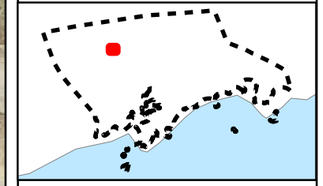
Field Map: **9**

Culvert ID: **2664**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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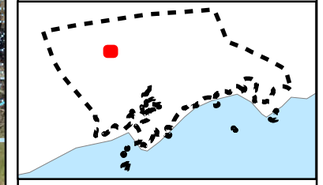
Field Map: **10**

Culvert ID: **2664**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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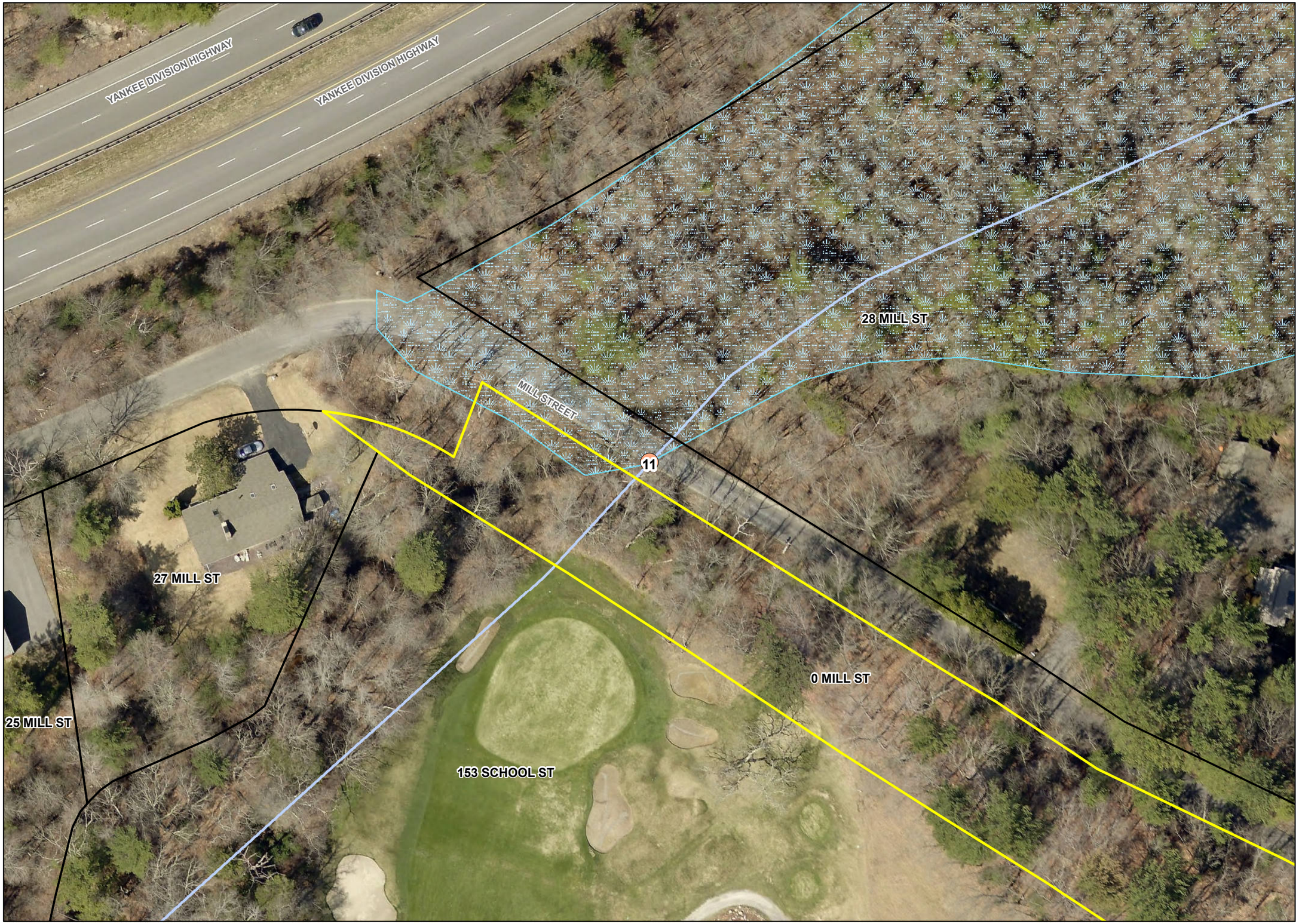


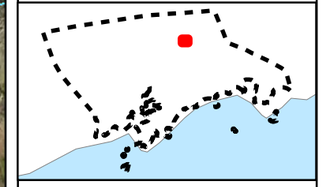
Field Map: **11**

Culvert ID: **2665**

Stream: **CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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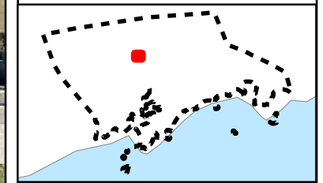
Field Map: **12**

Culvert ID: **2668**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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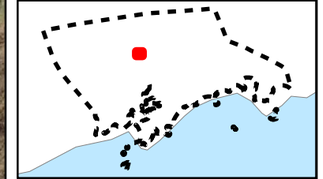
Field Map: **13**

Culvert ID: **2668**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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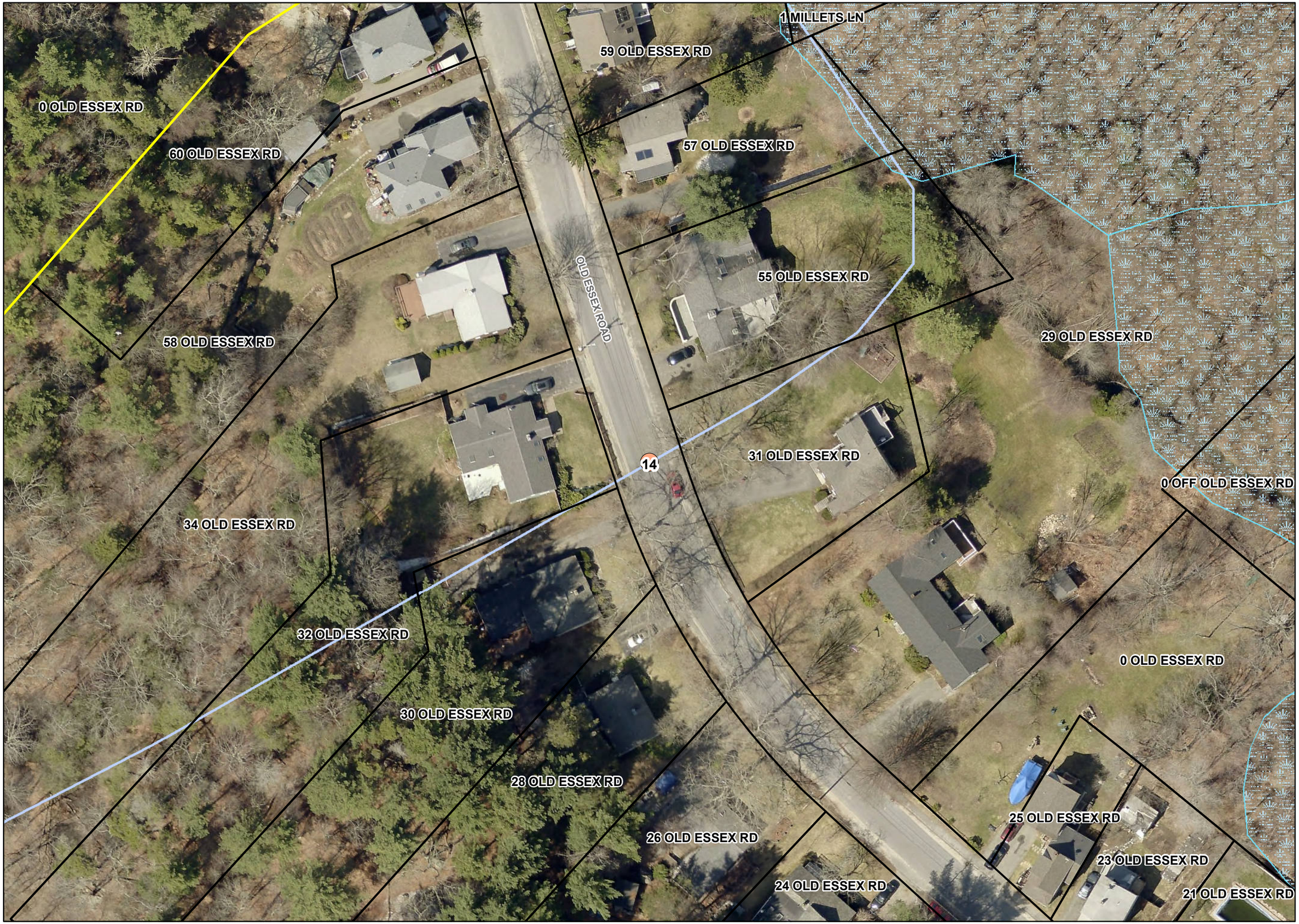


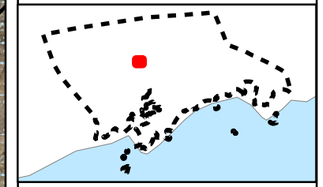
Field Map: **14**

Culvert ID: **2668**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

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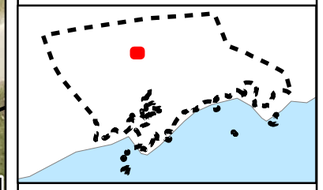
Field Map: **15**

Culvert ID: **2668**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

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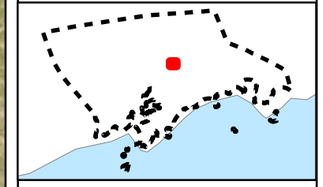
Field Map: **16**

Culvert ID: **2669**

Stream: **CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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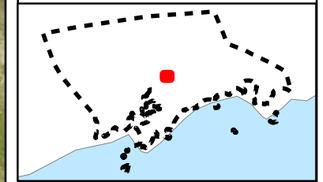
Field Map: **17**

Culvert ID: **2672**

Stream: **CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

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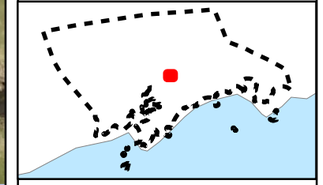
Field Map: **18**

Culvert ID: **2673**

Stream: **CAUSEWAY BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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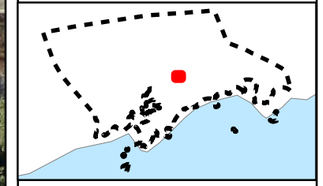
Field Map: **19**

Culvert ID: **2673**

Stream: **CAUSEWAY BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

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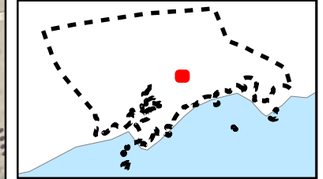
Field Map: **20**

Culvert ID: **2673**

Stream: **CAUSEWAY BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



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0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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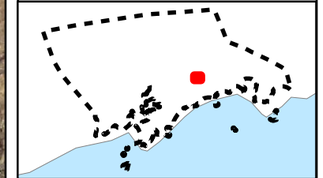
Field Map: **21**

Culvert ID: **2675**

Stream: **CAUSEWAY BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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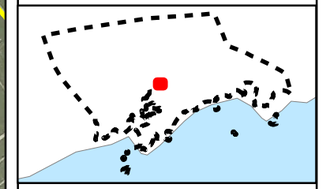
Field Map: **22**

Culvert ID: **2686**

Stream: **CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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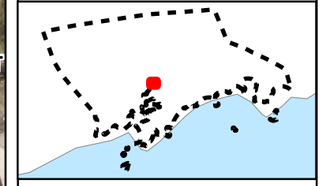
Field Map: **23**

Culvert ID: **2686**

Stream: **CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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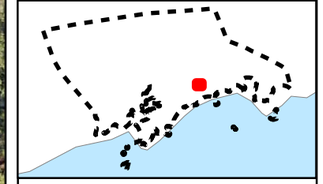
Field Map: **24**

Culvert ID: **2687**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

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NOTES

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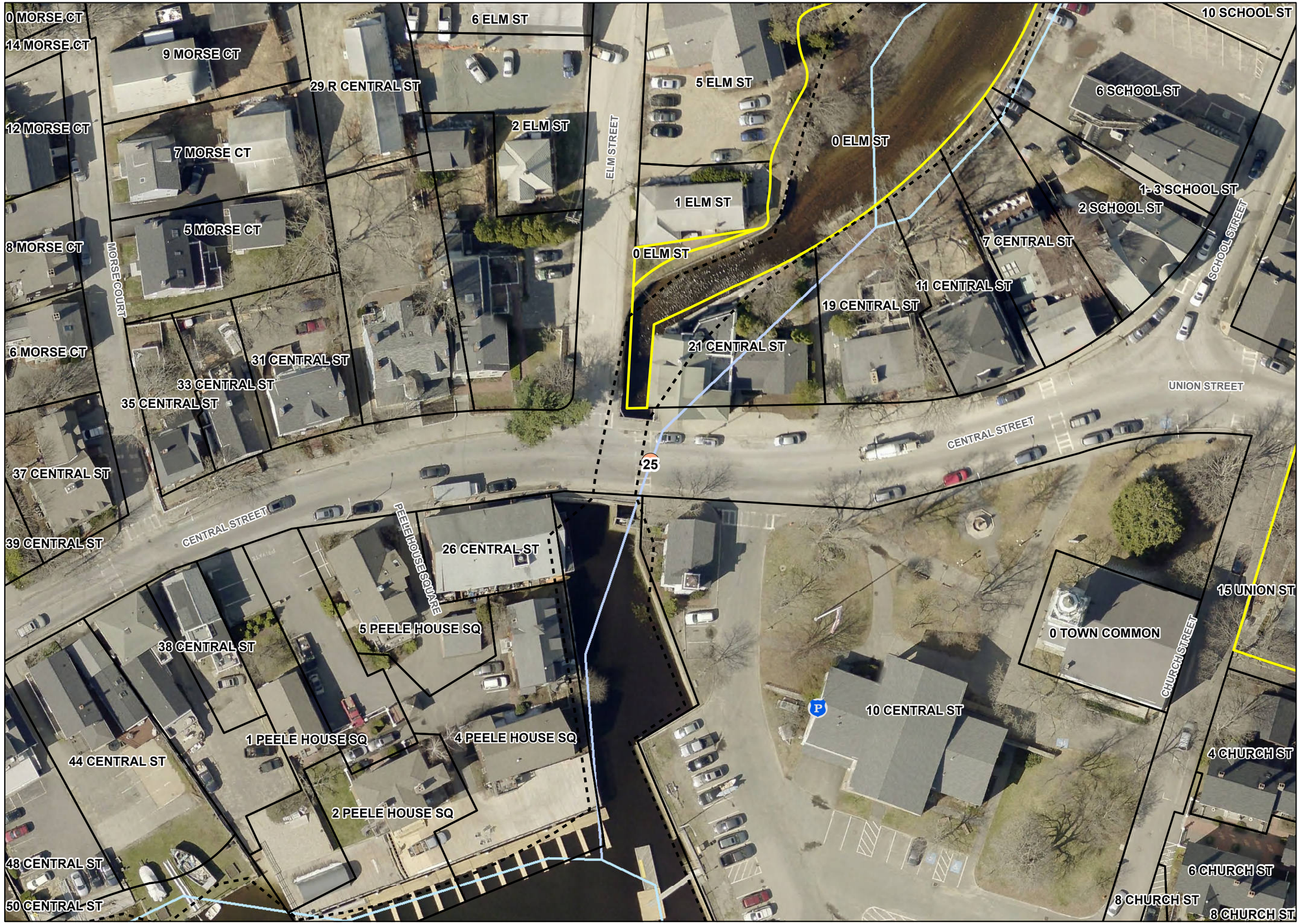


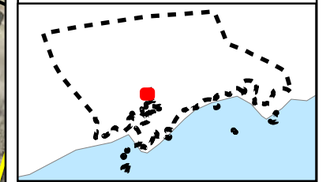
Field Map: **25**

Culvert ID: **2697**

Stream: **CAT BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

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NOTES

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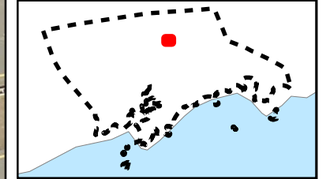
Field Map: **26**

Culvert ID: **2666**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

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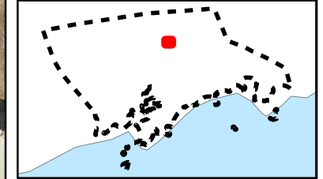
Field Map: **27**

Culvert ID: **2666**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

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NOTES

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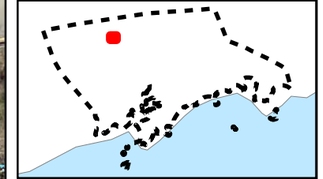
Field Map: **28**

Culvert ID: **2664**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

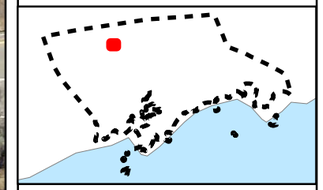
Field Map: **29**

Culvert ID: **2664**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

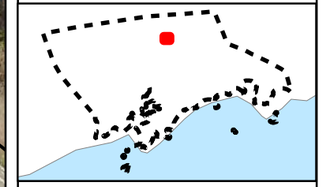
Field Map: **30**

Culvert ID: **2653**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

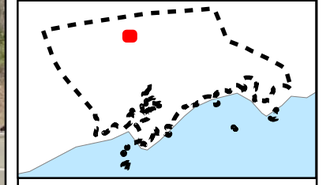
Field Map: **31**

Culvert ID: **2642**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

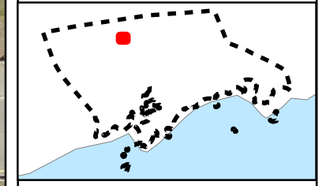
Field Map: **32**

Culvert ID: **2645**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

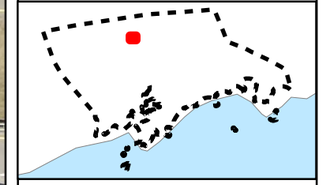
Field Map: **33**

Culvert ID: **2647**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

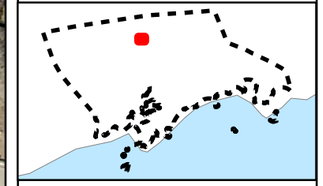
Field Map: **34**

Culvert ID: **2648**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

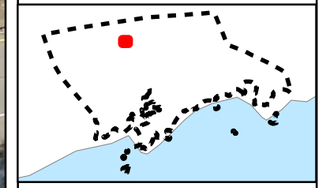
Field Map: **35**

Culvert ID: **2650**

Stream:

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

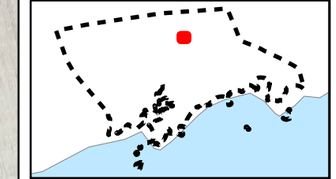
Field Map: **36**

Culvert ID: **2652**

Stream: **SAWMILL BROOK**

- MassDOT Culvert
- Culvert
- Fire Station
- Police Station
- WTP Wastewater Treatment Plant
- Schools (PK - High School)
- Inland Wetlands
- Coastal Wetlands
- Waterbodies
- Rivers and Streams
- Municiple Properties
- Parcels
- Sawmill Brook Watershed

LOCUS MAP



N

0 12.5 25 50

Feet

1 inch equals 50 feet

NOTES

Based on Town's GIS and Color Orthophotography received from AppliedGeo in January 2014

Manchester-by-the-Sea
Massachusetts

May 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

Path: G:\GIS\MA\ManchesterMA\avproj\MBTS_Culvert_Mapbook.mxd

X-XXXX

Tighe&Bond

APPENDIX B

Culvert Survey, May 2015

Volunteer Field Work in Sawmill Brook Watershed, Manchester-by-the-Sea

VOLUNTEER TEAM HELPS WITH CULVERT SURVEY

A group of volunteers led by the Manchester-by-the-Sea Stream Team and Salem Sound Coast Watch assisted Tighe & Bond engineers and scientists with a field effort to photograph and collect vital statistics on 40 culverts throughout the Sawmill Brook Watershed on May 30th, 2015.

This survey effort was part of a Coastal Zone Management Grant to evaluate the capacity of culverts under future climate change conditions and identify options to reduce flooding by developing flood storage in the watershed.

Top: Jessica Lamothe, Stream Team Coordinator and Mary Reilly, Town Conservation Administrator plan the survey route.

Middle: Tighe & Bond Staff instruct the group on field data collection.

Bottom: Volunteers look on and gear up to take on assigned culverts. See Page 5 for list of all volunteers.

TEAMWORK

MERHS Green Team members, Jake Brugger, Redmond Pulver, Belle Allmendinger and Eric Magers survey culverts along Causeway Brook and enjoy some beautiful vistas along the way.

Barbara Warren, Salem Sound Coast Watch and Eric Thomsin, Stream Team, take on culverts at the top of the watershed where poison ivy, briars and beaver dams created some challenges to obtaining data.

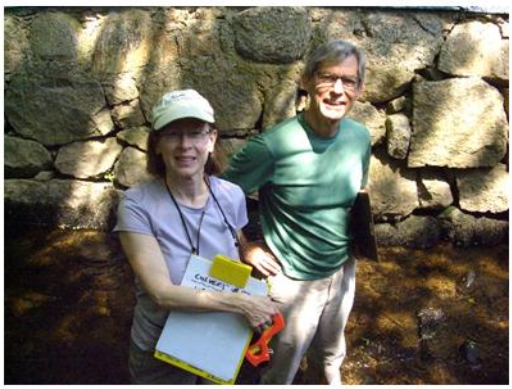
Susan demonstrates technique for culvert photo identification

Examining culvert arch and bottom construction material

Steve and Jessica measure the headwall

Jessica provides directions on measuring "bank-full width"

Jennie and Susan compare notes



Mary and David discuss strategy to measure road crossing width

A HUGE THANK YOU TO ALL THE AWESOME VOLUNTEERS* WHO GAVE UP A SATURDAY TO HELP OUT!!

Jennie Moonan and Amanda Crouch-Smith, Tighe and Bond staff are all smiles thanks to everyone's help, in spite of the creepy bugs, poison ivy and missing culverts.

***Awesome Volunteers:**

Mary Reilly
Jessica Lamothe
Barbara Warren
Eric Thomsin
Jack Nessen
Belle Allmendinger
Redmond Pulver
Jack Brugger
Lisa Watt-Bucci
Olga Hayes
Francie Caudill
Eric Magers
Lynn Atkinson
Carolyn Kelly
Susan Costello
David Lumsden
Joan Nesbit
Donna Dowal
Steve Gang

Tighe&Bond

APPENDIX C

Culvert #1
Culvert was not found and believed to not exist

Culvert #2
Old School Street

Amanda / Frankie / Donna

Town of Manchester-by-the-Sea

Tighe&Bond

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room

QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: #~~1~~ 2

Nearest Address: Cedar Swamp near parking along upper school Street

Stream Name: Unamed

Observer Names:

Date: 5/30/15 Time: 10:30AM

Flow Conditions: ☐ Unusually low ☑ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☑ 1 unimproved gravel lane	☐ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ ~~1~~ None	☐ 2		
Road Surface:	☐ Paved unpaved	☐ Unpaved	Pea stone	
Road Type	☐ Road	☑ Trail	☐ Railroad	

Structure Information

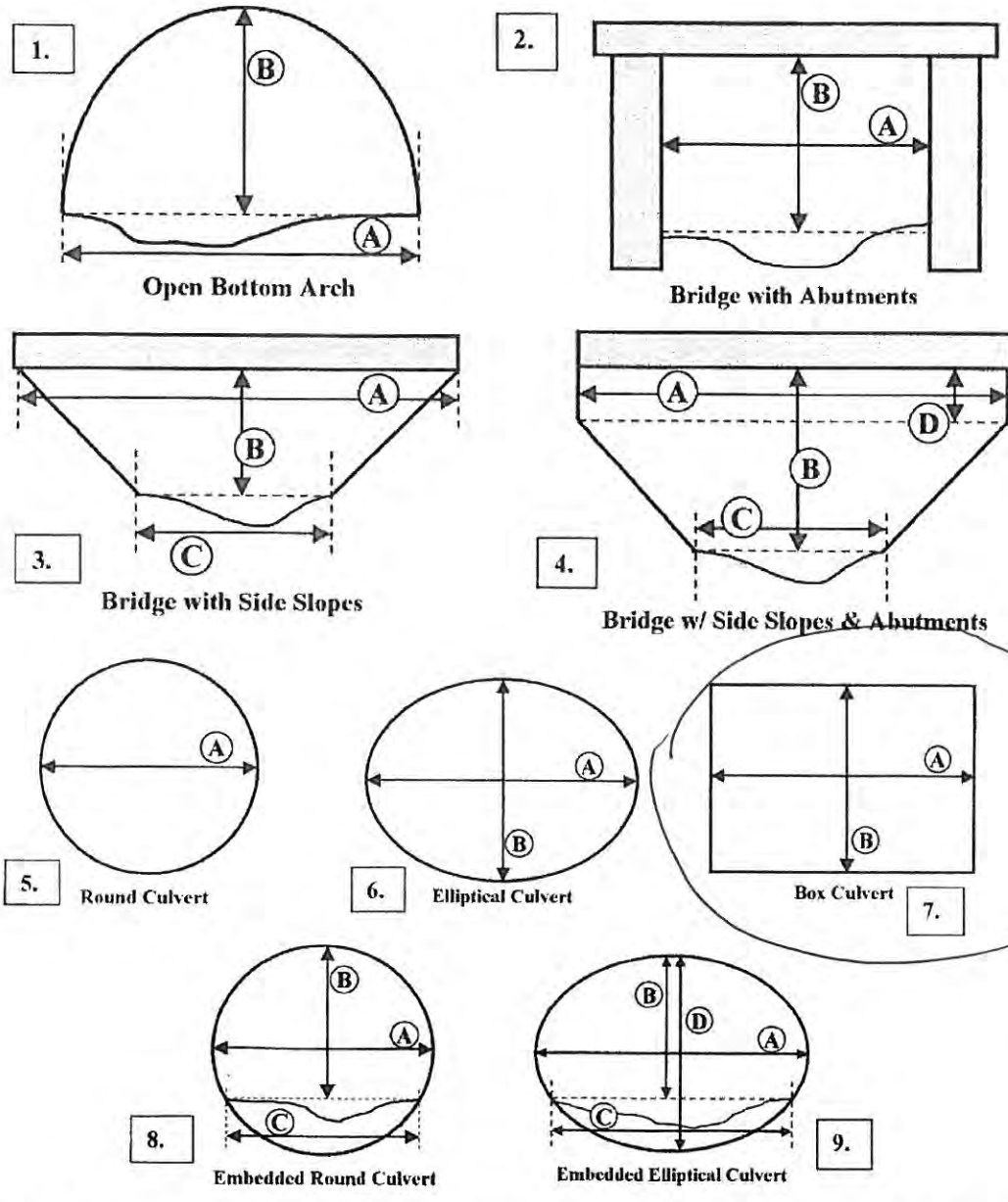
Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): dry stoned masonry	
Structure Skewed to Roadway?	☑ Yes	☐ No		
(W) Approximate Length (if feasible to measure):	40 feet			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



NOTE: dry stone masonry open bottom. W/ tons of organic matter

Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☑ 7. ☐ 8. ☐ 9.

* varies due to old stone

Upstream Dimensions (feet): A = 32-34 inches B = 2 Feet 8 inches C = _____ D = _____

Downstream Dimensions (feet): A = 2 Feet, 8 inches B = 3 Feet, 4 inches C = 2 Feet 10 inches D = _____

Structure ID: CULVERT #5

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☑ Stone ☐ Other (describe): dry stone masonry

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☒ None Beaver Deceivers

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): N/A feet Swamp System

Downstream

Water depth in culvert (at outlet): ____ feet 10 INCHES approx.

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered ____ feet

Outlet drop (invert to water surface): N/A feet

Pool present immediately downstream of structure: ☑ Yes ☐ No * Swamp system low gradient stream

Pool depth at point of streamflow entry: ____ feet 10 inches approx.

Maximum pool depth: ____ feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: Sed. as natural feature ☐ Erosion ☐ Sediment Buildup ☑ None

Downstream bankfull widths (see page 4): N/A feet Swamp system low gradient stream

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle): (Silt/Organic)	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK			
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: ☐ Yes ☐ No Distance from structure to dam:	☐ Yes ☐ No ____ feet	☐ Yes ☐ No ____ feet	☐ Yes ☐ No ____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 2

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Old School Street, Culvert #2	Project No. M-1476

Photo No. 1	Date: 5/30/15
Direction Photo Taken: S	
Description: View downstream, in Cedar Swamp.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Old School Street, Culvert #2	Project No. M-1476

Photo No. 2	Date: 5/30/15
Direction Photo Taken: N	
Description: View of culvert outlet, Cedar Swamp	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Old School Street, Culvert #2	Project No. M-1476

Photo No.	Date:
3	5/30/15

Direction Photo Taken: S

Description:
View of culvert inlet, upstream in Cedar Swamp. Beaver guard.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Old School Street, Culvert #2	Project No. M-1476

Photo No.	Date:
4	5/30/15

Direction Photo Taken: S

Description:
View of culvert inlet, upstream in Cedar Swamp. Beaver guard.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Old School Street, Culvert #2**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: N	
Description: View upstream of culvert looking at Cedar Swamp. Beaver guard.	

Culvert #3
Old School Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 3

Nearest Address: 0 School Street

Stream Name:

Observer Names: Belle, Eric, Red, Jake

Date: 5/30 Time: 11:23

Flow Conditions: ☐ Unusually low ☑ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

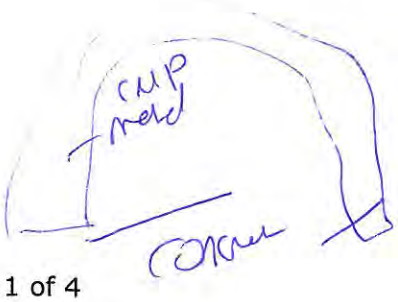
Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☑ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☑ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☐ No		
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☑ New	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted
Number of Crossings:	1			

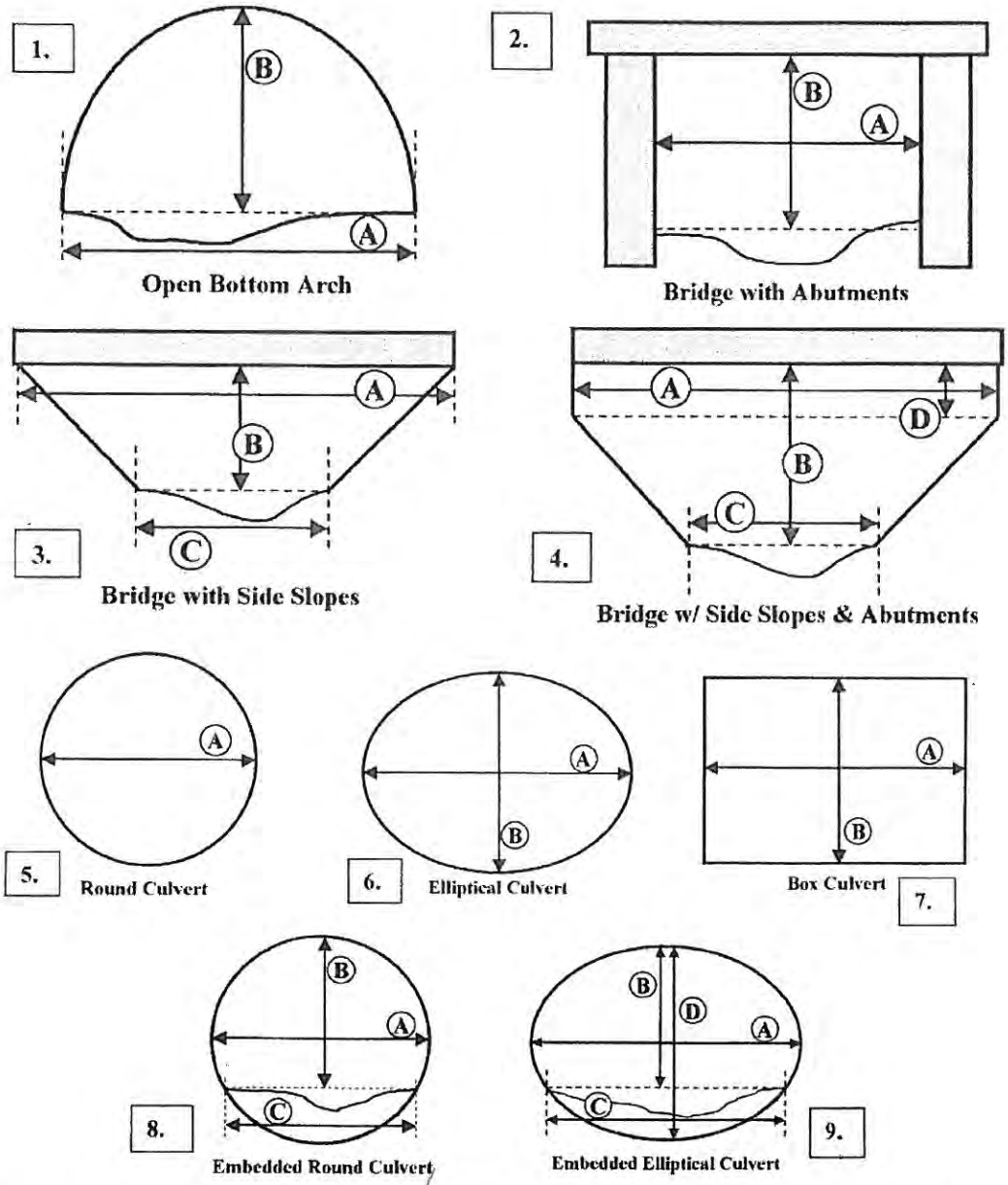
Crossing Type: See next page

new metal.



INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 15.35 B = bf 7in C = _____ D = _____

Downstream Dimensions (feet): A = 15.75 B = bf 7 C = _____ D = _____

Structure ID: _____

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☑ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☑ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 31.2 feet

Downstream

Water depth in culvert (at outlet): _____ feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): _____ feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: _____ feet

Maximum pool depth: _____ feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Downstream bankfull widths (see page 4): 31.2 feet

Pretty smooth

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK			
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID:_____

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #3**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: SW	
Description:	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #3**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: Upstream Culvert Inlet	

Tighe&Bond	**PHOTOGRAPHIC LOG**

Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #3**	**Project No. M-1476**

Photo No. 3 / **Date:** 5/30/15	
Direction Photo Taken: W	
Description: Upstream view from culvert	

Tighe&Bond	**PHOTOGRAPHIC LOG**

Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #3**	**Project No. M-1476**

Photo No. 4 / **Date:** 5/30/15	
Direction Photo Taken: NW	
Description: View upstream from culvert	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #3**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: View Downstream, culvert outlet	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #3**	**Project No. M-1476**

Photo No. 6	**Date: 5/30/15**
Direction Photo Taken: S	
Description: View of culvert outlet, downstream	

Culvert #4
Atwater Avenue

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: # 4

Nearest Address: Atwater Ave (Manchester Athletic Club)

Stream Name: Saw Mill Brook

Observer Names: Jack / Caidlyn

Date: 5-30-13 Time: 11:10

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	0	
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

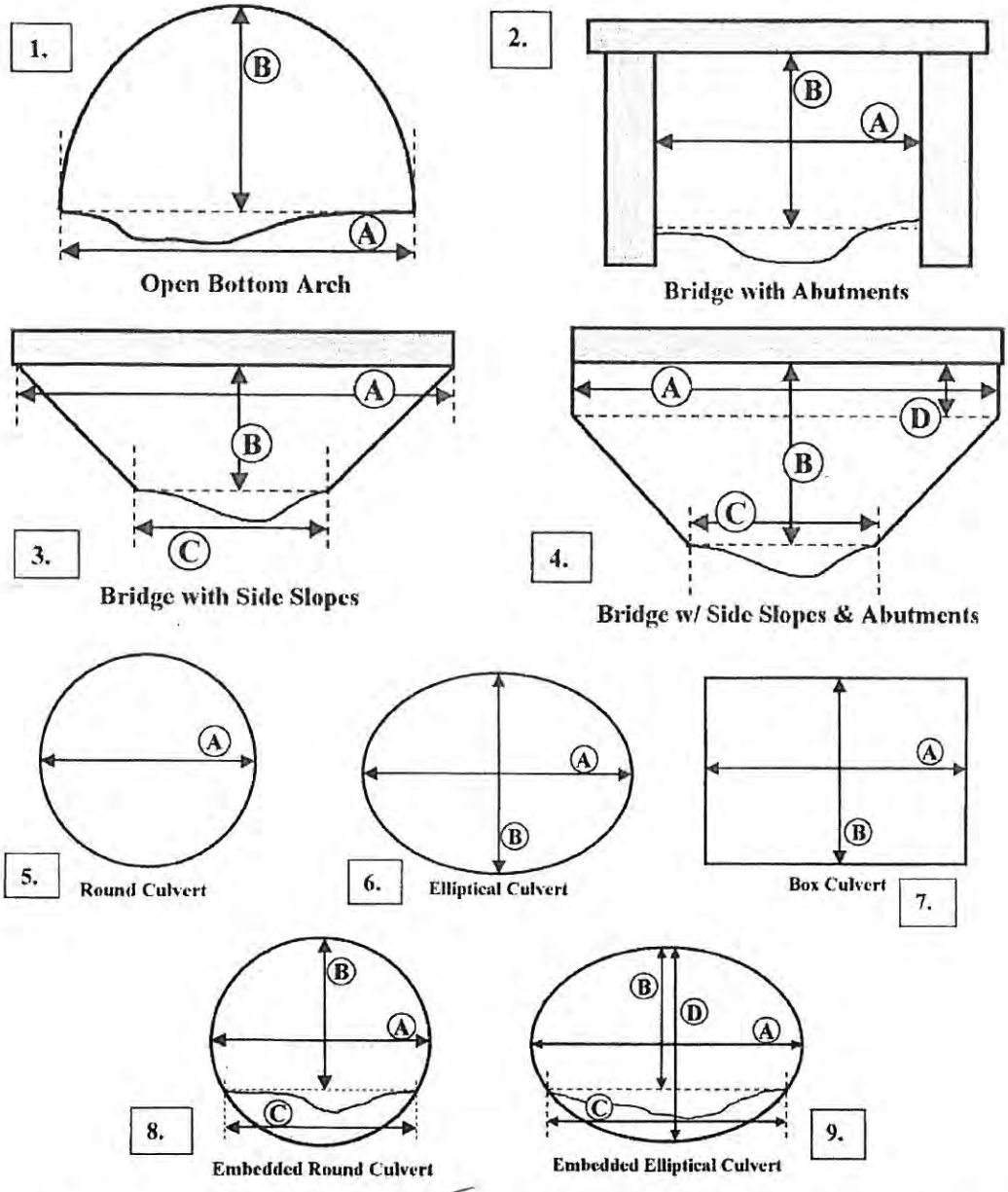
Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	X feet			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 14.7 B = 8.3 C = _____ D = _____

Downstream Dimensions (feet): A = 14.7 B = 8.3 C = _____ D = _____

Structure ID: _____

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☐ Stone ☑ Other (describe): earth

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☑ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☑ Erosion ☐ Sediment Buildup ☐ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 19 feet

Downstream

Water depth in culvert (at outlet): 1.7 feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): X feet

Pool present immediately downstream of structure: ☑ Yes ☐ No

Pool depth at point of streamflow entry: 1.7 feet

Maximum pool depth: 17 feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Downstream bankfull widths (see page 4): X feet Beaver Dam Blocking Access

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☐ No _____ feet	☑ Yes ☐ No 1 feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 4

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Atwater Ave. Culvert #4	Project No. M-1476

Photo No.	Date:
1	5/30/15

Direction Photo Taken: SE

Description: Sawmill Brook. View downstream from culvert outlet.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Atwater Ave. Culvert #4	Project No. M-1476

Photo No.	Date:
2	5/30/15

Direction Photo Taken: NW

Description: Sawmill Brook. View of culvert outlet.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Atwater Ave. Culvert #4	Project No. M-1476

Photo No.	Date:
3	5/30/15

Direction Photo Taken: NW

Description: Sawmill Brook. Culvert Outlet, Beaver Dam

Tighe&Bond

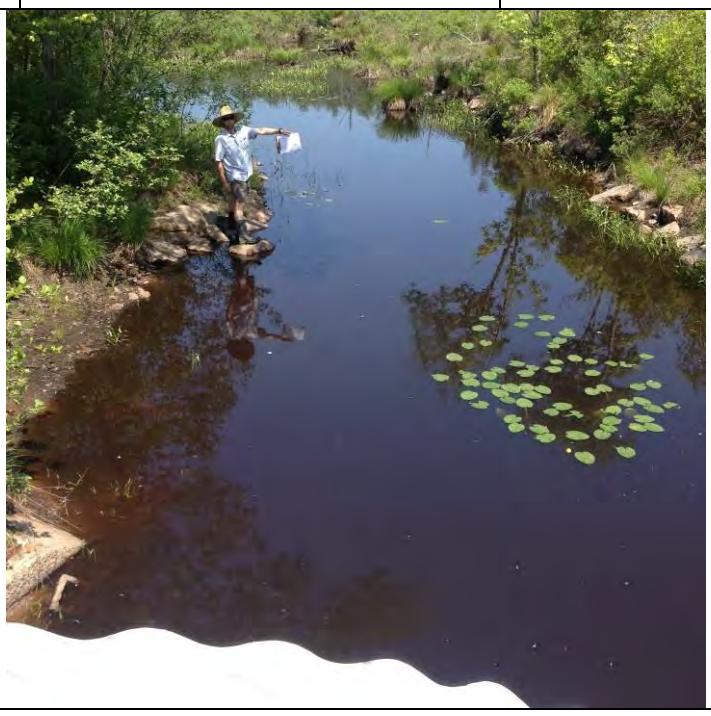
PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Atwater Ave. Culvert #4	Project No. M-1476

Photo No.	Date:
4	5/30/15

Direction Photo Taken: NW

Description: Sawmill Brook. View upstream from inlet



Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Atwater Ave. Culvert #4	Project No. M-1476

Photo No.	Date:
5	5/30/15

Direction Photo Taken: SE

Description: Sawmill Brook. Culvert inlet

Culvert #5
Cedar Swamp

Town of Manchester-by-the-Sea

Tighe&Bond

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: #5

Nearest Address: Wilderness Conservation Area near 128 (North)

Stream Name: Cedar Swamp

Observer Names:

Date: 5/30 Time: ~~##~~ 11:31AM

Flow Conditions: ☐ Unusually low ☐ Typical low flow (average) ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☑ 1	☐ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	None	
Road Surface:	☐ Paved	☑ Unpaved	(dirt)	
Road Type	☐ Road	☑ Trail	☐ Railroad	abandoned

Structure Information

Culvert Material:	☑ Metal-corrugated FES	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe):	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	38 feet		(cable)	
Condition of Crossing:	☐ New	☐ Old	☐ Collapsing	☐ Eroding ☑ Rusted

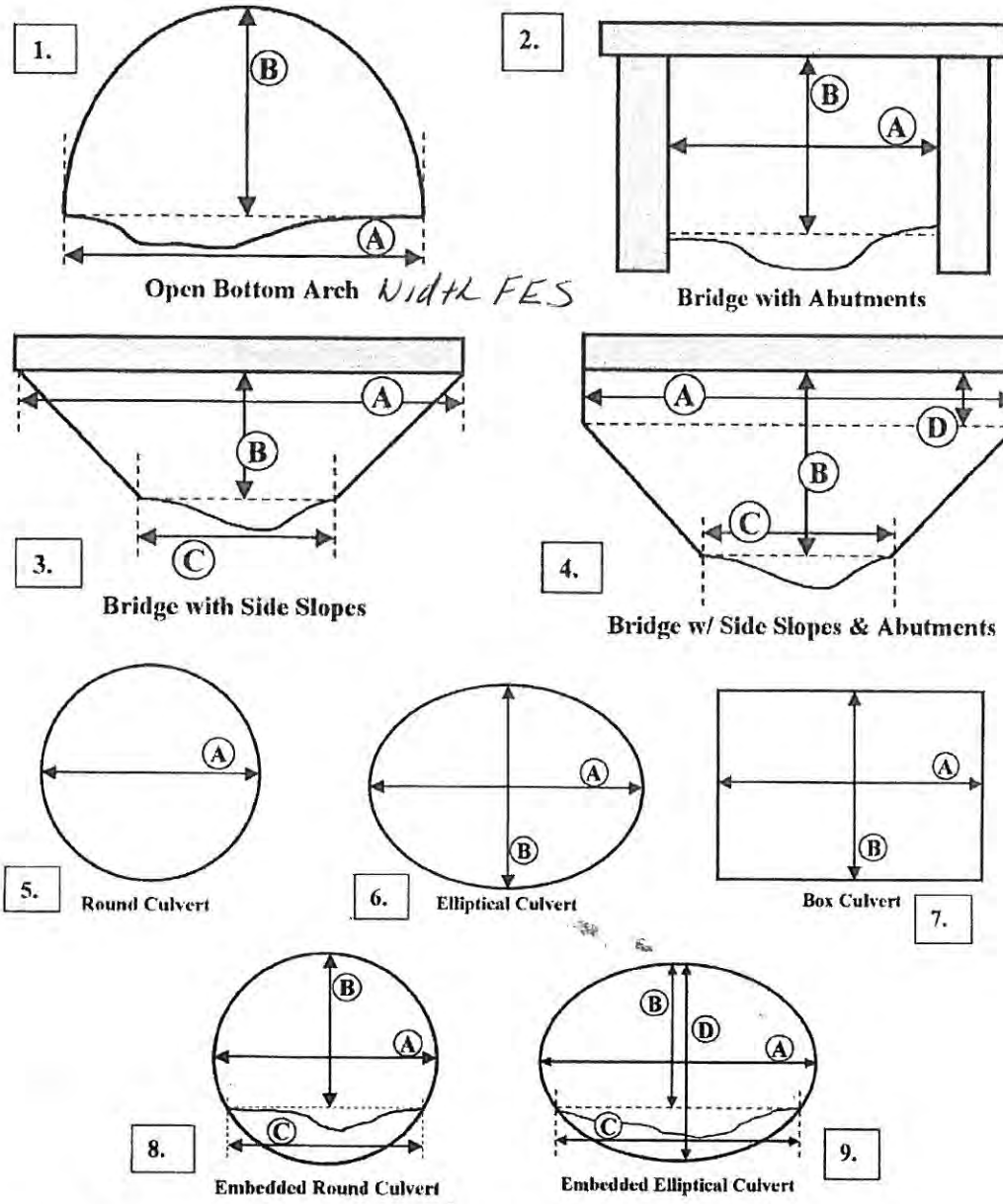
* mild [redacted] corrosion

Number of Crossings: 1

Crossing Type: 1 See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Width FES

3'7" H2O in culvert

Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 9 Feet B = 5'7" C = [illegible]" D = _____

Downstream Dimensions (feet): A = 9 Feet B = 5'8" C = _____ D = _____

Structure ID: 5

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☐ Stone ☐ Other (describe): None

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☑ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: Scour ☐ Erosion ☐ Sediment Buildup ☐ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 30 feet

Downstream

Water depth in culvert (at outlet): 3'5" feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered ____ feet

Outlet drop (invert to water surface): None feet

Pool present immediately downstream of structure: ☐ Yes ~~N/A~~ ☑ No (Standing water swamp)

Pool depth at point of streamflow entry: ____ feet N/A

Maximum pool depth: N/A feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Downstream bankfull widths (see page 4): N/A feet (SWAMP)

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle): * w/silt	☐ Bedrock ☐ Boulder ☒ Cobble ☒ Gravel ☒ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☒ Cobble ☒ Gravel ☒ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand ☐ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK			Open bottom
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☐ No NO ____ feet	☐ Yes ☑ No ____ feet	☐ Yes ☑ No ____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert NO ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: H5

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Old Manchester Rd. Culvert #5**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: Sawmill Brook. View looking upstream from culvert-Cedar Swamp	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Old Manchester Rd. Culvert #5**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: Sawmill Brook. View looking downstream from culvert Cedar Swamp	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Old Manchester Rd. Culvert #5	Project No. M-1476

Photo No.	Date:
3	5/30/15

Direction Photo Taken: NE

Description: Sawmill Brook. View of culvert inlet looking downstream into inlet

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Old Manchester Rd. Culvert #5	Project No. M-1476

Photo No.	Date:
4	5/30/15

Direction Photo Taken: SW

Description: Sawmill Brook. View culvert outlet looking upstream.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Old Manchester Rd. Culvert #5**	**Project No. M-1476**

Photo No.	**Date:**
5	**5/30/15**

Direction Photo Taken: SW

Description:

Sawmill Brook. View of culvert outlet – looking upstream into culvert.

Culvert #6
School Street

Town of Manchester-by-the-Sea

Tighe&Bond

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 6 → Flood Culvert ?

Nearest Address: School St

Stream Name:

Observer Names: Jack + Carolyn Group 5

Date: Time:

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

no H2O

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	0	
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

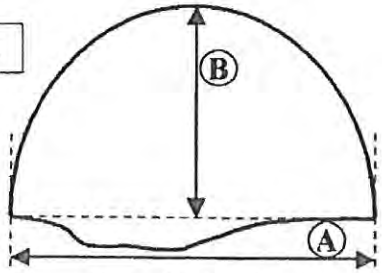
Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☑ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☑ New	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 1

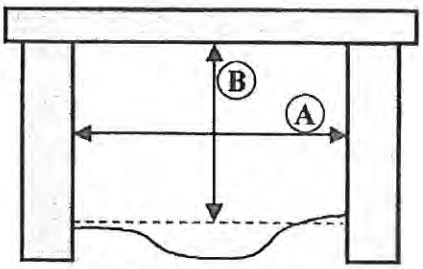
Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

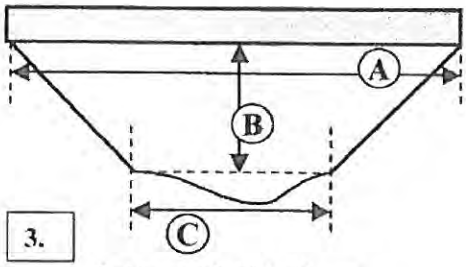
Crossing Dimensions

1.


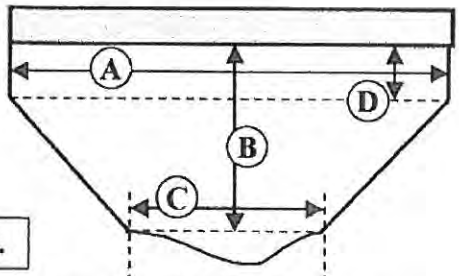
Open Bottom Arch

2.


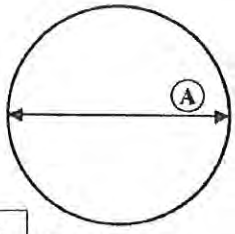
Bridge with Abutments



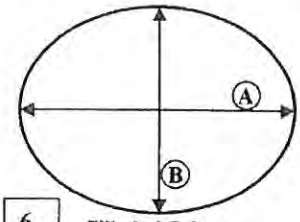
3.
Bridge with Side Slopes



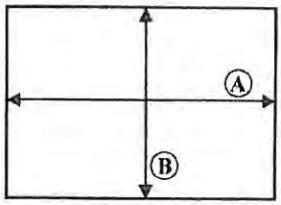
4.
Bridge w/ Side Slopes & Abutments



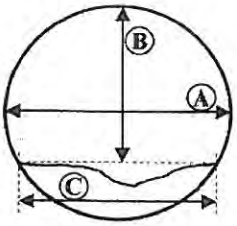
5.
Round Culvert



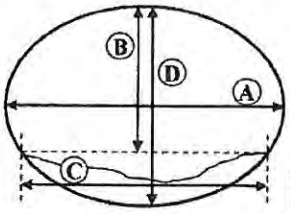
6.
Elliptical Culvert



Box Culvert
7.



8.
Embedded Round Culvert



9.
Embedded Elliptical Culvert

Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☑ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Downstream Dimensions (feet): A = 1.1 B = _____ C = _____ D = _____

Structure ID: _____

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☐ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☐ Sediment Buildup ☐ None

Culvert inlet: ☐ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): _____ feet

Downstream

Water depth in culvert (at outlet): 0 feet

Culvert outlet: ☐ At Grade ☑ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 1.9 feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: X feet

Maximum pool depth: X feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Downstream bankfull widths (see page 4): _____ feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK			
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☐ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 6

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Kit Glass Dr. Culvert #6	Project No. M-1476

Photo No.	Date:
1	5/30/15

Direction Photo Taken: NE

Description:

Inlet-Upstream. Culvert is raised above grade of wetland (dry).

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Kit Glass Dr. Culvert #6	Project No. M-1476

Photo No.	Date:
2	5/30/15

Direction Photo Taken: SW

Description: Outlet downstream. Culvert is raised in concrete road crossing above base of wetland. Wetland was dry.

Culvert # 7
Forest Lane

Town of Manchester-by-the-Sea

Tighe&Bond

Check for

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: #7

Nearest Address: Fovrest St. Forest Lane

Stream Name: Cat Brook

Observer Names: Eric Thoresin + B. Warren

Date: 5/30/15 Time:

Flow Conditions: ☐ Unusually low ☑ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2 (narrow)	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2 NONE		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

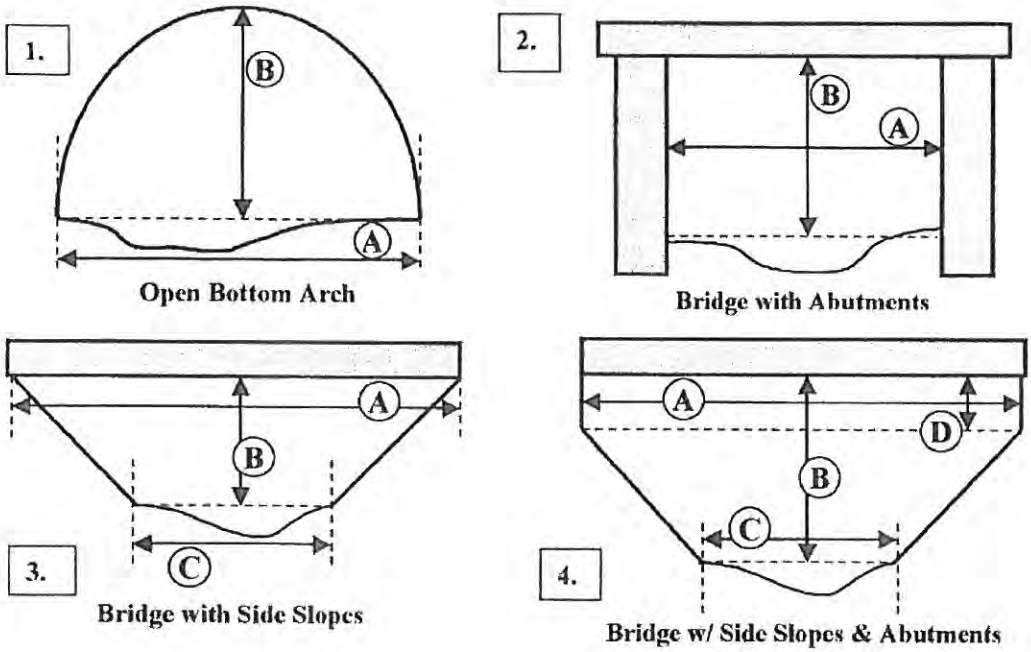
Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☑ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	20.2 feet			
Condition of Crossing:	☐ New	☑ Old	☑ Collapsing (appears)	☐ Eroding ☐ Rusted
Number of Crossings:	1			
Crossing Type:	See next page			

appears in bad shape.
upstream flow backup.

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 11.6' B = 29' C = _____ D = _____

Downstream Dimensions (feet): A = 11.6' B = 2.9' C = _____ D = _____

Structure ID: 7

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☑ Stone ☐ Other (describe):

Excessive sediment

Structure opening partially obstructed by:	☑ Wood	☑ Sediment	☑ Wood and Sediment	☑ Culvert Deformed	☐ None
Angle of stream flow approaching structure:	☐ Sharp Bend	☑ Mild Bend	☑ Naturally Straight	☐ Channelized Straight	
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☐ Erosion	☑ Sediment Buildup	☐ None		
Culvert inlet:	☑ At Grade	☐ Cascade	☐ Free Fall		
Upstream bankfull widths (see page 4): 32.8 feet					

Downstream

Water depth in culvert (at outlet): 2.2 feet

Culvert outlet: ☒ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 1.2 feet

Pool present immediately downstream of structure: ☐ Yes ☒ No - flows into POND

Pool depth at point of streamflow entry: ~~3.3~~ feet

Maximum pool depth: _____ feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☑ Erosion ☐ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): 11 feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand ☐ UNK	☑ ~~Bedrock~~ ☐ Boulder ☑ Cobble ☐ Gravel ☑ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☑ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☑ Mid- ☐ Side Channel	☑ None ☐ Point ☐ Delta ☐ Mid- ☐ Side Channel	☐ None ☐ Point ☐ Delta ☐ Mid- ☐ Side Channel UNK
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☐ No _____ feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 7

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Forest Lane Culvert #7**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: East Cat Brook. View upstream from culvert. Bacterial film present.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Forest Lane Culvert #7**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: East Cat Brook. View upstream from culvert.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Forest Lane Culvert #7	Project No. M-1476

Photo No. 3	Date: 5/30/15
Direction Photo Taken: NW	
Description: East Cat Brook. View of culvert inlet, upstream.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Forest Lane Culvert #7	Project No. M-1476

Photo No. 4	Date: 5/30/15
Direction Photo Taken: NW	
Description: East Cat Brook. View downstream from culvert outlet	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Forest Lane Culvert #7**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: East Cat Brook, View of the culvert outlet. Looking upstream.	

Culvert #8
Loading Place Road

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 8

Nearest Address: loading Place Rd.

Stream Name: Cat Brook

Observer Names: Eric Thomsin + B. Warren

Date: 5/30/15 Time: 11:25 AM

Flow Conditions: ☐ Unusually low ☑ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	NONE	
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

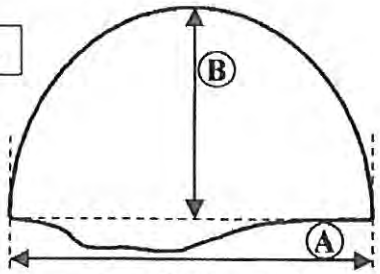
Culvert Material:	☐ Metal-corrugated	☑ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	30.7 feet			
Condition of Crossing:	☑ New	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 3 pipes

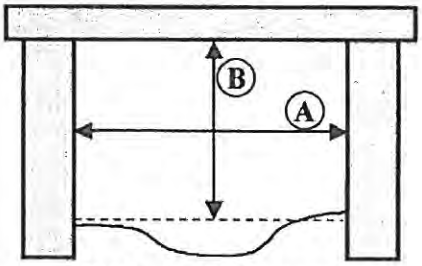
Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

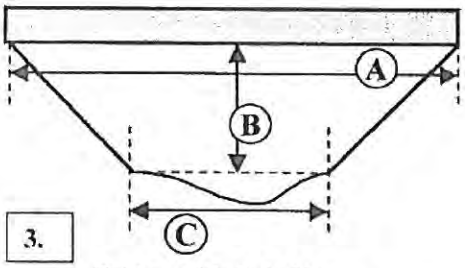
Crossing Dimensions

1.


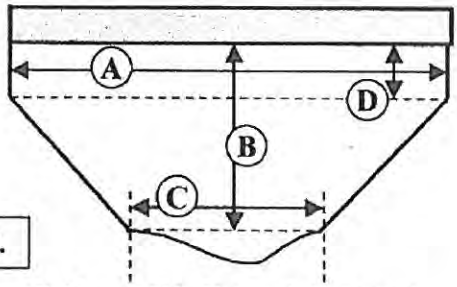
Open Bottom Arch

2.


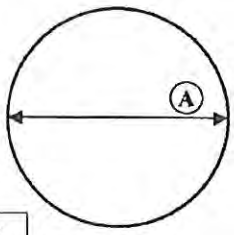
Bridge with Abutments



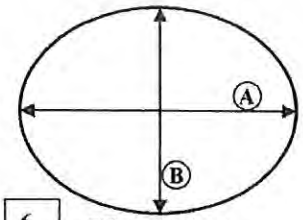
3. Bridge with Side Slopes



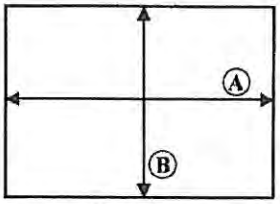
4. Bridge w/ Side Slopes & Abutments



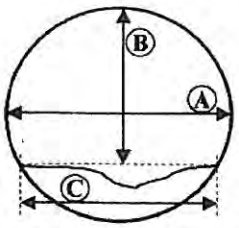
5. Round Culvert



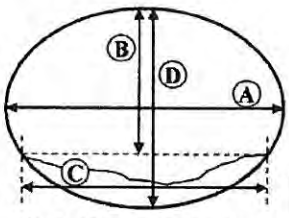
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



Embedded Elliptical Culvert 9.

Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☑ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 7' wide: 3 pipes each 2.3' B = 2' C = _____ D = _____

Downstream Dimensions (feet): A = 7' B = 2' C = _____ D = _____

Structure ID: 8

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☐ Stone ☑ Other (describe): PVC pipes (3)

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☑ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☐ Mild Bend ☑ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☑ Sediment Buildup ☐ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 17.6 feet

Downstream

Water depth in culvert (at outlet): 3" feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): _____ feet NONE

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: N/A feet

Maximum pool depth: N/A feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☑ Sediment Buildup Heavy ☐ None

Downstream bankfull widths (see page 4): 12.6 feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☑ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☑ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☑ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☑ Yes ☐ No ~40 feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 8

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Loading Place Rd. Culvert #8	Project No. M-1476

Photo No. 1	Date: 5/30/15
Direction Photo Taken: SE	
Description: East Cat Brook. View upstream from culvert inlet.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Loading Place Rd. Culvert #8	Project No. M-1476

Photo No. 2	Date: 5/30/15
Direction Photo Taken: NW	
Description: East Cat Brook. View into culvert inlets, looking downstream.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Loading Place Rd. Culvert #8**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: East Cat Brook. View looking into culvert inlets.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Loading Place Rd. Culvert #8**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: East Cat Brook. Downstream view from culvert.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Loading Place Rd. Culvert #8	Project No. M-1476

Photo No. 5	Date: 5/30/15

Direction Photo Taken: SE

Description: East Cat Brook. View looking upstream into the culvert outlets.

Culvert #9
Pine Street

Town of Manchester-by-the-Sea

Tighe&Bond

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 9

Nearest Address:
Pine Street

Stream Name:

Observer Names:
Joan Nesbit, Lynn Atkinson, Lisa

Date: 5/30/15 Time:

Flow Conditions: ☒ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions
STAGNANT

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☒ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material: (1)
☒ Metal-corrugated ☐ Plastic – corrugated ☐ Concrete ☐ Stone
☐ Metal – smooth ☐ Plastic– smooth ☐ Other (describe): _____

Structure Skewed to Roadway? ☐ Yes ☐ No

Approximate Length (if feasible to measure): _____ feet

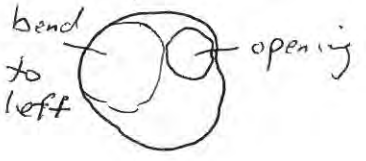
Condition of Crossing: ☐ New ☒ Old ☐ Collapsing ☒ Eroding ☐ Rusted

Number of Crossings: _____

Crossing Type: See next page

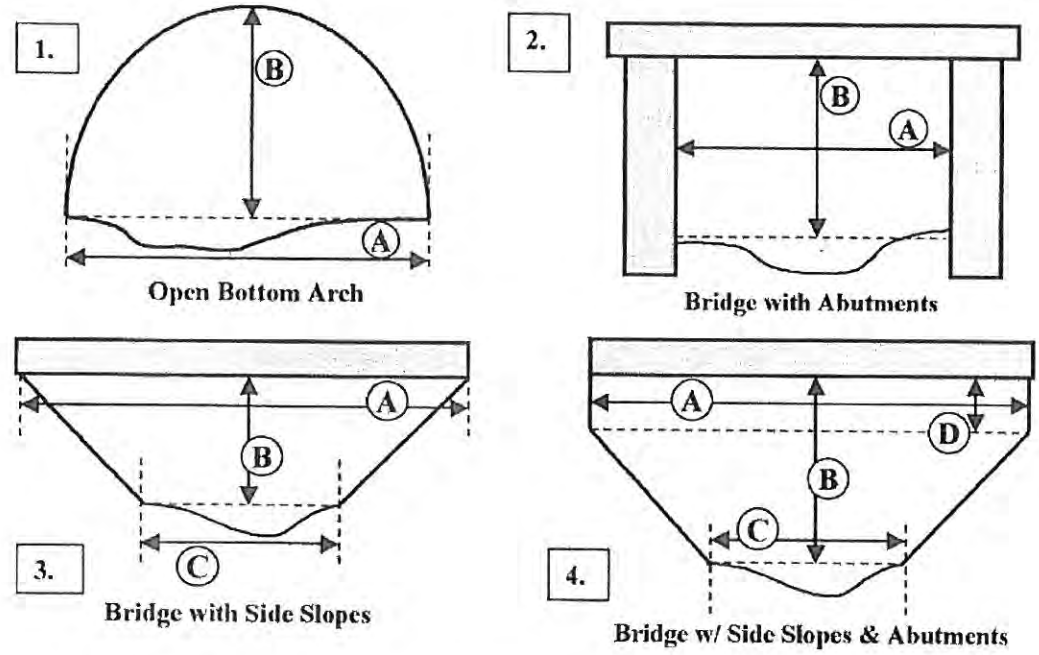
(2) Concrete
Round, Flares at the End
Has 2 Branches
Goes straight, upper culvert, goes left

3ft 5" across
6ft 4" at wider point



INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Downstream 1.)

~~Upstream~~ **Dimensions (feet):** A = 2'11" B = 3'1" C = 2'3" D = Soil

2.)

Upstream

Downstream Dimensions (feet): A = 2'11" B = 2'8" C = 2'8" D = _____

Structure ID: _____

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

~~Upstream~~ DOWNSTREAM

Headwall Material: ☐ Concrete ☐ Metal ☐ Stone ☐ Other (describe): BOULDERS

Structure opening partially obstructed by: ROUND BALL	☐ Wood	☐ Sediment	☐ Wood and Sediment	☐ Culvert Deformed	☐ None
Angle of stream flow approaching structure:	☐ Sharp Bend	☒ Mild Bend	☐ Naturally Straight	☐ Channelized Straight	
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☐ Erosion	☒ Sediment Buildup	☐ None		
Culvert inlet:	☒ At Grade	☐ Cascade	☐ Free Fall		
Upstream bankfull widths (see page 4): ____ feet	5' 4"				

~~Downstream~~ UPSTREAM

Water depth in culvert (at outlet): ____ feet

Culvert outlet: ☐ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered ____ feet

Outlet drop (invert to water surface): ____ feet

Pool present immediately downstream of structure: ☐ Yes ☐ No Channelized Straight

Pool depth at point of streamflow entry: ____ feet

Maximum pool depth: ____ feet 5'11

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☐ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): ____ feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☒ Cobble ☐ Gravel ☒ Sand & mud ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☒ Sand & mud ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☐ < 1 foot	☐ 1-2 feet	☐ > 2 feet ☐ UNK
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☒ No ____ feet	☐ Yes ☒ No ____ feet	☐ Yes ☒ No ____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: _____

Tighe&Bond	PHOTOGRAPHIC LOG	
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Pine Street Culvert #9**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: N	
Description: **Sawmill Brook. Downstream view.**	

Tighe&Bond	PHOTOGRAPHIC LOG	
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Pine Street Culvert #9**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: N	
Description: **Sawmill Brook. Upstream inlet -**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Pine Street Culvert #9**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: S	
Description: **Sawmill Brook. View into culvert outlet.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Pine Street Culvert #9**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: S	
Description: **Sawmill Brook. View of dry, sediment in first outlet.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Pine Street Culvert #9**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: S	
Description: **View of second outlet. View is looking upstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Pine Street Culvert #9**	**Project No. M-1476**

Photo No. 6	**Date: 5/30/15**
Direction Photo Taken: S	
Description: **Sawmill Brook. Upstream view**	

Culvert #10
Rockwood Heights

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 10

Nearest Address:
Rockwood Heights

Stream Name:

Observer Names:
~~Joan Nesbit, Lynn Atkinson, Lisa~~
Joan Nesbit, Lynn Atkinson, Lisa

Date: 5/30/15 Time: 10:35 am

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	no shoulder	
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

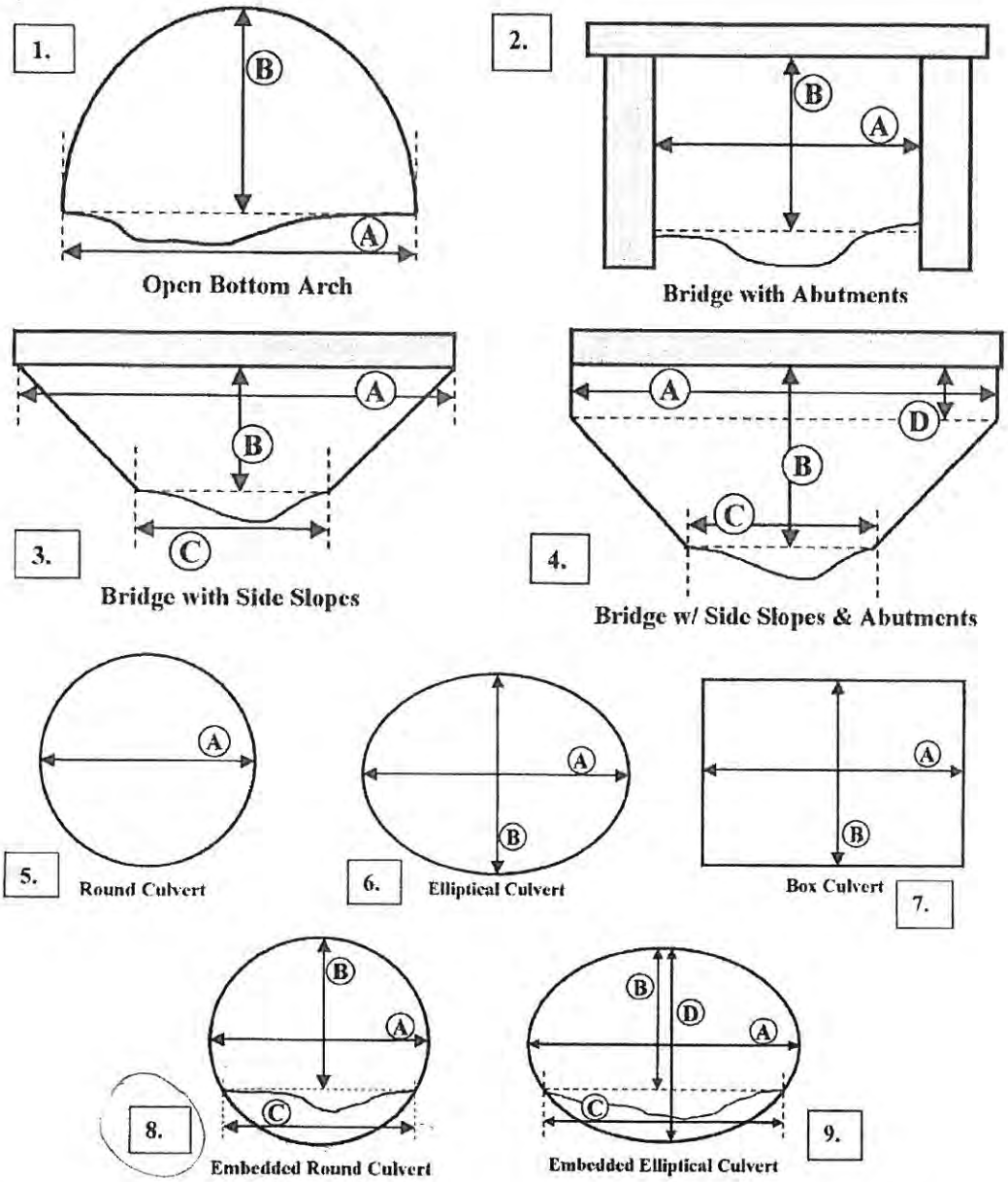
Culvert Material:	☐ Metal-corrugated ☐ Metal – smooth	☐ Plastic – corrugated ☐ Plastic– smooth	☒ Concrete culvert ☐ Other (describe):	☑ Stone wall
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	25 feet			
Condition of Crossing:	☐ New	☒ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 2

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☒ 5. ☐ 6. ☐ 7. ☒ 8. ☐ 9.

Upstream Dimensions (feet): POND A = 1'10" B = 1'7" C = 1'8" D = X both the same

Downstream Dimensions (feet): A = 1'10" B = 1'3" C = 1'9" D = X

Structure ID: 10 (x2)

L left culvert missing chunk of concrete, downstream

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☒ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☒ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☒ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☒ Sediment Buildup LEAVES ~~GRASS~~ LILY PADS ☐ None

Culvert inlet: ☒ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 15 feet POND. WALL OVER CULVERT

Downstream

Water depth in culvert (at outlet): 6" feet

Culvert outlet: ☒ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): _____ feet

Pool present immediately downstream of structure: ☐ Yes ☒ No

Pool depth at point of streamflow entry: 6" feet

Maximum pool depth: _____ feet POND

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☒ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): 9 feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand MUD ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☒ Sand + MUD ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand MUD ☐ UNK
If substrate is present in the structure, how deep is it?	☒ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☒ No _____ feet	☐ Yes ☒ No _____ feet	☐ Yes ☒ No _____ feet
Streambank scour causing undermining around/under structure:	☒ None ☐ Culvert ☐ Footer ☐ Wing Walls	☒ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 10

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Rockwood Heights Rd. Culvert #10**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: NE	
Description: Sawmill Brook. View downstream.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Rockwood Heights Rd. Culvert #10**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: NE	
Description: Sawmill Brook, View of left culvert inlet.	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Rockwood Heights Rd. Culvert #10	Project No. M-1476

Photo No. 3	Date: 5/30/15

Direction Photo Taken: NE

Description: Sawmill Brook. View of right culvert inlet with beaver guard.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Rockwood Heights Rd. Culvert #10	Project No. M-1476

Photo No. 4	Date: 5/30/15

Direction Photo Taken: NE

Description: Sawmill Brook. Close up of right culvert inlet beaver guard

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Rockwood Heights Rd. Culvert #10**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: N	
Description: Sawmill Brook. View of both inlets.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Rockwood Heights Rd. Culvert #10**	**Project No. M-1476**

Photo No. 6	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: Sawmill Brook. View of culvert outlets. Looking upstream.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Rockwood Heights Rd. Culvert #10**	**Project No. M-1476**

Photo No. 7	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: Sawmill Brook. View upstream.	

Culvert #11
Mill Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 11

Nearest Address: 28 Mill St.

Stream Name: Cat Brook

Observer Names: ERIC THOMSIN & BARBARA WARREN

Date: May 30 '15 Time: 10:25 AM

Flow Conditions: ☐ Unusually low ☑ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	NONE	
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☑ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe):	
Structure Skewed to Roadway?	☑ Yes	☐ No		
Approximate Length (if feasible to measure): Across Road	20.1 feet			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☐ Rusted

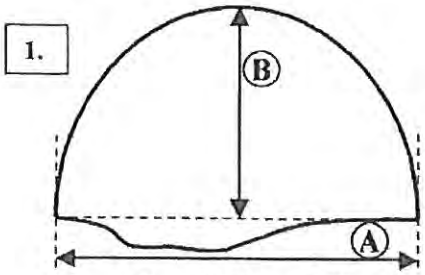
Number of Crossings: 1

Crossing Type: See next page

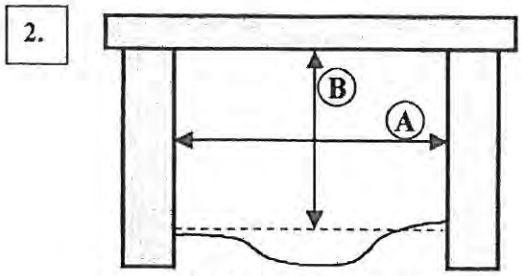
Cat Brier & poison ivy.
went in up stream
Did not go into downstream
est. mated from Road top

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

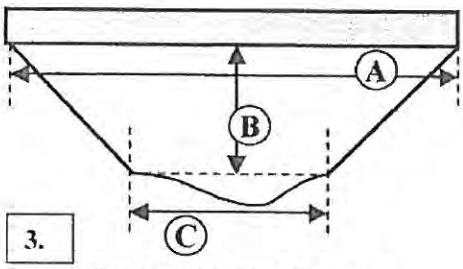
Crossing Dimensions



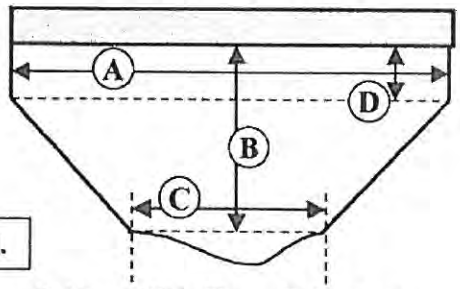
Open Bottom Arch



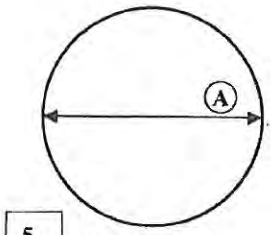
Bridge with Abutments



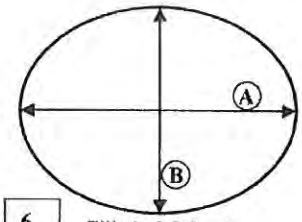
Bridge with Side Slopes



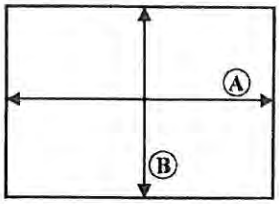
Bridge w/ Side Slopes & Abutments



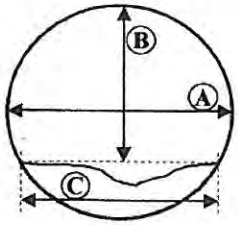
Round Culvert



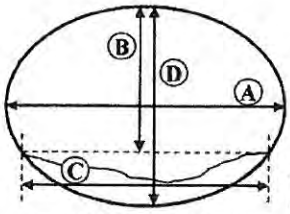
Elliptical Culvert



Box Culvert 7.



Embedded Round Culvert



Embedded Elliptical Culvert

Crossing Type (from above): ☒ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 12.5' B = 3.7' C = _____ D = _____

Downstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Structure ID: _____

downstream
upstream

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☑ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☑ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☑ Sharp Bend ☐ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☑ Sediment Buildup ☐ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 13.7 feet

Downstream

Water depth in culvert (at outlet): ____ feet SAME

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered ____ feet

Outlet drop (invert to water surface): ____ feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: 1 feet

Maximum pool depth: 1 feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☑ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): SAME feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☑ Boulder ☑ Cobble ☐ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☑ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☐ < 1 foot	☑ 1-2 feet	☐ > 2 feet ☐ UNK
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☑ Mid- ☐ Side ☑ Channel	☐ None ☐ Point ☐ Delta ☐ Mid- ☐ Side Channel	☐ None ☐ Point ☐ Delta ☐ Mid- ☑ Side Channel
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No ____ feet	☐ Yes ☑ No ____ feet	☐ Yes ☑ No ____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 11

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Mill Street Culvert #11	Project No. M-1476

Photo No. 1	Date: 5/30/15
Direction Photo Taken: NE	
Description: Cat Brook. View upstream.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Mill Street Culvert #11	Project No. M-1476

Photo No. 2	Date: 5/30/15
Direction Photo Taken: NW	
Description: Cat Brook. View of inlet.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Mill Street Culvert #11**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: Cat Brook. View inside culvert, looking downstream towards outlet..	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Mill Street Culvert #11**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: Cat Brook. View downstream.	

Culvert #12
Millets Lane

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 12 Pi - photos mislabeled opstream + downstream b/c stagnant

Nearest Address: Millets Lane

Stream Name: Sawmill Brook

Observer Names: Sue Costello & Jenny Moonan

Date: 5-30-15 Time: 10:22

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☑ 1 residential	☐ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

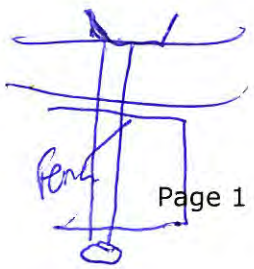
Structure Information

Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☑ New "OK"	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 1

Crossing Type: See next page

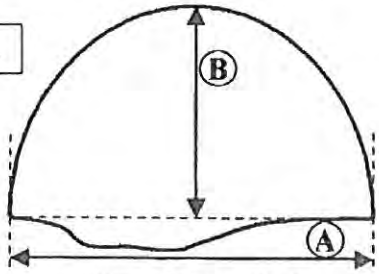
15' downstream - outflow pipes from road (photo)



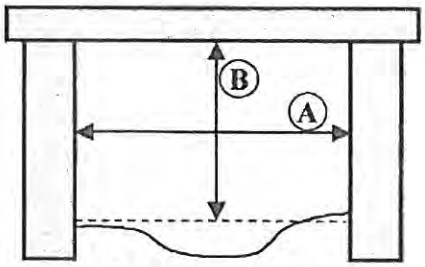
measure on GIS

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

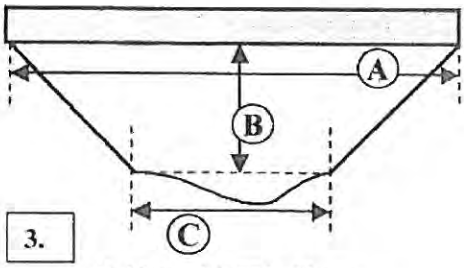
Crossing Dimensions

1.


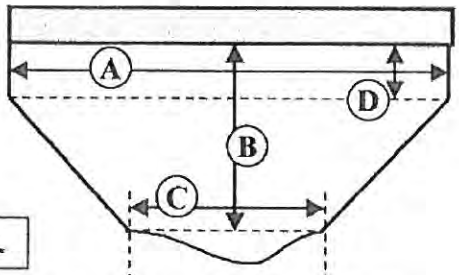
Open Bottom Arch

2.


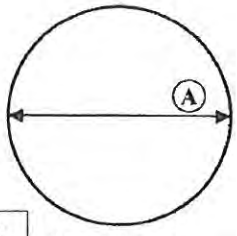
Bridge with Abutments



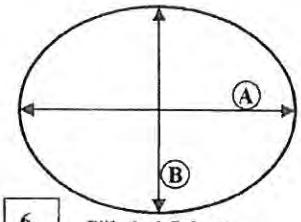
3. Bridge with Side Slopes



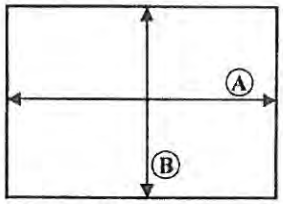
4. Bridge w/ Side Slopes & Abutments



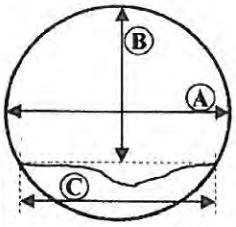
5. Round Culvert



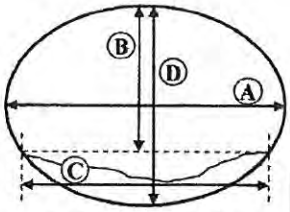
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



9. Embedded Elliptical Culvert

Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☑ 5. ☐ 6. ☐ 7. ☑ 8. ☑ 9.

Upstream Dimensions (feet): A = 5'2" B = 34" C = 45" D = ~40"

Downstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Structure ID: 12

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☑ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by:	☐ Wood	☑ Sediment	☐ Wood and Sediment	☐ Culvert Deformed	☐ None
Angle of stream flow approaching structure:	☐ Sharp Bend	☐ Mild Bend	☑ Naturally Straight	☐ Channelized Straight	
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☐ Erosion	☑ Sediment Buildup organic debris + standing water	☐ None		
Culvert inlet:	☐ At Grade	☐ Cascade	☐ Free Fall		
Upstream bankfull widths (see page 4): 7'4" feet					

Downstream

different 30" material than upstream corrugated - rusty metal pipe.

Water depth in culvert (at outlet): 8½" feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 0 feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: _____ feet

Maximum pool depth: _____ feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☑ Sediment Buildup organics ☐ None

Downstream bankfull widths (see page 4): 8' feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☐ Sand ☑ UNK organics	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☐ Sand ☑ UNK organic	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☐ Sand ☑ UNK organics
If substrate is present in the structure, how deep is it?	☑ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☑ Mid-Channel organics ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls erosion abutting headwall	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 12

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln. Culvert #12**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: Sawmill Brook. View of inlet on upstream side. Looking downstream.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln. Culvert #12**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: Sawmill Brook. View of inlet looking downstream	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln. Culvert #12**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: S	
Description: Sawmill Brook. View upstream	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln. Culvert #12**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: Sawmill Brook. View of inlet bank conditions.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln Culvert #12**	**Project No. M-1476**

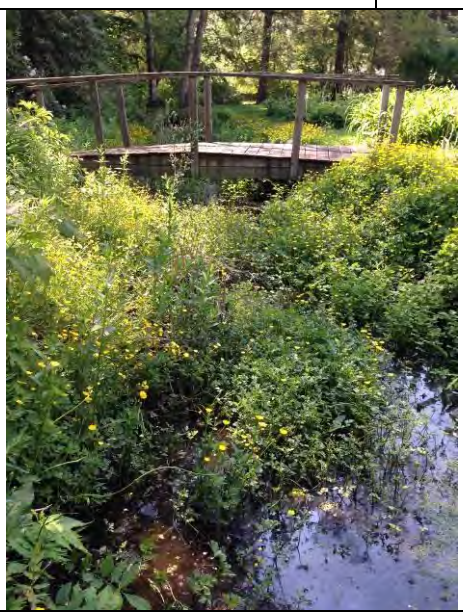
Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: Sawmill Brook. View of inlet bank conditions	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln Culvert #12**	**Project No. M-1476**

Photo No. 6	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: Sawmill Brook. View of outlet, looking upstream.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln Culvert #12**	**Project No. M-1476**

Photo No. 7	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: Sawmill Brook. View downstream	



Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Millets Ln Culvert #12**	**Project No. M-1476**

Photo No. 8	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: Drainage contributing to Sawmill Brook on Millets Lane.	

Culvert #13
The Plains

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 13

Nearest Address: The Plains

Stream Name: The Plains

Observer Names: Sue Costello + Jenny Moonan

Date: 5-30-15 Time: 1049

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☑ Yes	☐ No	—	
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☑ New	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted

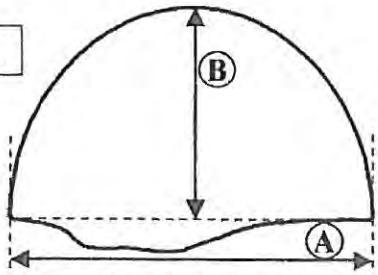
Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

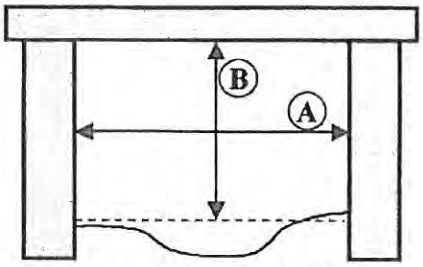
Crossing Dimensions

1.

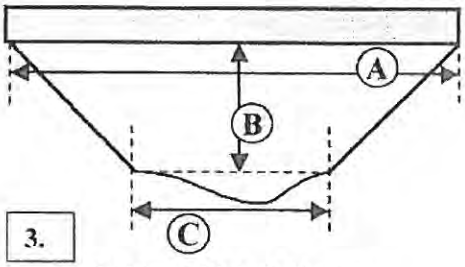


Open Bottom Arch

2.

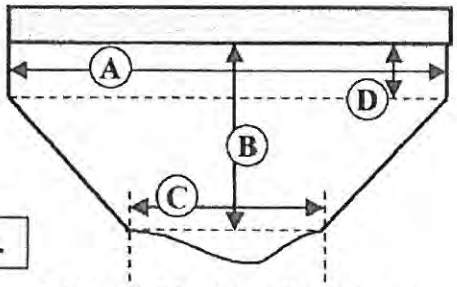


Bridge with Abutments



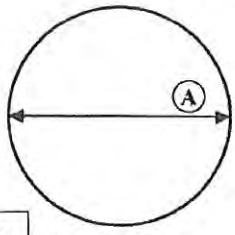
3.

Bridge with Side Slopes

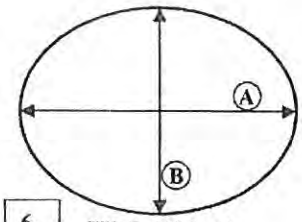


4.

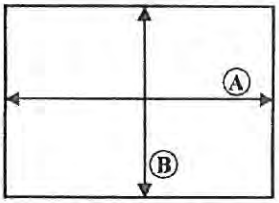
Bridge w/ Side Slopes & Abutments



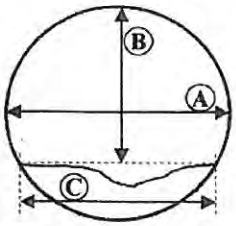
5. Round Culvert



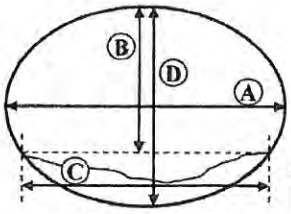
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



9. Embedded Elliptical Culvert

Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 5' B = 2' C = _____ D = _____

Downstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Structure ID: 13

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☑ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☑ Sediment ☑ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☑ Sediment Buildup ☐ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 10 feet

Downstream

Water depth in culvert (at outlet): 10" feet 5' across

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): _____ feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: _____ feet

Maximum pool depth: _____ feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☑ Sediment Buildup organic ☐ None

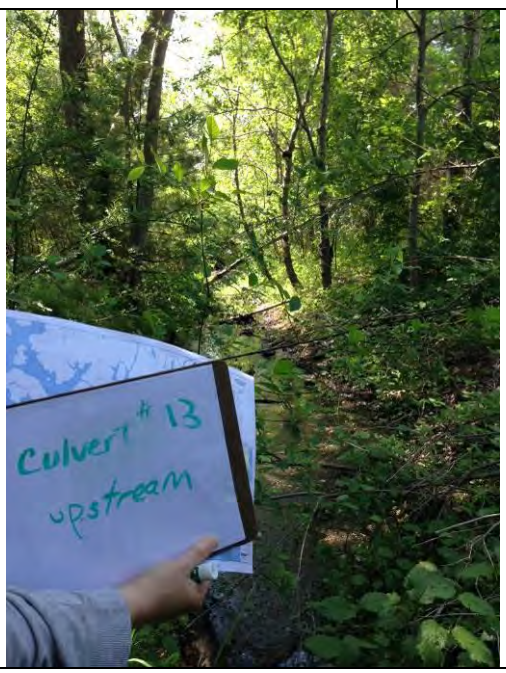
Downstream bankfull widths (see page 4): 10 feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☐ Sand ☑ UNK organics	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☐ Sand ☑ UNK organic	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☑ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK	3ft downstream	
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☑ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ? ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 13

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, The Plains Culvert #13**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: Sawmill Brook. View upstream.	



Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, The Plains Culvert #13**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: **Sawmill Brook. View upstream**	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, The Plains Culvert #13	Project No. M-1476

Photo No. 3	Date: 5/30/15

Direction Photo Taken: SE

Description:

Sawmill Brook. View upstream bank conditions.

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, The Plains Culvert #13	Project No. M-1476

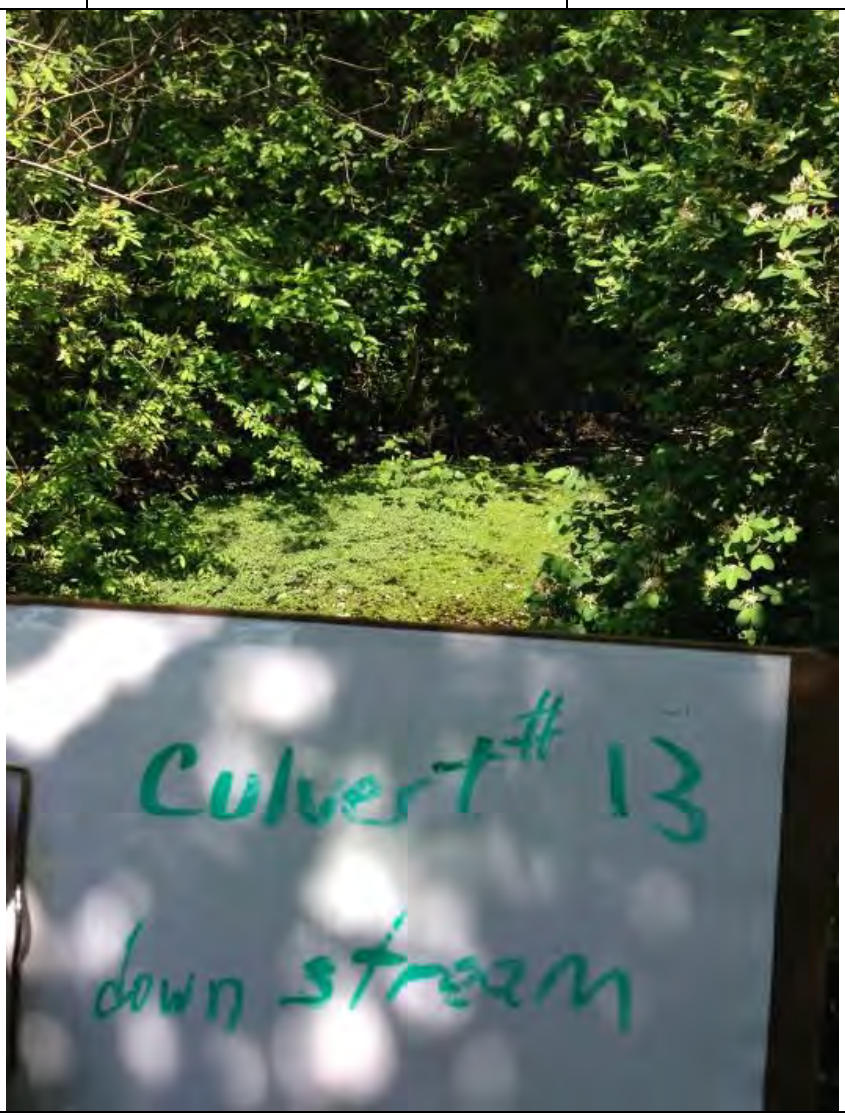
Photo No. 4	Date: 5/30/15

Direction Photo Taken: E

Description:
Sawmill Brook. View of outlet on downstream side.

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, The Plains Culvert #13**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: Sawmill Brook. View downstream	



Culvert #14
Culvert was not found
and believed to not exist

Culvert #15
Blue Heron Lane

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 15

Nearest Address: Blue Heron

Stream Name: Sawmill Brook

Observer Names: Sue Costello & Jenny Moonan

Date: 5-30-15 Time: 1108

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☑ 1 1.5	☐ 2	☐ 3	☐ 4	
Number of Shoulder Lanes:	☐ 1	☐ 2			
Road Surface:	☑ Paved	☐ Unpaved			
Road Type	☑ Road	☐ Trail	☐ Railroad		

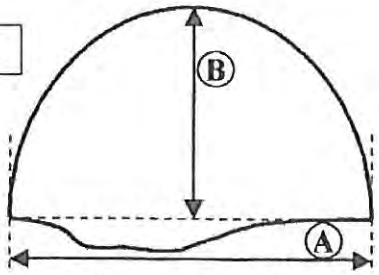
Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☑ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☑ New	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted
Number of Crossings:	1			
Crossing Type:	See next page			

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

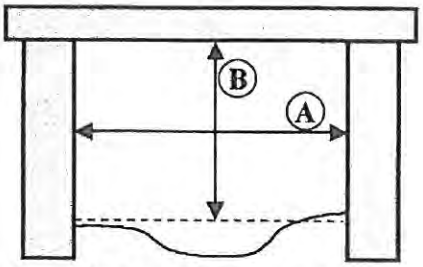
Crossing Dimensions

1.

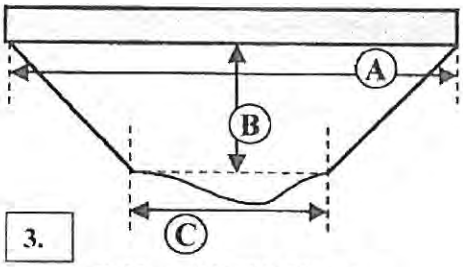


Open Bottom Arch

2.

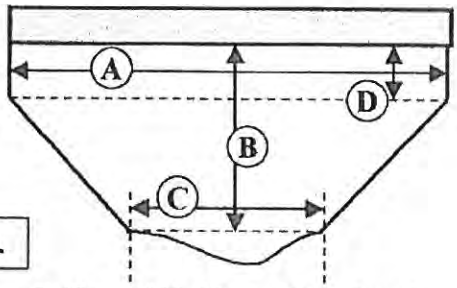


Bridge with Abutments



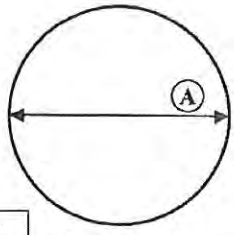
3.

Bridge with Side Slopes

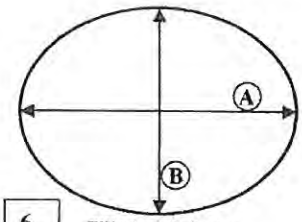


4.

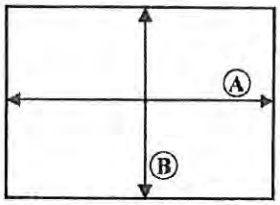
Bridge w/ Side Slopes & Abutments



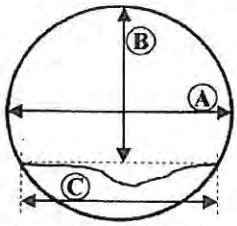
5. Round Culvert



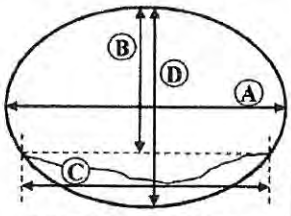
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



Embedded Elliptical Culvert 9.

Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 30" B = 30" C = _____ D = _____

Downstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Structure ID: 15

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material:	☐ Concrete	☐ Metal	☐ Stone	☐ Other (describe): needs patching	
Structure opening partially obstructed by:	☐ Wood	☑ Sediment	☐ Wood and Sediment	☐ Culvert Deformed	☑ None
Angle of stream flow approaching structure:	☐ Sharp Bend	☐ Mild Bend	☑ Naturally Straight	☐ Channelized Straight	
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☑ Erosion bank	☑ Sediment Buildup	☐ None		
Culvert inlet:	☑ At Grade	☐ Cascade	☐ Free Fall		
Upstream bankfull widths (see page 4): 8' feet					

Downstream

Water depth in culvert (at outlet): 8' feet				
Culvert outlet:	☑ At Grade	☐ Cascade	☐ Free Fall	☐ Backwatered _____ feet
Outlet drop (invert to water surface): _____ feet				
Pool present immediately downstream of structure:	☐ Yes	☐ No		
Pool depth at point of streamflow entry: _____ feet				
Maximum pool depth: _____ feet				
Evidence of streambed erosion or sediment buildup immediately downstream of culvert:	☑ Erosion	☑ Sediment Buildup	☐ None	
Downstream bankfull widths (see page 4): 7 feet				

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☐ Sand ☑ UNK organic	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☐ Sand ☑ UNK organic 26" depth of sediment downstream	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☑ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☑ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side organic debris	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls bank erosion	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls bank erosion	N/A

15

Structure ID: _____

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Blue Heron Ln. Culvert #15**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: W	
Description: Blue Heron Lane	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Blue Heron Ln. Culvert #15**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: NE	
Description: Sawmill Brook. View upstream of inlet.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Blue Heron Ln. Culvert #15	Project No. M-1476

Photo No. 3	Date: 5/30/15
Direction Photo Taken: SE	
Description: Sawmill Brook. View upstream	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Blue Heron Ln. Culvert #15	Project No. M-1476

Photo No. 4	Date: 5/30/15
Direction Photo Taken: SE	
Description: Sawmill Brook. View upstream	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Blue Heron Ln. Culvert #15**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: Sawmill Brook. Outlet.	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Blue Heron Ln. Culvert #15**	**Project No. M-1476**

Photo No. 6	**Date: 5/30/15**
Direction Photo Taken: N	
Description: **Sawmill Brook. View downstream.**	

Culvert #16
Golf Course

Information to be
added July 2015

Culvert #17
Lincoln Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: #17 Lincoln St next to high school

Nearest Address: ~~Sawmill~~ & 41 Lincoln St.

Stream Name: Sawmill Brook

Observer Names:

Date: 5-30-15 Time: 9:55

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☑ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☑ Yes	☐ No		
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☑ New good	☐ Old	☐ Collapsing	☐ Eroding ☐ Rusted
Number of Crossings:	1			
Crossing Type:	See next page			

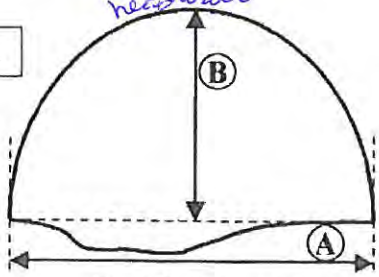
INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions

headwall

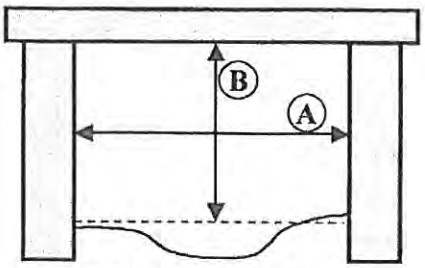
concrete slab bottom - partly covered w/ SILT

1.

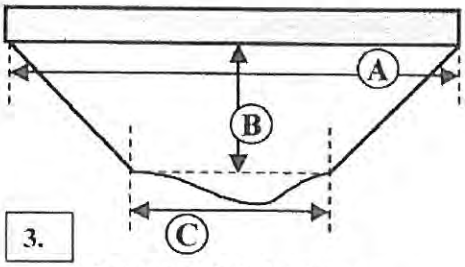


Open Bottom Arch

2.

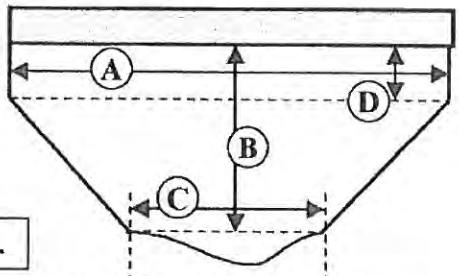


Bridge with Abutments



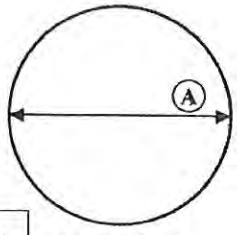
3.

Bridge with Side Slopes

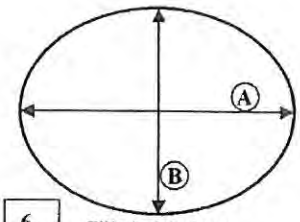


4.

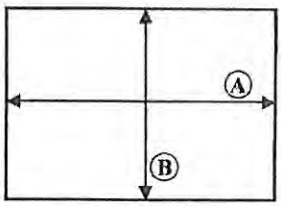
Bridge w/ Side Slopes & Abutments



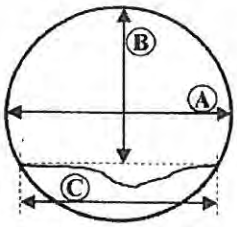
5. Round Culvert



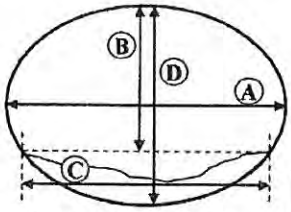
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



Embedded Elliptical Culvert 9.

Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 12'0" B = 6'0" C = _____ D = _____

Downstream Dimensions (feet): A = 12' B = 6' C = _____ D = _____

Structure ID: 17

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☑ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☑ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☑ Erosion ☐ Sediment Buildup ☑ None ~~trunk~~ undercutting

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 18' 8" feet

Downstream

Water depth in culvert (at outlet): 3" ~~feet~~

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 0 feet

Pool present immediately downstream of structure: ☑ Yes ☐ No

Pool depth at point of streamflow entry: 5" feet

Maximum pool depth: 12" ~~feet~~

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☑ Erosion ☑ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): 18' 10" ~~feet~~

Stone granite blocks

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK none			
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☐ No _____ feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☐ Footer ☑ Wing Walls RT	☐ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 17

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 1	Date: 5/30/15
Direction Photo Taken: S	
Description: Sawmill Brook Downstream From Outlet	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 2	Date: 5/30/15
Direction Photo Taken: NE	
Description: Sawmill Brook. View of Culvert outlet looking upstream.	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 3	Date: 5/30/15
Direction Photo Taken: SE	
Description: Sawmill Brook. Downstream bank undercut.	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 4	Date: 5/30/15
Direction Photo Taken: SE	
Description: Sawmill Brook. Downstream bank erosion.	

Tighe&Bond

PHOTOGRAPHIC LOG

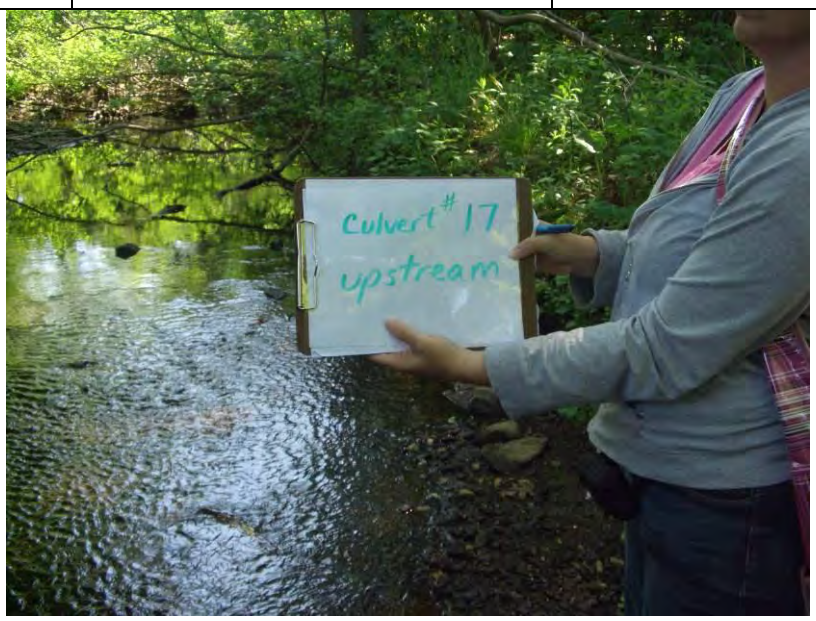
Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 5	Date: 5/30/15

Direction Photo Taken: NE

Description:

Sawmill Brook. View upstream.



Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 6	Date: 5/30/15

Direction Photo Taken: NE

Description:

Sawmill Brook. View upstream.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No.	Date:
7	5/30/15

Direction Photo Taken: SW

Description:

Sawmill brook Upstream. View of undercut bank.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No.	Date:
8	5/30/15

Direction Photo Taken: SW

Description:

Sawmill Brook. Upstream outfall scour and bank undercut

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 9	Date: 5/30/15

Direction Photo Taken: SW

Description:

Sawmill Brook. View of culvert inlet.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln Street Culvert #17	Project No. M-1476

Photo No. 10	Date: 5/30/15

Direction Photo Taken: SW

Description:

Sawmill Brook. Inside culvert. View looking downstream. Stone construction.

Culvert #18
Lincoln Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 18

Nearest Address: Memorial School

Stream Name: ~~Sawmill~~ Causeway Brook

Observer Names: Jessica Lemothe Steve Gang
Olga Hayes

Date: 5-30-15 Time: 10:20am

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☑ Yes	☐ No		
Approximate Length (if feasible to measure):	_____ feet Too busy			
Condition of Crossing:	☐ New	☑ Old good condition	☐ Collapsing	☐ Eroding ☐ Rusted

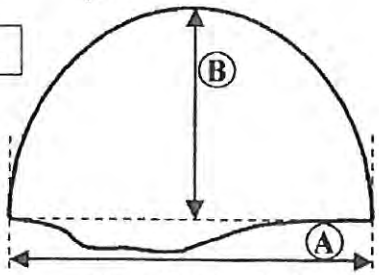
Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

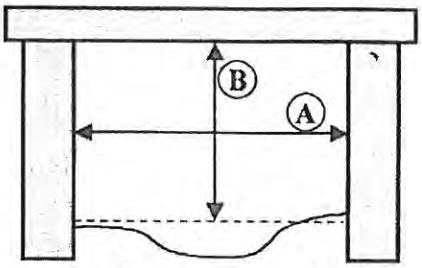
Crossing Type and Dimensions

1.

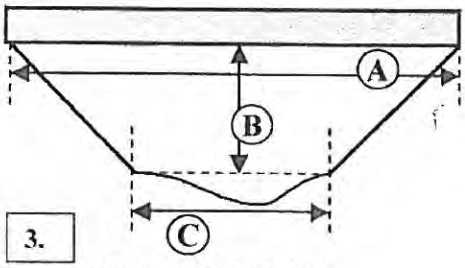


Open Bottom Arch

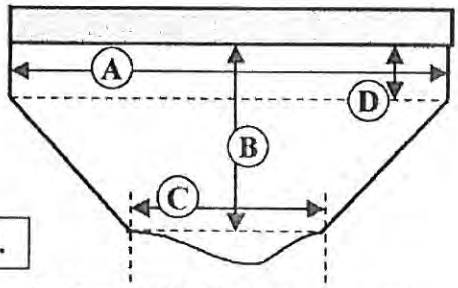
2.



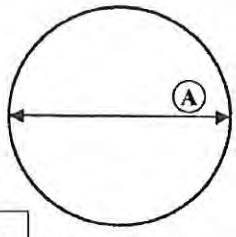
Bridge with Abutments



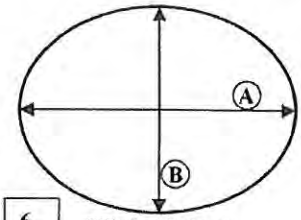
3. Bridge with Side Slopes



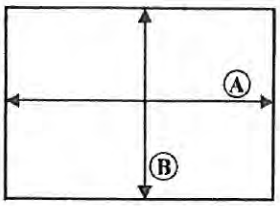
4. Bridge w/ Side Slopes & Abutments



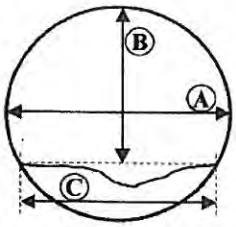
5. Round Culvert



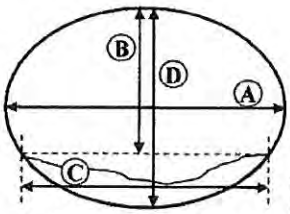
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



9. Embedded Elliptical Culvert

Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 14'6" B = 3'8" C = _____ D = _____

Downstream Dimensions (feet): A = 13' B = 3'8" C = _____ D = _____

Structure ID: 18

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☑ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by: some overhanging branches ☐ Wood ☑ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☐ Mild Bend ☑ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 8 feet 3"

Downstream

Water depth in culvert (at outlet): 3 ~~feet~~ inches

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): _____ ~~feet~~

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: _____ ~~feet~~ N/A

Maximum pool depth: _____ ~~feet~~ N/A

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: lots of overhanging branches in stream ☐ Erosion ☐ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): 14 feet 4"

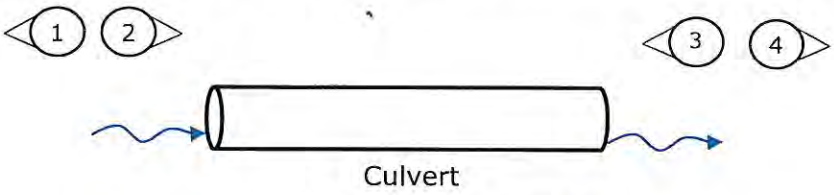
	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand/muck ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand/muck ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand/muck ☐ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK NO			
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 18

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Photograph Instructions

Take at least four (4) photographs of the culvert and surrounding area. These photographs must be taken for every culvert that is visited. Additional photographs are also acceptable.



Photograph 1:	Upstream from culvert inlet ✓
Photograph 2:	Culvert inlet ✓
Photograph 3:	Culvert outlet
Photograph 4:	Downstream from culvert outlet
Photograph 5 and on:	Miscellaneous photographs – Branches in front of upstream culvert

A number with the **structure ID** and **description of what you are photographing** must be visible and clear in EVERY photograph that is taken. For the description of what you are photographing, the following codes can be used: "UPSTREAM," "INLET," "OUTLET," or "DOWNSTREAM." For example:

Structure ID

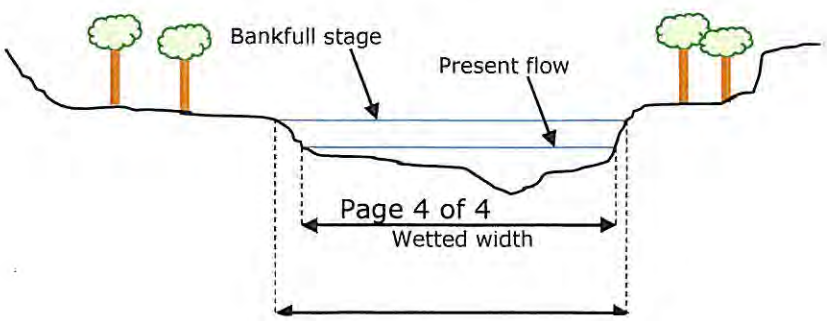
Downstream

If additional photographs are taken, please include the structure ID and description of the photograph. For example:

Structure ID

Sediment buildup in culvert

Bankfull Width



Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Lincoln St. Culvert #18**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: E	
Description: **Causeway Brook View upstream from inlet.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Lincoln St. Culvert #18**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: W	
Description: **Causeway Brook** **Culvert inlet.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Lincoln St. Culvert #18**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: W	
Description: **Causeway Brook Closeup of culvert inlet**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Lincoln St. Culvert #18**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: **Causeway Brook Downstream view of outlet.**	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln St. Culvert #18	Project No. M-1476

Photo No.	Date:
5	5/30/15

Direction Photo Taken: SW

Description:
Causeway Brook

View downstream.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Lincoln St. Culvert #18	Project No. M-1476

Photo No.	Date:
6	5/30/15

Direction Photo Taken: SW

Description:

Causeway Brook

View downstream.

Culvert #19
School Street
Golf Course

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 19

Nearest Address: 153 School St / Golf Course

Stream Name: Causeway Brook

Observer Names: Jessica Lamothe Steve Gang
Olga Hayes

Date: 5-30-15 Time: 10:59 am

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☑ 1	☐ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☑ Paved old	☑ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

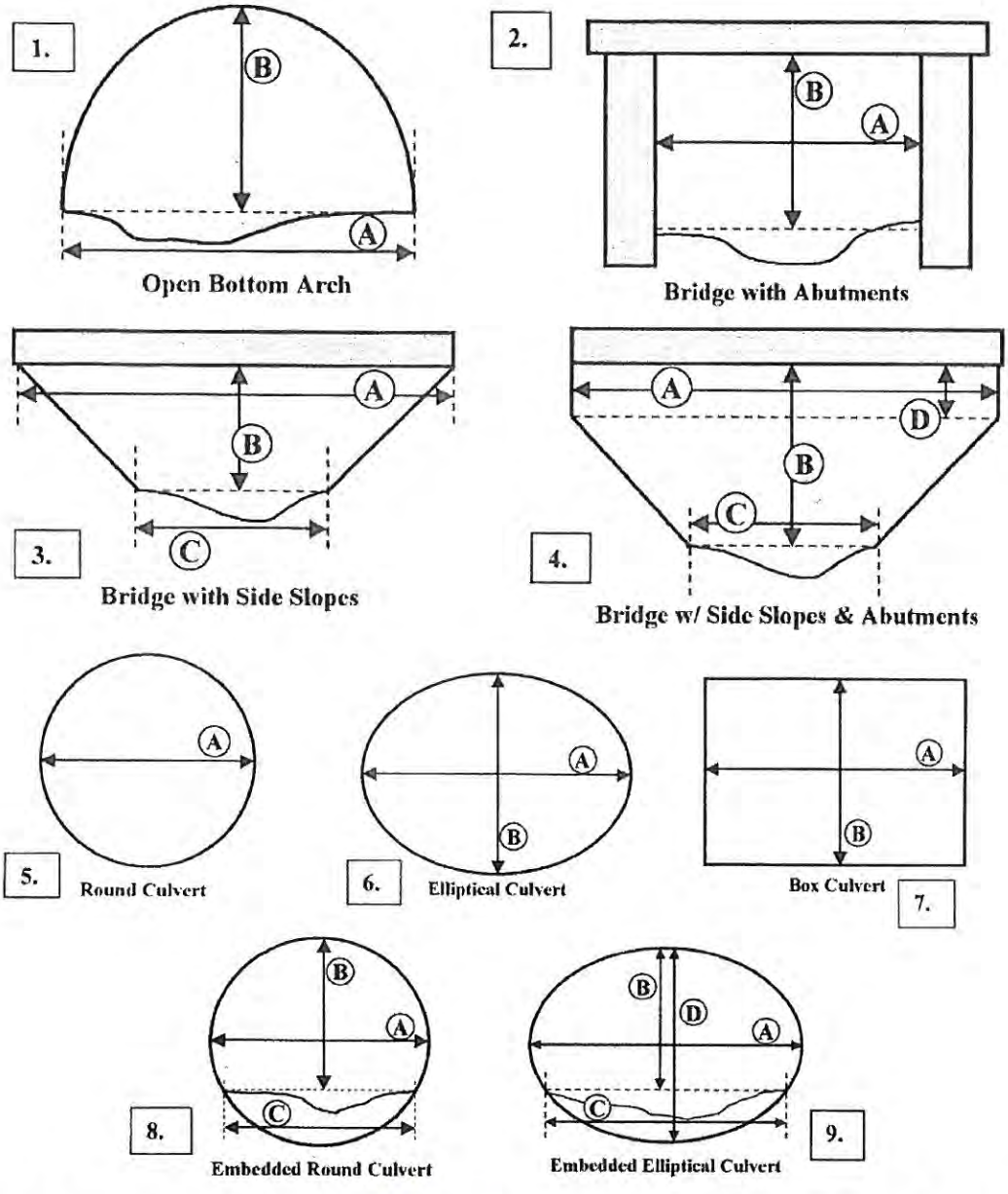
Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☑ Yes	☐ No		
Approximate Length (if feasible to measure): road width	41'3" feet			
Condition of Crossing:	☐ New	☑ Old good	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 8'4" B = 4'6" C = _____ D = _____

Downstream Dimensions (feet): A = 7'9" B = 4'1" C = _____ D = _____

Structure ID: 19

28' 6"
12' 9"

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☑ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☑ None

Angle of stream flow approaching structure: ☑ Sharp Bend ☐ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 13 feet at mouth - then narrows considerably to ~4' 50' upstream of culvert

Upstream obstruction w/ vegetation & logs

Downstream

Water depth in culvert (at outlet): 1" ~~feet~~

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 0 feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: _____ feet N/A

Maximum pool depth: _____ feet N/A

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☑ Sediment Buildup in end of culvert ☐ None

Downstream bankfull widths (see page 4): 31 feet 10"

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand/Mud ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand/mud ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand/mud ☐ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK N/A			
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side see below	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

→ There are concrete blocks just past mouth of culvert obstructing flow - enabling wetland vegetation to flourish - along banks - not impeding flow - at high water would be no problem

Structure ID: 19

Beautiful

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, 153 School St/Golf Course Culvert #19**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: E	
Description: **Causeway Brook** **View Upstream**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, 153 School St/Golf Course Culvert #19**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Causeway Brook. View of inlet looking downstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, 153 School St/Golf Course Culvert #19**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: NE	
Description: **Causeway Brook** **View of culvert outlet**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, 153 School St/Golf Course Culvert #19**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: W	
Description: **Causeway Brook** **View Downstream**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, 153 School St/Golf Course Culvert #19**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: NA	
Description: **Causeway Brook Overhead view of outlet from the road to show bank growth.**	

Culvert #20
Summer Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 20

Nearest Address: 120 Summer St

Stream Name: Causeway Brook

Observer Names: Jessica Lamothe, Olga Hayes, Steve Gang

Date: 5-30-15 Time: 11:26am

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

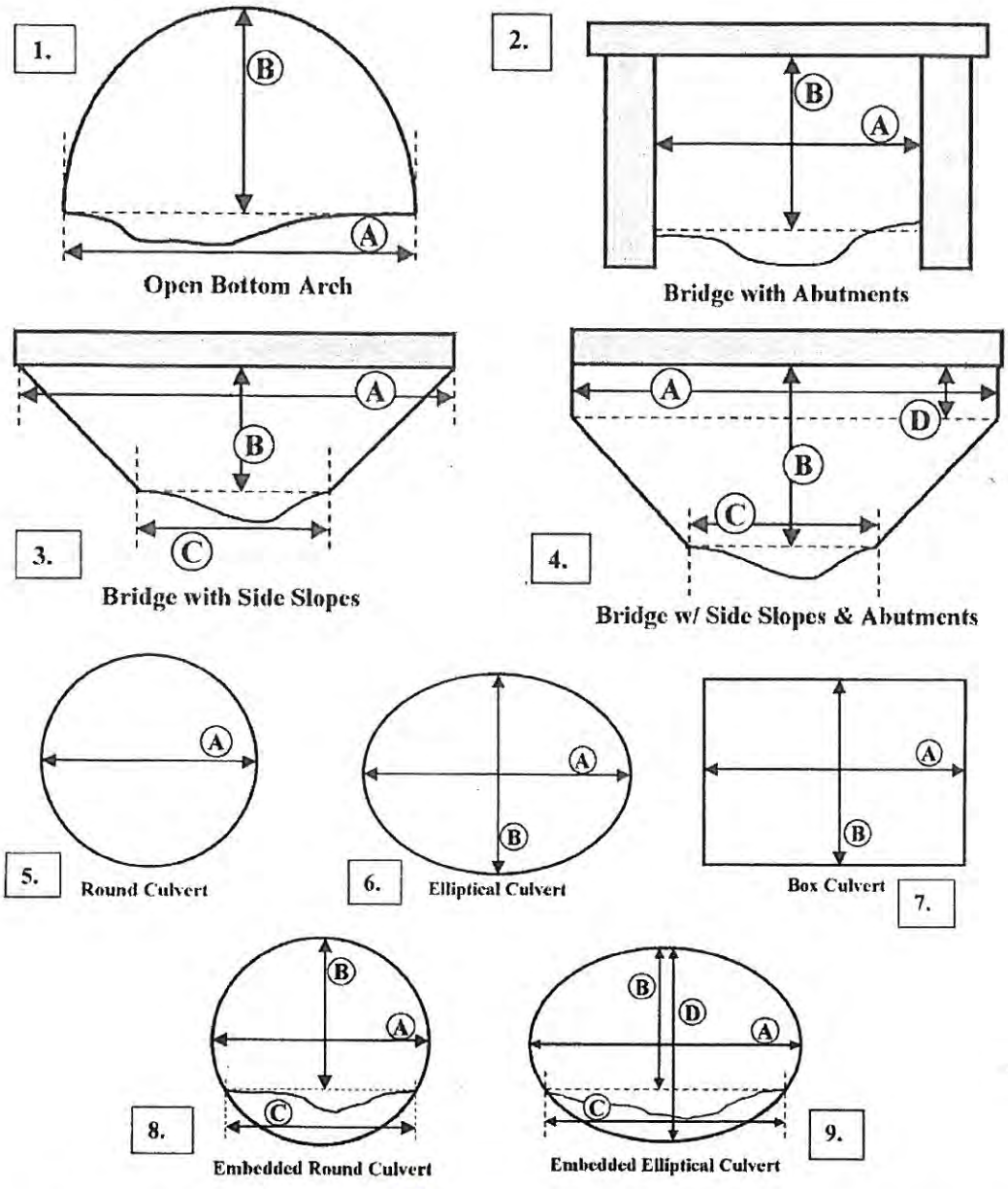
Structure Information

Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	~15 feet too busy			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☑ Rusted some rusting
Number of Crossings:	1			
Crossing Type:	See next page			

→ large tree sitting right on edge of culvert
hubcap in stream just before culvert

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 8'2" B = 4'3" C = _____ D = _____

Downstream Dimensions (feet): A = roughly 10'3" B = roughly 4'11 C = _____ D = _____

Structure ID: 20

roughly same size, but can't access due to fence on either side downstream

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☑ Stone ☐ Other (describe): dirt bank

Structure opening partially obstructed by: tree limbs & brush overhang ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☐ Mild Bend ☑ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☐ Sediment Buildup ☑ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 12 feet 10"

lots of vegetation upstream

Downstream

Water depth in culvert (at outlet): ~~feet~~ 1-2" not really moving

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☑ Backwatered _____ feet

Outlet drop (invert to water surface): 0 feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: N/A feet

Maximum pool depth: N/A feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: This side of culvert is concrete channel. Fence ☐ Erosion ☐ Sediment Buildup ☑ None

Downstream bankfull widths (see page 4): _____ feet roughly 10'3" | at top has some damage

→ top of concrete above culvert is cracked & photographed

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☒ Sand/mud ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☒ Sand/mud ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand/mud ☐ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK N/A			
Sediment deposit types:	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 20

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #20**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: SE	
Description: **Causeway Brook View upstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #20**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: **Causeway Brook View of culvert inlet, looking downstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #20**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: S	
Description: **Causeway Brook View of outlet, looking upstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #20**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: S	
Description: **Causeway Brook. View of outlet, crack in concrete headwall.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #20**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: **Causeway Brook. View downstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #20**	**Project No. M-1476**

Photo No. 6	**Date: 5/30/15**
Direction Photo Taken: NW	
Description: **Causeway Brook. View downstream.**	

Culvert #21
Summer Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 21

Nearest Address: 165 Summer Street

Stream Name:

Observer Names: Red, Belle, Eric, Jake

Date: 5/30 Time: 10:28

Flow Conditions: ☐ Unusually low ☑ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

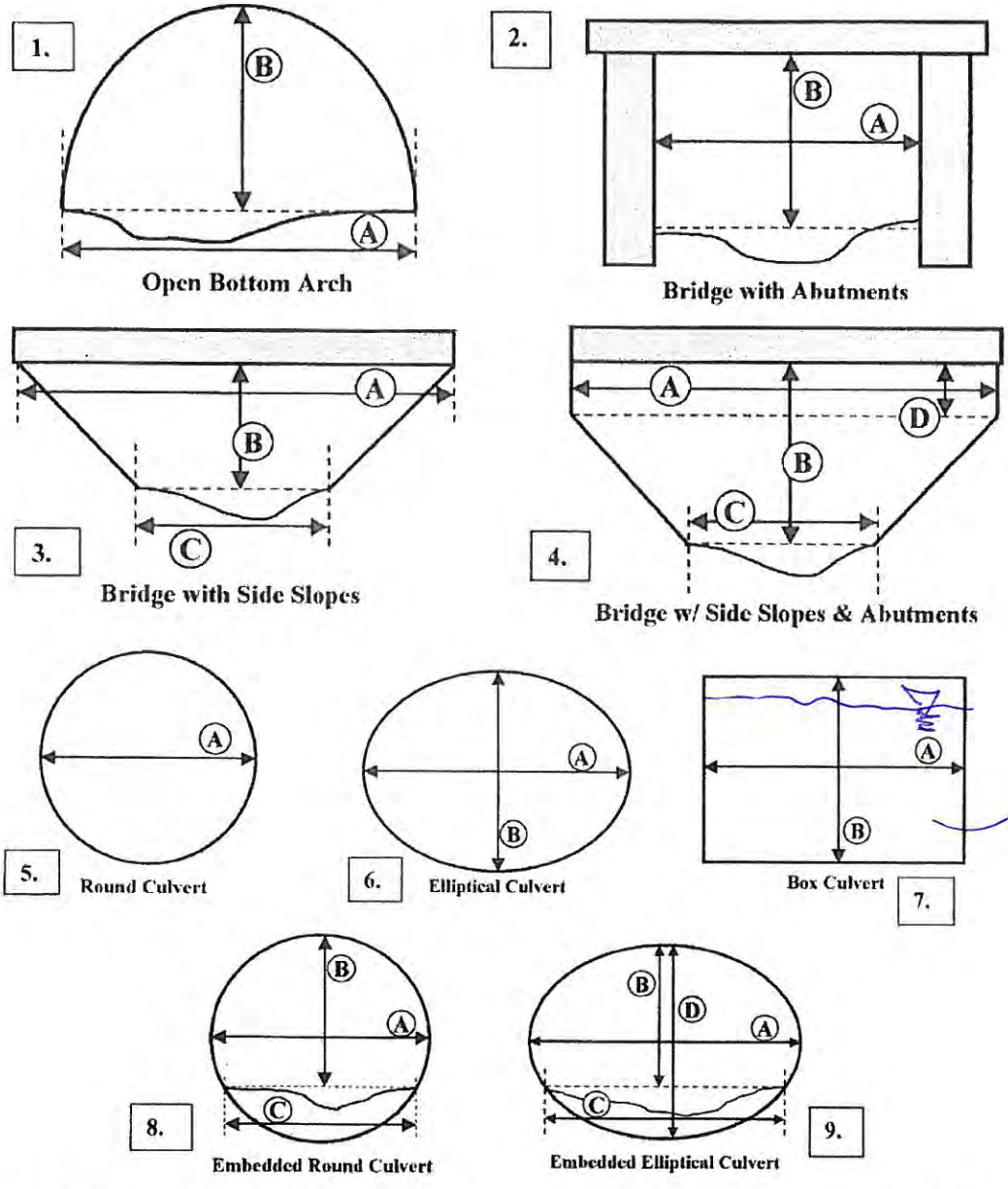
Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☑ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☑ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe):	
Structure Skewed to Roadway?	☑ Yes	☐ No		
Approximate Length (if feasible to measure):	59 ft 3 in feet			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☐ Rusted
Number of Crossings:	1			
Crossing Type:	See next page			

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☒ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 5ft 5in B = 3ft 1.5in C = _____ D = _____

Downstream Dimensions (feet): A = 5ft 5in B = 3ft 1.5in C = _____ D = _____

Structure ID: 21

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☑ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☑ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☐ Erosion ☑ Sediment Buildup ☐ None

Culvert inlet: ☐ At Grade Still in way ☑ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 29.5 feet

Dramatic depth diff. Alot blockage

Downstream

Water depth in culvert (at outlet): 1 in feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): _____ feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: _____ feet

Maximum pool depth: _____ feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: lots of growth ☐ Erosion ☐ Sediment Buildup ☑ None

Downstream bankfull widths (see page 4): 2-4 feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ UNK ☐ Sand	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ UNK
If substrate is present in the structure, how deep is it?	☐ < 1 foot	☐ 1-2 feet	☐ > 2 feet ☑ UNK
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☐ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

water low changed from upstream to dam.

Structure ID: 21

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #21**	**Project No. M-1476**

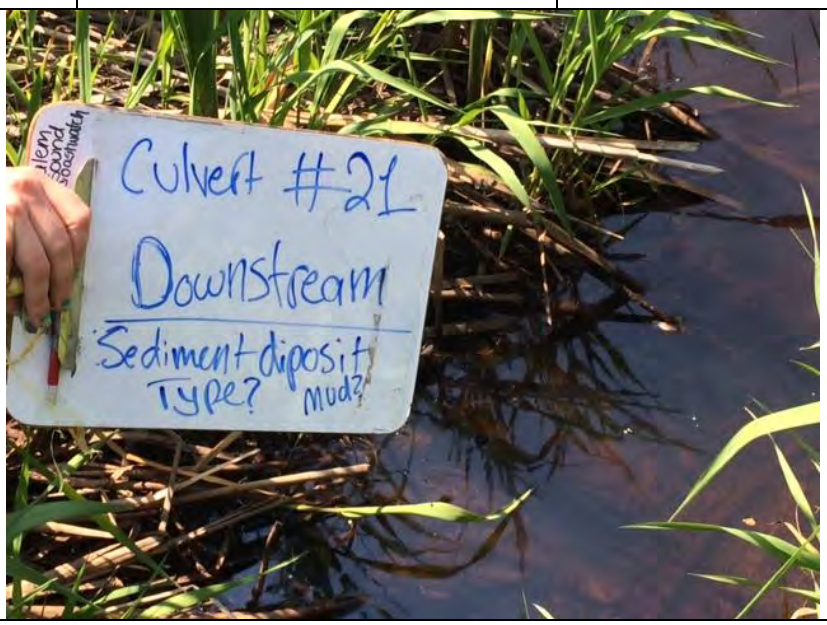
Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Causeway Brook** **View downstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #21**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Causeway Brook** **View downstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #21**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Causeway Brook** **View downstream.**	



Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #21**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: NE	
Description: **Causeway Brook** **View of culvert outlet. Looking upstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Summer St. Culvert #21**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Causeway Brook** **View of culvert inlet.**	

Culvert #22
Norwood Avenue

MARY KEILLY + DAVID LUMSDEN

GROUP 8 = #22 #23 #17 (part)

Town of Manchester-by-the-Sea

Tighe&Bond

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room

QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 22

Nearest Address: 44 NORWOOD AVE

Stream Name: SAWMILL BROOK

Observer Names: MARY REILLY + DAVID LUMSDEN

Date: 5/30/15 Time: 11:30 am

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

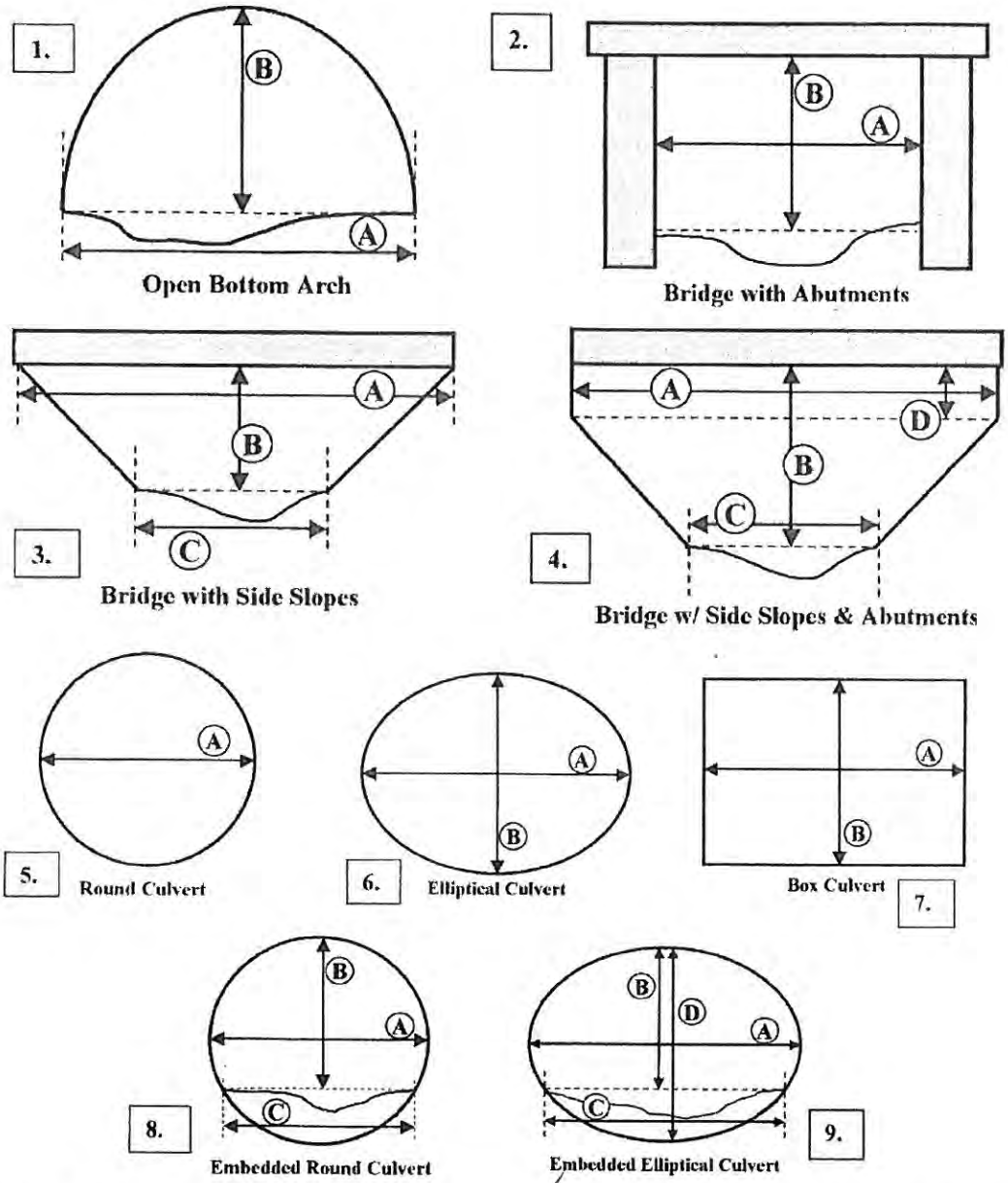
Structure Information

Culvert Material:	☑ Metal-~~corrugated~~ galvanized	☐ Plastic – corrugated	☐ Concrete	☑ Stone ABT.
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☑ Yes	☐ No		
Approximate Length (if feasible to measure):	42 feet	Road width (length of culv)		
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☑ Rusted
Number of Crossings:	2	eg. 2 pipes		
Crossing Type:	See next page			

PHOTOS !

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☐ 1. ☑ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 14ft 3" B = 5'6" C = _____ D = _____

Downstream Dimensions (feet): A = 13 B = 5'5" C = _____ D = _____

Structure ID: 22

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☑ Metal ☑ Stone ☐ Other (describe):

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☑ ~~Culvert~~ Deformed (corrugated metal collapsing) ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☑ Erosion ☑ Sediment Buildup ☐ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 13 feet

Downstream

Water depth in culvert (at outlet): 4" feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 0 feet

Pool present immediately downstream of structure: ☐ Yes ☑ No

Pool depth at point of streamflow entry: N/A feet

Maximum pool depth: N/A feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☑ Erosion ☐ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): 12 feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☑ Sand ☑ UNK (veg + junk)	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☑ Sand ☑ UNK
If substrate is present in the structure, how deep is it?	☑ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		(variable)
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☑ Mid- ☐ Side Channel	☐ None ☐ Point ☐ Delta ☐ Mid- ☑ Side Channel	☐ None ☐ Point ☐ Delta ☐ Mid- ☑ Side Channel
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 22

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Norwood Ave Culvert #22**	**Project No. M-1476**

Photo No. 1	**Date: 5/30/15**
Direction Photo Taken: NE	
Description: **Sawmill Brook. Looking upstream from inlet.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Norwood Ave Culvert #22**	**Project No. M-1476**

Photo No. 2	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Sawmill Brook Upstream inlet, looking downstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Norwood Ave Culvert #22**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: NE	
Description: **Sawmill Brook Outlet, looking upstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Norwood Ave Culvert #22**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Sawmill Brook View downstream from outlet.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Norwood Ave Culvert #22**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **View downstream streambank erosion.**	

Culvert #23
School Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 23

Nearest Address:

Sawmill Brook

Stream Name:

~~Mary Reilly~~ + ~~David Lumsden~~

Observer Names:

Mary Reilly + David Lumsden

Date: 5/30/15 Time: 1135 AM

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

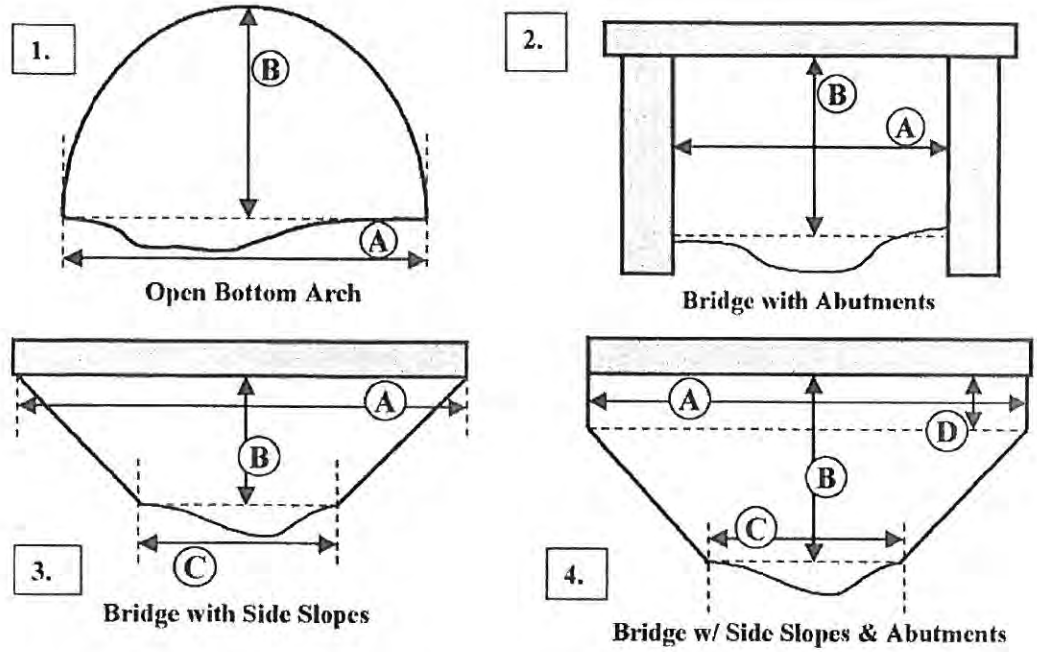
Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	sidewalk	
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☑ Concrete	☑ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe):	
Structure Skewed to Roadway?	☑ Yes	☑ No		
Approximate Length (if feasible to measure):	36' feet			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☐ Rusted
Number of Crossings:	2 major + multiple small culverts	Stormwater Pipes		
Crossing Type:	See next page			

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions



Crossing Type (from above): ☑ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 8'8" B = 4'8" C = _____ D = _____

Downstream Dimensions (feet): A = 8'11" B = 4'10" C = _____ D = _____

Structure ID: 23

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material:	☐ Concrete ☐ Metal ☑ Stone ☐ Other (describe):
Structure opening partially obstructed by:	☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☑ None
Angle of stream flow approaching structure:	☐ Sharp Bend ☐ Mild Bend ☐ Naturally Straight ☑ Channelized Straight
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☐ Erosion ☑ Sediment Buildup ☐ None
Culvert inlet:	☑ At Grade ☐ Cascade ☐ Free Fall
Upstream bankfull widths (see page 4):	0 feet

Downstream

Water depth in culvert (at outlet):	18" ~~feet~~
Culvert outlet:	☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet
Outlet drop (invert to water surface):	0 feet
Pool present immediately downstream of structure:	☐ Yes ☑ No
Pool depth at point of streamflow entry:	0 feet
Maximum pool depth:	0 feet
Evidence of streambed erosion or sediment buildup immediately downstream of culvert:	☐ Erosion ☐ Sediment Buildup ☑ None
Downstream bankfull widths (see page 4):	12 feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☑ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☑ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☑ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☑ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 23

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, School St. Culvert #23	Project No. M-1476

Photo No. 1 | **Date:** 5/30/15

Direction Photo Taken: E

Description:

Sawmill Brook. View upstream from inlet

Tighe&Bond

PHOTOGRAPHIC LOG

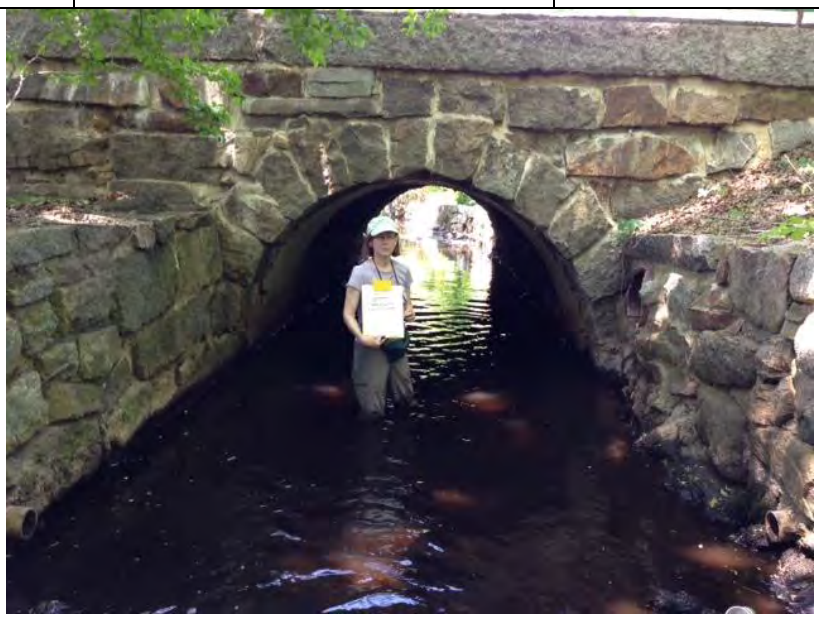
Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, School St. Culvert #23	Project No. M-1476

Photo No. 2 | **Date:** 5/30/15

Direction Photo Taken: W

Description:

Sawmill Brook. Upstream Inlet, view looking downstream.



Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #23**	**Project No. M-1476**

Photo No. 3	**Date: 5/30/15**
Direction Photo Taken: E	
Description: **Sawmill Brook. Downstream outlet, view is looking upstream.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, School St. Culvert #23**	**Project No. M-1476**

Photo No. 4	**Date: 5/30/15**
Direction Photo Taken: W	
Description: **Sawmill Brook. Downstream view from outlet.**	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, School St. Culvert #23	Project No. M-1476

Photo No. 5	Date: 5/30/15

Direction Photo Taken: N

Description:

Downstream outfall in channel wall.

Culvert #24
Summer Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 24

Nearest Address: 185 Summer Street

Stream Name:

Observer Names: Belle, Eric, Jake, Red

Date: 5/20 Time: 10:52

Flow Conditions: ☐ Unusually low ☑ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☑ 1	☐ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☑ 1	☐ 2		
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☐ Metal-corrugated ☐ Metal – smooth	☐ Plastic – corrugated ☑ Plastic– smooth	☑ Concrete ☐ Other (describe): _____	☐ Stone
Structure Skewed to Roadway?	☑ Yes	☐ No		
Approximate Length (if feasible to measure):	60.15 feet			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding	☑ Rusted

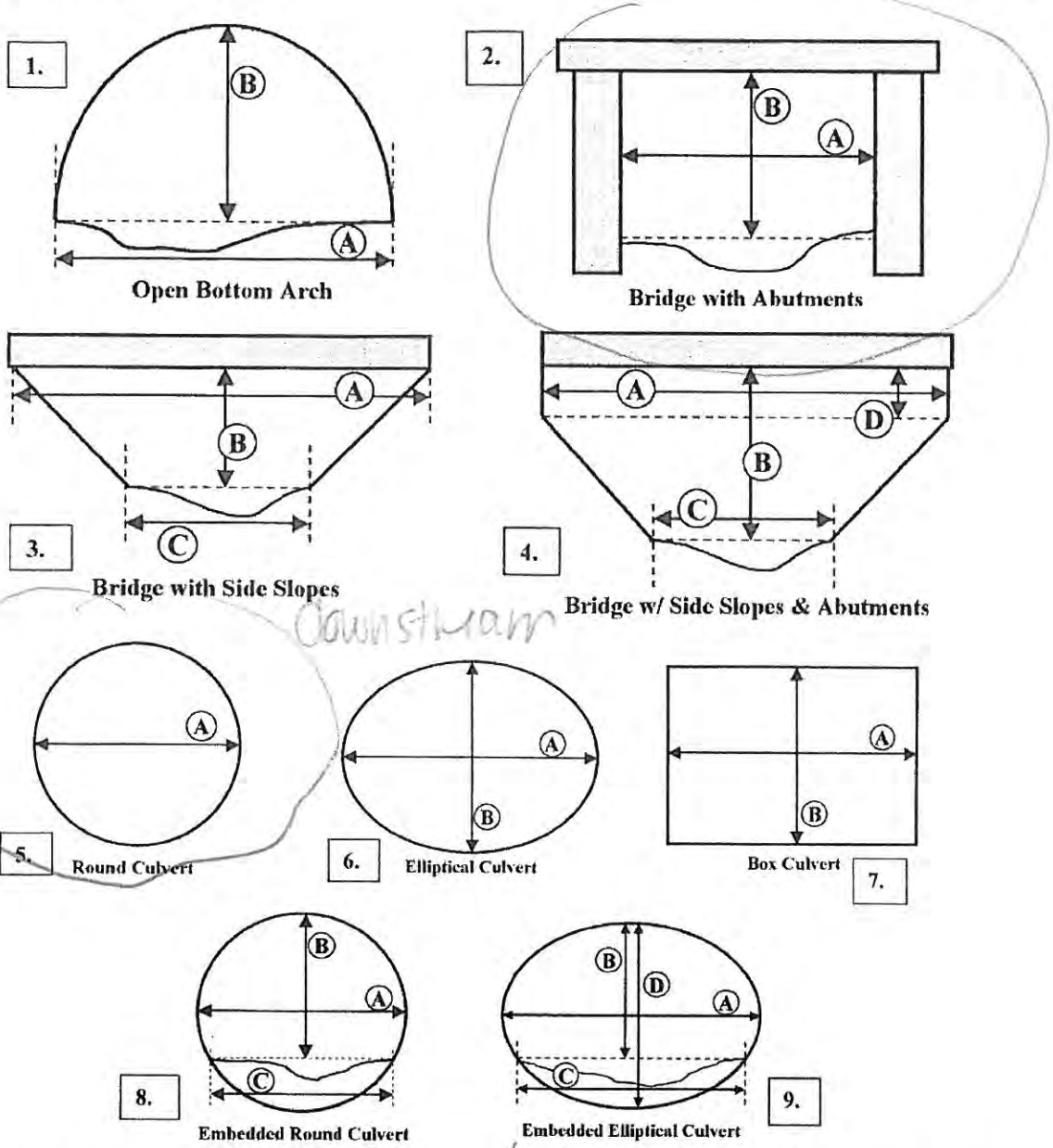
Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Dimensions

upstream



Crossing Type (from above): ☐ 1. ☑ 2. ☐ 3. ☐ 4. ☑ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 3ft 7in B = 2ft 5in C = _____ D = _____

Downstream Dimensions (feet): A = 1.58in B = _____ C = _____ D = _____

Structure ID: _____

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material:	☐ Concrete	☐ Metal	☑ Stone	☐ Other (describe):	
Structure opening partially obstructed by:	☐ Wood	☐ Sediment	☐ Wood and Sediment	☐ Culvert Deformed	☑ None
Angle of stream flow approaching structure:	☑ Sharp Bend	☑ Mild Bend	☐ Naturally Straight	☐ Channelized Straight	
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☐ Erosion	☑ Sediment Buildup	☐ None		
Culvert inlet:	☑ At Grade	☐ Cascade	☐ Free Fall		
Upstream bankfull widths (see page 4): 16-20 feet					

Downstream

Water depth in culvert (at outlet): 1ft 3in feet				
Culvert outlet: ☐ At Grade	☑ Cascade	☐ Free Fall	☐ Backwatered _____ feet	
Outlet drop (invert to water surface): 1ft 1in feet				
Pool present immediately downstream of structure:	☑ Yes	☐ No		
Pool depth at point of streamflow entry: 1ft 3in feet				
Maximum pool depth: 2 feet				
Evidence of streambed erosion or sediment buildup immediately downstream of culvert:	☐ Erosion	☐ Sediment Buildup	☑ None	
Downstream bankfull widths (see page 4): 1ft 1in feet				

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☑ Gravel ☑ Sand ☐ UNK plants	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☑ UNK
If substrate is present in the structure, how deep is it? ☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK			
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☐ Footer ☑ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID: 24

changed from 12 to 24

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, 185 Summer St. Culvert #24	Project No. M-1476

Photo No. 1	Date: 5/30/15
Direction Photo Taken: SW	
Description: Causeway Brook View of inlet, looking downstream.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, 185 Summer St.Culvert #24	Project No. M-1476

Photo No. 2	Date: 5/30/15
Direction Photo Taken: NE	
Description: Causeway Brook. Looking upstream.	

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, 185 Summer St. Culvert #24	Project No. M-1476

Photo No.	Date:
3	5/30/15

Direction Photo Taken: SW

Description:

Causeway Brook. View of inlet.

Tighe&Bond

PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, 185 Summer St. Culvert #24	Project No. M-1476

Photo No.	Date:
4	5/30/15

Direction Photo Taken: W

Description:

Causeway Brook. View downstream.

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, 185 Summer St.Culvert #24**	**Project No. M-1476**

Photo No. 5	**Date: 5/30/15**
Direction Photo Taken: SW	
Description: **Causeway Brook. View of downstream banks.**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, 185 Summer St. Culvert #24**	**Project No. M-1476**

Photo No. 6	**Date: 5/30/15**
Direction Photo Taken: E	
Description: **Causeway Brook. Downstream outlet.**	

Culvert #25
& Tide Gate
Central Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID:

Nearest Address:

CENTRAL ST.

Stream Name:

SAWMILL BROOK

Observer Names:

DUNCAN MELLOR, PE

Date: 6-11-15 Time: 1-2 PM

Flow Conditions: ☐ Unusually low ☒ Typical low flow ☐ Higher than average ☐ Flood conditions

GATE OPENED TO DEWATER CULVERT

Road Information

Number of Travel Lanes:	☐ 1	☒ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☒ 1	☐ 2		
Road Surface:	☒ Paved	☐ Unpaved		
Road Type	☒ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☒ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☒ No		
Approximate Length (if feasible to measure):	42 feet			
Condition of Crossing:	☐ New	☒ Old	☒ Collapsing	☐ Eroding ☐ Rusted

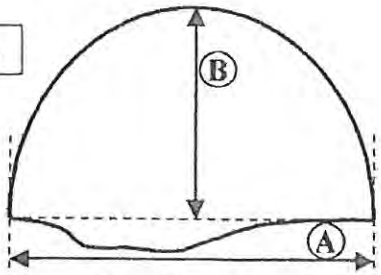
Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

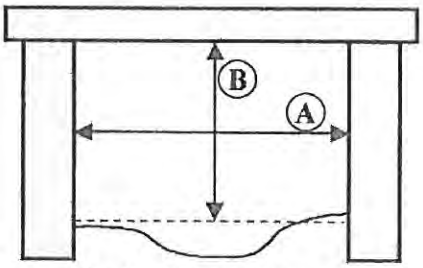
Crossing Dimensions

1.

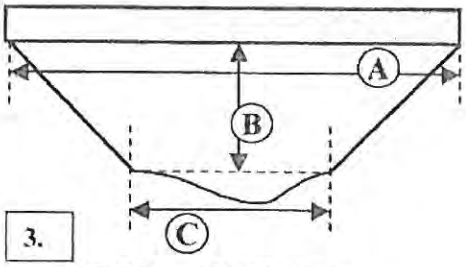


Open Bottom Arch

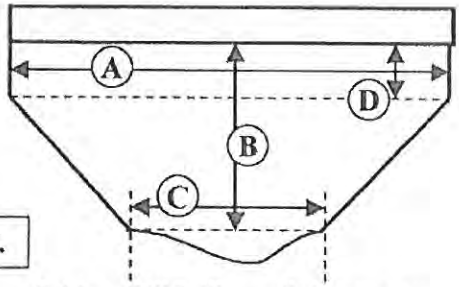
2.



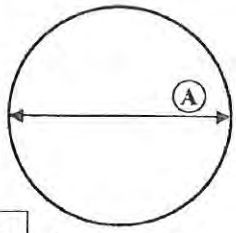
Bridge with Abutments



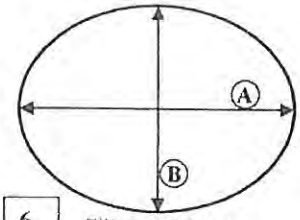
3. Bridge with Side Slopes



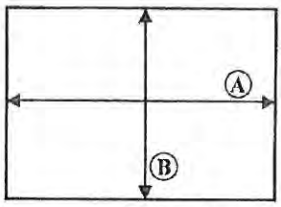
4. Bridge w/ Side Slopes & Abutments



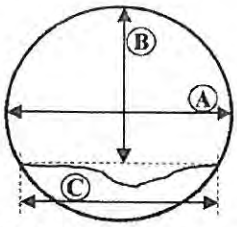
5. Round Culvert



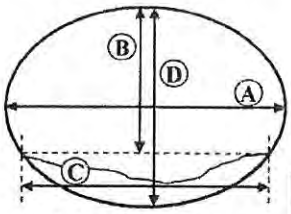
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



Embedded Elliptical Culvert 9.

Crossing Type (from above): ☒ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 16' B = 6.8' C = _____ D = _____

Downstream Dimensions (feet): A = 14'± B = 8.3'± C = _____ D = _____

Structure ID: _____

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☒ Stone ☐ Other (describe): SOME SHOTCRETE OVERLAY

Structure opening partially obstructed by: ☐ Wood ☒ Sediment BEDROCK & CONCRETE ☐ Wood and Sediment ☐ Culvert Deformed ☐ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☐ Mild Bend ☐ Naturally Straight ☒ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☒ Erosion ☐ Sediment Buildup ☐ None

Culvert inlet: ☒ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 20± feet

Downstream

Water depth in culvert (at outlet): 0.2± feet GATE OPEN

Culvert outlet: ☐ At Grade ☐ Cascade ☒ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 2.2± feet

Pool present immediately downstream of structure: ☒ Yes GATE IMPOUND. ☐ No

Pool depth at point of streamflow entry: 0.5 feet

Maximum pool depth: 2± feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☐ Erosion ☐ Sediment Buildup ☒ None BEDROCK

Downstream bankfull widths (see page 4): 48± feet

	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☒ Cobble ☐ Gravel ☐ Sand ☐ UNK	☒ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☒ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☒ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK		
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☒ Side	☒ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side	☒ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☒ No _____ feet	☐ Yes ☒ No _____ feet	☐ Yes ☒ No _____ feet
Streambank scour causing undermining around/under structure:	☐ None ☐ Culvert ☒ Footer ☐ Wing Walls	☒ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID:_____

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert	Project No. M-1476

Photo No. 1	Date: 6/11/15
Direction Photo Taken: S	
Description: Arch culvert looking downstream	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert	Project No. M-1476

Photo No. 2	Date: 6/11/15
Direction Photo Taken: S	
Description: Inside culvert looking toward tide gate	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert**	**Project No. M-1476**

Photo No. 3	**Date: 6/11/15**
Direction Photo Taken: NE	
Description: **Upper weir, bedrock left**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert**	**Project No. M-1476**

Photo No. 4	**Date: 6/11/15**
Direction Photo Taken: N	
Description: **Lower weir, concrete facing on apparent rock filled timber cribs**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert**	**Project No. M-1476**

Photo No. 5	**Date: 6/11/15**
Direction Photo Taken: W	
Description: Apparent rock filled timber cribs at lower weir	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert**	**Project No. M-1476**

Photo No. 6	**Date: 6/11/15**
Direction Photo Taken: S	
Description: View of tide gate from lower weir	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert**	**Project No. M-1476**

Photo No. 7	**Date: 6/11/15**
Direction Photo Taken: SE	
Description: **Gate track near invert with corrosion/erosion**	

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert**	**Project No. M-1476**

Photo No. 8	**Date: 6/11/15**
Direction Photo Taken: N	
Description: **Tide gate invert**	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert	Project No. M-1476

Photo No. 9	Date: 6/11/15

Direction Photo Taken: NE

Description:

Tide gate structure, note overlay repair concrete covering original concrete

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert	Project No. M-1476

Photo No. 10	Date: 6/11/15

Direction Photo Taken: N

Description:

Bedrock configuration downstream of tide gate structure

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert	Project No. M-1476

Photo No. 11	Date: 6/11/15

Direction Photo Taken: W

Description:

Arch culvert stone separation approximately 4 feet inside upstream end

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Sawmill Brook Tide Gate Culvert	Project No. M-1476

Photo No. 12	Date: 6/11/15

Direction Photo Taken: S

Description:

Upstream west entrance corner of stone arch culvert showing unsupported culvert stonework, possibly caused by scour or loss of footing stones – apparent cause of separation in photo 11

Culvert #26
MassDOT 128

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 26
Nearest Address: X

Stream Name: X

Observer Names: PJS & DWD

Date: 7/21/15 Time: 2-3 PM

Flow Conditions: ☐ Unusually low ☒ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☐ 2	☐ 3	☒ 4
Number of Shoulder Lanes:	☐ 1	☒ 2		
Road Surface:	☒ Paved	☐ Unpaved		
Road Type	☒ Road	☐ Trail	☐ Railroad	

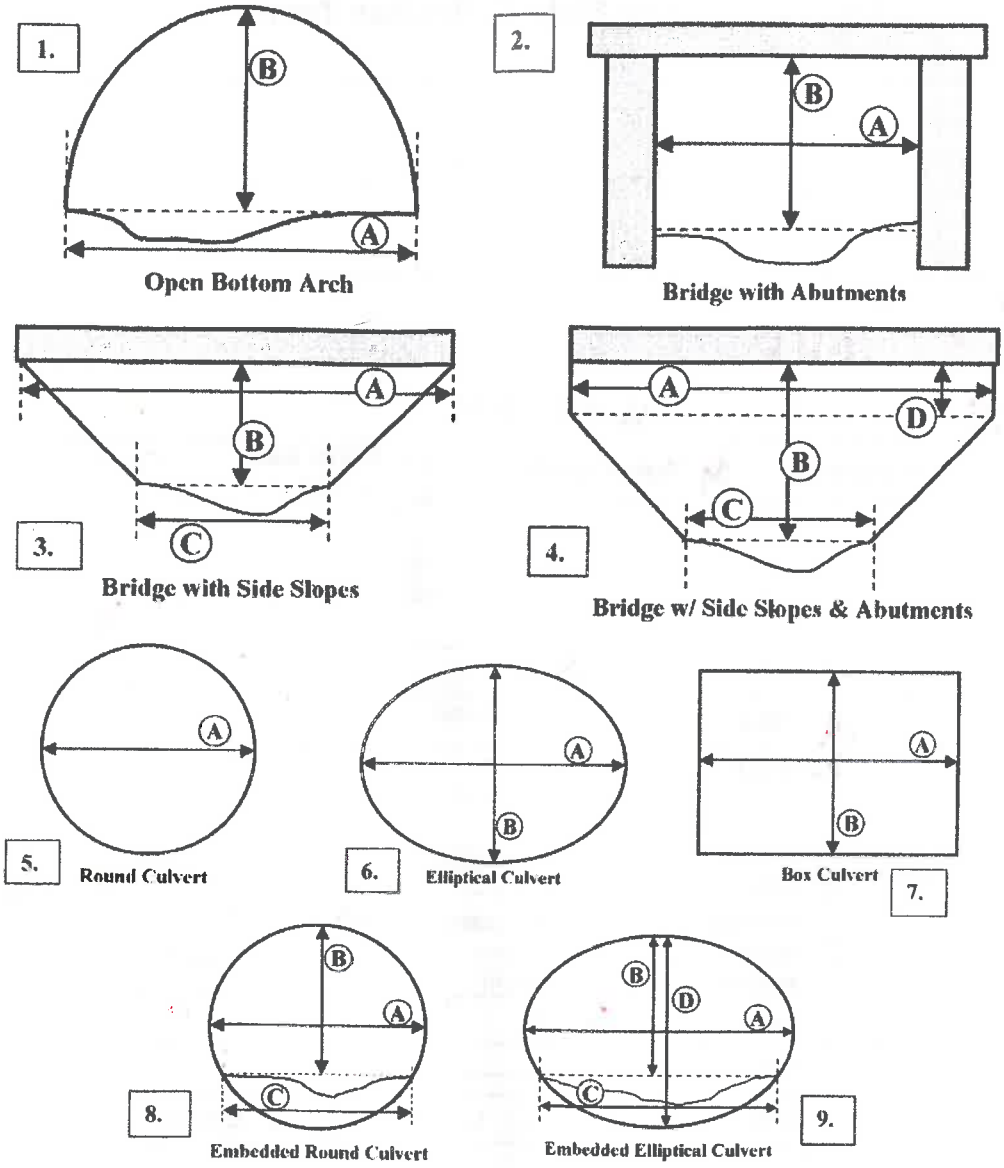
Structure Information

Culvert Material:	☐ Metal-corrugated	☐ Plastic – corrugated	☒ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe): _____	
Structure Skewed to Roadway?	☐ Yes	☒ No		
Approximate Length (if feasible to measure):	_____ feet			
Condition of Crossing:	☐ New	☒ Old	☐ Collapsing	☐ Eroding ☐ Rusted

Number of Crossings: 1

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Crossing Type and Dimensions



Crossing Type (from above): ☐ 1. ☒ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 14.7' B = 8.1' C = _____ D = _____

Downstream Dimensions (feet): A = _____ B = _____ C = _____ D = _____

Structure ID: 26

INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☒ Concrete ☐ Metal ☐ Stone ☐ Other (describe):

Structure opening partially obstructed by:	☐ Wood	☒ Sediment	☐ Wood and Sediment	☐ Culvert Deformed	☐ None
Angle of stream flow approaching structure:	☐ Sharp Bend	☐ Mild Bend	☐ Naturally Straight	☐ Channelized Straight	
Evidence of streambed erosion or sediment buildup immediately upstream of culvert:	☐ Erosion	☒ Sediment Buildup	☐ None		
Culvert inlet:	☒ At Grade	☐ Cascade	☐ Free Fall		
Upstream bankfull widths (see page 4): 25+/- feet					

Downstream

Water depth in culvert (at outlet): 0.2 feet				
Culvert outlet: ☒ At Grade	☐ Cascade	☐ Free Fall	☐ Backwatered _____ feet	
Outlet drop (invert to water surface): 2+/- feet				
Pool present immediately downstream of structure:	☐ Yes	☒ No		
Pool depth at point of streamflow entry: ~ feet				
Maximum pool depth: ~ feet				
Evidence of streambed erosion or sediment buildup immediately downstream of culvert:	☐ Erosion	☒ Sediment Buildup	☐ None	
Downstream bankfull widths (see page 4): 25+/- feet				

	Upstream	*In Structure*	*Downstream*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☒ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☒ Cobble ☐ Gravel ☐ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☒ Sand ☐ UNK
If substrate is present in the structure, how deep is it?	☐ < 1 foot	☒ 1-2 feet	☐ > 2 feet ☐ UNK
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☒ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☒ Side	☐ None ☐ Point ☐ Delta ☐ Mid-Channel ☒ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☒ No _____ feet	☐ Yes ☒ No _____ feet	☐ Yes ☒ No _____ feet
Streambank scour causing undermining around/under structure:	☒ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A	☒ None ☐ Culvert ☐ Footer ☐ Wing Walls

Structure ID: 26

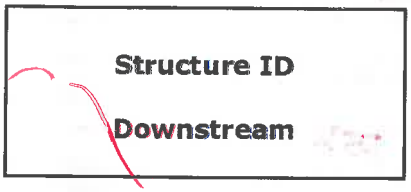
INSTRUCTIONS: Please return complete forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Photograph Instructions

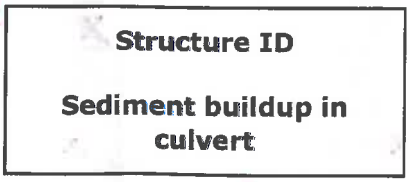
Take at least four (4) photographs of the culvert and surrounding area. These photographs must be taken for every culvert that is visited. Additional photographs are also acceptable.

Photograph 1:	Upstream from culvert inlet
Photograph 2:	Culvert inlet
Photograph 3:	Culvert outlet
Photograph 4:	Downstream from culvert outlet
Photograph 5 and on:	Miscellaneous photographs

A number with the **structure ID** and **description of what you are photographing** must be visible and clear in EVERY photograph that is taken. For the description of what you are photographing, the following codes can be used: "UPSTREAM," "INLET," "OUTLET," or "DOWNSTREAM." For example:



If additional photographs are taken, please include the structure ID and description of the photograph. For example:



Structure ID: 26

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Culvert #26	Project No. M-1476

Photo No. 1	Date: 7/21/15

Direction Photo Taken: South facing culvert

Description:

Upstream side of Culvert #26, owned by MassDOT

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Culvert #26	Project No. M-1476

Photo No. 2	Date: 7/21/15

Direction Photo Taken: North

Description:

View of upstream from inside Culvert #26, owned by MassDOT

Tighe&Bond		PHOTOGRAPHIC LOG
Client Name: Manchester-by-the Sea, MA	**Site Location: Sawmill Brook Watershed, Culvert #26**	**Project No. M-1476**

Photo No. 3	**Date: 7/21/15**
Direction Photo Taken: North	
Description: **Downstream side of Culvert #26, owned by MassDOT**	

Culvert #27
Mill Street

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Culvert Inventory Field Collection Form

Structure ID: 27

Nearest Address: mill St

Stream Name:

Observer Names: Jack & Carolyn Group 5

Date: Time: 10:35

Flow Conditions: ☑ Unusually low ☐ Typical low flow ☐ Higher than average ☐ Flood conditions

Road Information

Number of Travel Lanes:	☐ 1	☑ 2	☐ 3	☐ 4
Number of Shoulder Lanes:	☐ 1	☐ 2	0	
Road Surface:	☑ Paved	☐ Unpaved		
Road Type	☑ Road	☐ Trail	☐ Railroad	

Structure Information

Culvert Material:	☑ Metal-corrugated	☐ Plastic – corrugated	☐ Concrete	☐ Stone
	☐ Metal – smooth	☐ Plastic– smooth	☐ Other (describe):	
Structure Skewed to Roadway?	☐ Yes	☑ No		
Approximate Length (if feasible to measure):	47 feet			
Condition of Crossing:	☐ New	☑ Old	☐ Collapsing	☐ Eroding ☐ Rusted A bit but OK

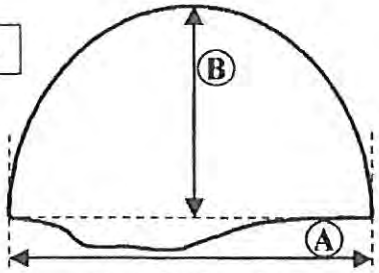
Number of Crossings: 1

Crossing Type: See next page

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

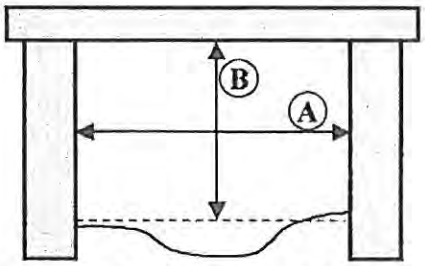
Crossing Dimensions

1.

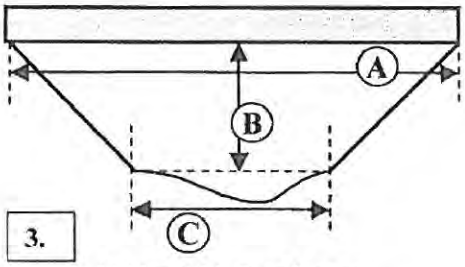


Open Bottom Arch

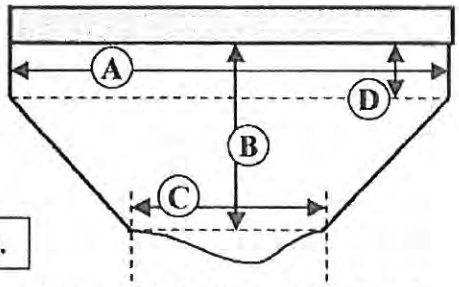
2.



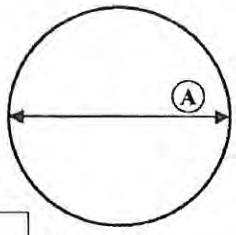
Bridge with Abutments



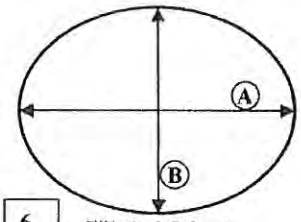
3. Bridge with Side Slopes



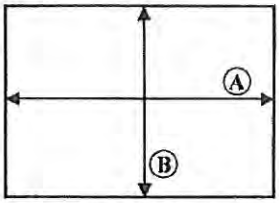
4. Bridge w/ Side Slopes & Abutments



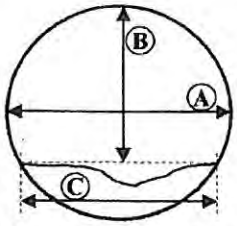
5. Round Culvert



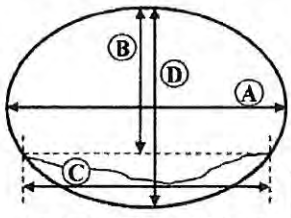
6. Elliptical Culvert



Box Culvert 7.



8. Embedded Round Culvert



9. Embedded Elliptical Culvert

Crossing Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☑ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9.

Upstream Dimensions (feet): A = 7.1 B = _____ C = _____ D = _____

Downstream Dimensions (feet): A = 6.8 B = _____ C = _____ D = _____

Structure ID: _____

INSTRUCTIONS: When you have completed your culverts, please return forms to Town Hall Meeting Room
QUESTIONS: during field work, call 508-367-5598

Upstream

Headwall Material: ☐ Concrete ☐ Metal ☐ Stone ☑ Other (describe): Earth

Structure opening partially obstructed by: ☐ Wood ☐ Sediment ☐ Wood and Sediment ☐ Culvert Deformed ☑ None

Angle of stream flow approaching structure: ☐ Sharp Bend ☑ Mild Bend ☐ Naturally Straight ☐ Channelized Straight

Evidence of streambed erosion or sediment buildup immediately upstream of culvert: ☑ Erosion ☒ Sediment Buildup ☐ None

Culvert inlet: ☑ At Grade ☐ Cascade ☐ Free Fall

Upstream bankfull widths (see page 4): 16 feet

Downstream

Water depth in culvert (at outlet): 17 feet

Culvert outlet: ☑ At Grade ☐ Cascade ☐ Free Fall ☐ Backwatered _____ feet

Outlet drop (invert to water surface): 0 feet

Pool present immediately downstream of structure: ☑ Yes ☐ No

Pool depth at point of streamflow entry: 18 feet

Maximum pool depth: ? feet

Evidence of streambed erosion or sediment buildup immediately downstream of culvert: ☑ Erosion ☑ Sediment Buildup ☐ None

Downstream bankfull widths (see page 4): 17.9 feet

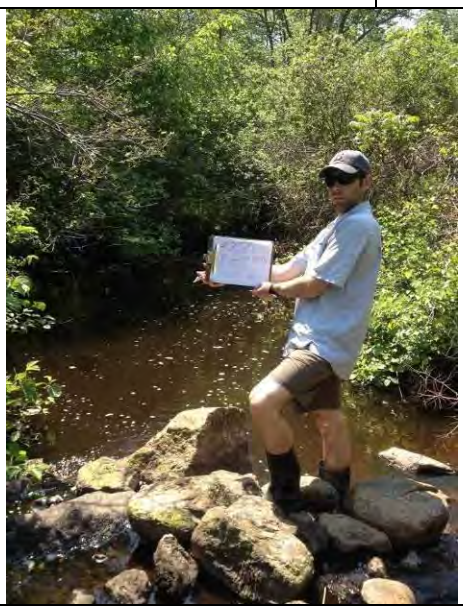
	Upstream	*Downstream*	*In Structure*
Dominant bed material at structure (circle):	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☑ Cobble ☑ Gravel ☑ Sand ☐ UNK	☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☑ Sand silt ☐ UNK
If substrate is present in the structure, how deep is it?	☐ < 1 foot ☐ 1-2 feet ☐ > 2 feet ☐ UNK none		
Sediment deposit types:	☐ None ☐ Point ☐ Delta ☑ Mid-Channel ☑ Side	☐ None ☐ Point ☐ Delta ☑ Mid-Channel ☑ Side	☑ None ☐ Point ☐ Delta ☐ Mid-Channel ☐ Side
Beaver dam near structure: Distance from structure to dam:	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet	☐ Yes ☑ No _____ feet
Streambank scour causing undermining around/under structure:	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	☑ None ☐ Culvert ☐ Footer ☐ Wing Walls	N/A

Structure ID:_____

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Mill Street Culvert #27	Project No. M-1476

Photo No. 1	Date: 5/30/15
Direction Photo Taken: N	
Description: Sawmill Brook. View upstream.	



Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Mill Street Culvert #27	Project No. M-1476

Photo No. 2	Date: 5/30/15
Direction Photo Taken: S	
Description: Sawmill Brook. Culvert inlet, looking downstream	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Mill Street Culvert #27	Project No. M-1476

Photo No. 3	Date: 5/30/15
Direction Photo Taken: N	
Description: Sawmill Brook. Culvert outlet, looking upstream.	

Tighe&Bond	PHOTOGRAPHIC LOG

Client Name: Manchester-by-the Sea, MA	Site Location: Sawmill Brook Watershed, Mill Street Culvert #27	Project No. M-1476

Photo No. 4	Date: 5/30/15
Direction Photo Taken: S	
Description: Sawmill Brook. Below outlet, looking downstream.	

APPENDIX D

Culvert #	Metcalf & Eddy Number	Stream	Street	Inlet Dimensions (ft)		Inlet Elevation	Doucet Inlet Elevation	Doucet Road Centerline	Top of Road	Outlet Dimensions (ft)		Outlet Elevation	Doucet Outlet Elevation	Top of Road	Length (ft)	# of Crossings	Culvert Type	Culvert		Stream bed issues		Other Issues
				Width	Height					Width	Height							Material	Condition	Upstream	Downstream	
2	8-1-A (upstream) 8-1-B (downstream)	Cedar Swamp	School Street	2.67	2.67	40.20	*39.20*	*44.90*	45.80	3.33	2.83	39.10	*39.30*	45.80	45.00	3	box culvert	Dry Stone	old			Beaver deceiver
2a	8-2-A/B	Cedar Swamp	School Street	1.50	1.50	41.40	*40.00*	*44.70*	45.40	1.50	1.50	41.10	*40..7*	45.40			round culvert	clay pipie		dry		
2b	8-3-A/B	Cedar Swamp	School Street	3.00	2.58	40.80	*39.50*	*39.10*	44.90	3.00	3.33	40.40	*39.10*	45.00			dry stone culvert box					
3	7A (upstream 7B (downstream)	Sawmill Brook	School Street	15.35	6.58	40.10	*38.40*	*48.10*	50.10	15.35	6.58	40.20	*38.40*	48.90	58.00	1	open bottom arch	Metal	new			
4		Sawmill Brook	Atwater Avenue	14.70	8.30		*37.70*	*48.10*		14.70	8.30		*37.70*		42.00	1	open bottom arch	Metal	old	erosion		beaver dam blocking access
5	9A (upstream) 9B (downstream)	Sawmill Brook	Conservation Winchester Drive	9.00	5.58	40.10			47.10	9.00	5.67	39.80		47.10	38.00	1	open bottom arch	Metal	rusted	scour upstream		
6		Sawmill Brook	School Street	1.10	1.10	N/A			N/A	1.10	1.10	N/A		N/A	28.00	1	round culvert	Concrete	new			
7	3-B (upstream) 3-A (downstream)	Cat Brook	Forest Lane	11.60	2.90	43.60			48.20	11.60	2.90	43.90		48.50	20.20	1	open bottom arch	Stone	old- collapsing	upstream backup/ sediment buildup	erosion	
8	4-B (upstream) 4A (downstream)	Cat Brook	Load Place	2.00	2.00	44.30			47.90	2.00	2.00	44.30		47.30	30.70	3	round culvert	Plastic	new	sediment buildup	sediment buildup	beaver dam upgradient
9		Sawmill Brook	Pine Street	2.92	2.92	N/A			N/A	2.92	2.92	N/A		N/A	42.00	2	round culvert	Metal	old		sediment buildup	full of sand
10		Sawmill Brook	Rockwood Heights	1.83	1.58	N/A				1.83	1.25	N/A		N/A	25.00	2	embedded round culvert	concrete/stone	old	sediment buildup	sediment buildup	full of sediment/mud
11	2-A (upstream) 2-B (downstream)	Cat Brook	Mill Street	12.50	3.70	33.50			40.40	12.00	5.58	31.70		40.50	20.10	1	open bottom arch	concrete		sediment buildup	sediment buildup	
12	12-B (upstream) 12-A (downstream)	Sawmill Brook	Millet Lane	5.00	5.00	46.50			49.30	2.50	2.50	46.30		52.20	35.00	1	round culvert	Concrete/metal	rusty outlet	organic debris sediment buildup	sediment buildup	erosion along headwall
13	11-B (upstream) 11-A (downstream)	Sawmill Brook	The Plains	5.00	2.00	45.80			51.20	5.00	2.75	45.00		51.80	40.00	1	open bottom arch (actually round)	Concrete	new	sediment buildup	sediment buildup	
15		Sawmill Brook	Blue Heron Lane	2.50	2.50	N/A			N/A	2.50	2.50	N/A		N/A	28.00	1	open bottom arch	concrete	new	sediment buildup	bank erosion/ sediment buildup	headwall needs patching
16	1-A (upstream) 1-B (downstream)	Sawmill Brook	Golf Course	12.00	9.42	11.50			21.60	11.50	9.58	11.40		21.60	20.00	*1*	*open bottom box culvert*	*stone*				
17		Sawmill Brook	Lincoln Street	12.00	6.00		*8.70*	*17.30*		12.00	6.00		*8.60*		50.00	1	open bottom arch	stone	good	bank erosion	bank erosion/ sediment buildup	
18		Causeway Brook	Lincoln Street	14.50	3.67		*8.20*	*16.30*		13.00	3.67		*8.20*		60.00	1	open bottom arch	stone	old but good		branches in stream	
19		Causeway Brook	School Street- Golf	8.33	4.50		*9.00*	*15.60*		7.75	4.08		*8.90*		41.25	1	open bottom arch	metal	old but good	wood debris	sediment buildup	concrete blocks past outlet may impede flow
20		Causeway Brook	Summer Street	8.17	4.25		*10.70*	*17.90*		10.25	4.92		*10.70*		15.00	1	open bottom arch	metal	old	concrete channel		
21		Causeway Brook	Summer Street	5.42	3.10	N/A			N/A	5.42	3.10	N/A		N/A	59.25	1	box culvert	concrete	old	sediment buildup		upstream blockages
22		Sawmill Brook	Norwood Avenue	14.25	5.50		*7.50*	*16.00*		13.00	5.42		*7.50*		42.00	1	bridge with abutments	metal/stone	old	erosion/ sediment buildup	erosion	corregated metal falling from bridge
23		Sawmill Brook	School Street	8.76	4.67		*3.60*	*13.10*		8.92	4.83		*3.10*		36.00	2	open bottom arch	concrete/stone	old	sediment buildup		
24		Causeway Brook	Summer Street	3.58	2.10	N/A			N/A	1.58	1.58	N/A		N/A	60.15	1	upstream bridge with abutments, dowstream round culvert	concrete/plastic	old- rusted	sediment buildup		
25		Sawmill Brook	Central Street	16.00	6.67		*-0.04*	*10.60*		14.00	8.25		*-4.00*		42.00	1	open bottom arch	stone	old collapsing	erosion	bedrock	tidegate overlay repair

Culvert #	Metcalf & Eddy Number	Stream	Street	Inlet Dimensions (ft)		Inlet Elevation	Doucet Inlet Elevation	Doucet Road Centerline	Top of Road	Outlet Dimensions (ft)		Outlet Elevation	Doucet Outlet Elevation	Top of Road	Length (ft)	# of Crossings	Culvert Type	Culvert		Stream bed issues		Other Issues
				Width	Height					Width	Height							Material	Condition	Upstream	Downstream	
26		Sawmill Brook	MassDOT Mill Street	14.70	8.10		***17.80***			14.70	8.10		***17.50***			1	bridge with abutments	concrete	old	sediment buildup		
27		Sawmill Brook	Mill Street	7.10	7.10		***16.20***	***24.40***		6.80	6.80		***15.60***		47.00	1	round culvert	metal	old	erosion/ sediment buildup	erosion/ sediment buildup	
30	5-A (upstream) 5-B (downstream)	Sawmill Brook	MassDOT Rte 128	14.00	6.50	26.1			44.6	14	6.5	18.3		45,5	60	1	box culvert	concrete				
36	6-A (upstream) 6-B (downstream)	Sawmill Brook	Mass DOT Rte 128 ramp	14.00	8.00	31.4			53.8	14	8	31.4		51.6	60	1	box culvert	concrete				

KEY:

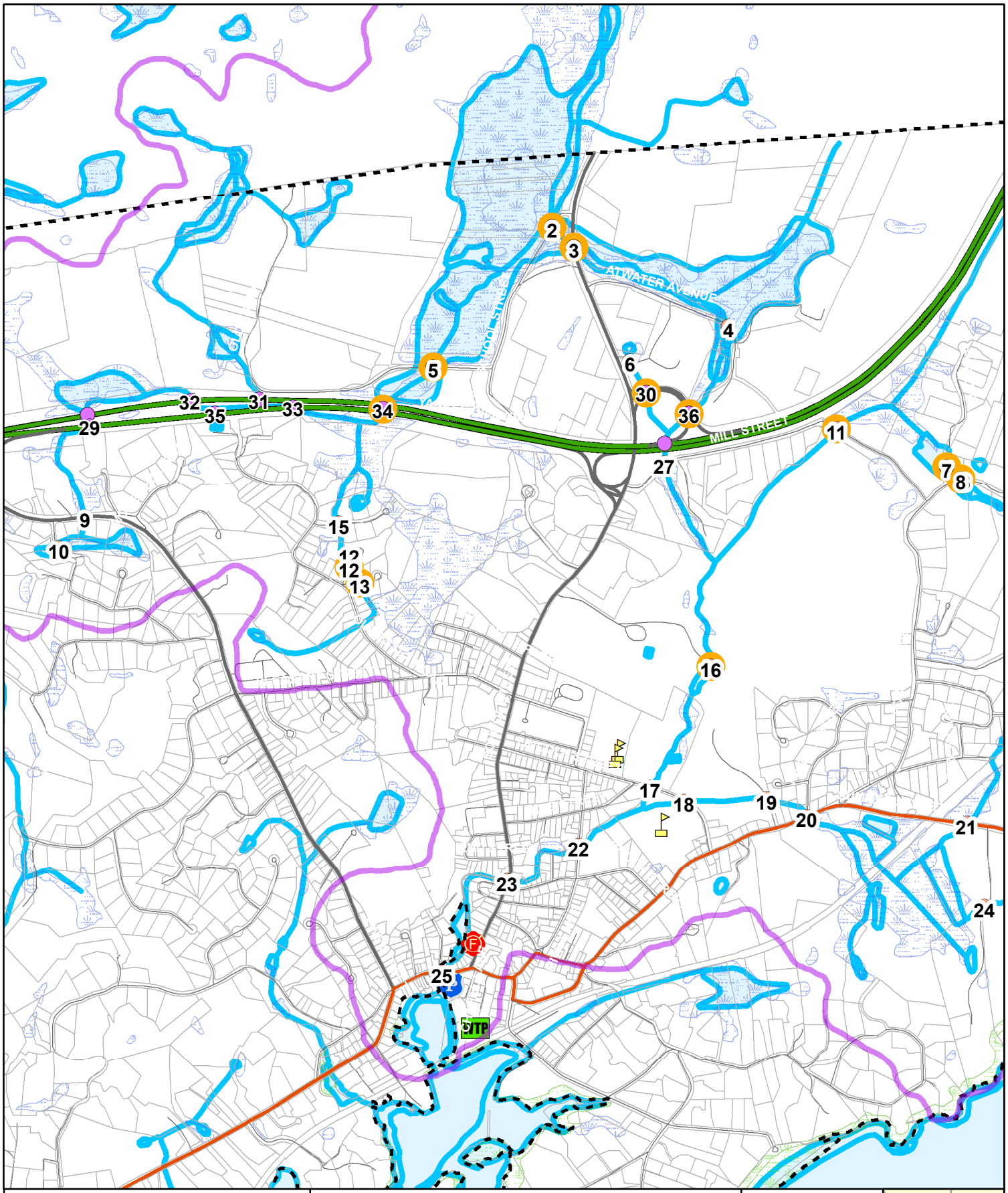
N/A

Notes:

July 2015 Survey completed by Doucet Survey Associates. Horizontal datum reference NAD83/2011 Massachusetts State Plane, Verticle Datum NAVD88.

August 24, 20017 Survey completed by Corcoran Associates, Inc. Horizantal Reference NAD 83 (FT), Vertical Datum NGVD 29 (FT)

Reminder of information results of May 30, 2015, volunteer data collection in Manchester-by-the-Sea



LEGEND

- Culvert Surveyed in 2008
- MassDOT Culvert
- Culvert
- Sawmill Brook Watershed
- Inland Wetlands
- Coastal Wetlands
- Waterbodes

SAWMILL BROOK
2007 CULVERT SURVEY

Manchester-by-the-Sea, MA

July 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

0 0.2
Miles
1 " = 1,333 '

NOTES

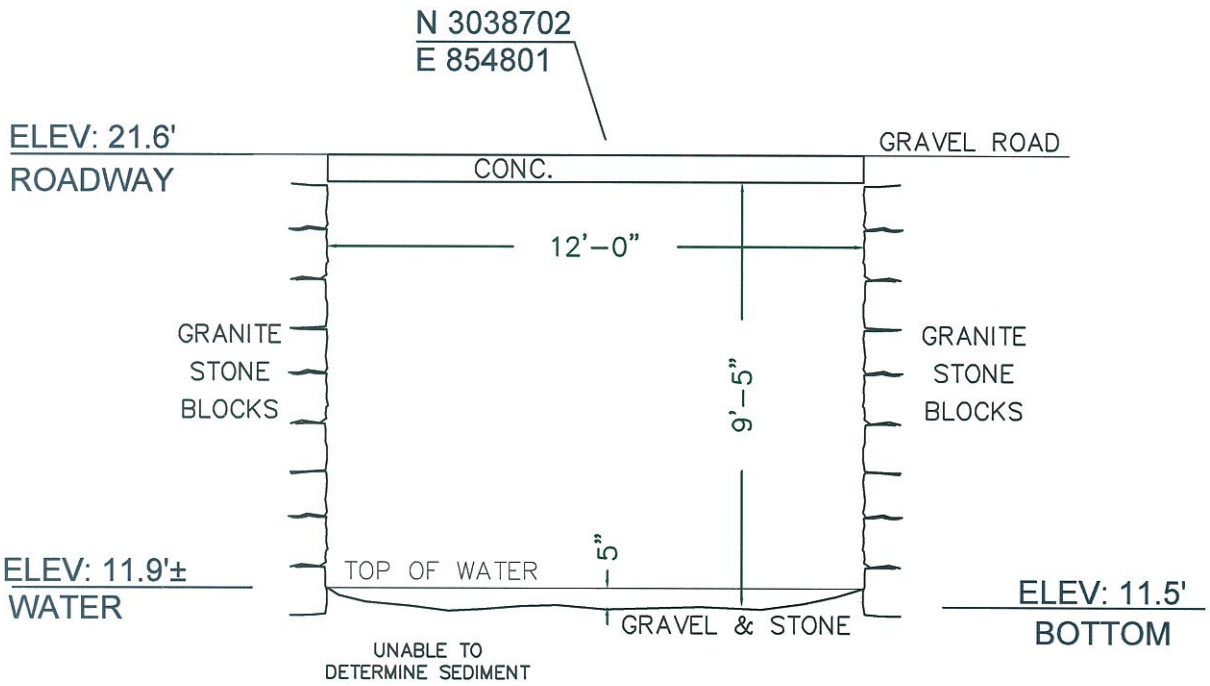
Data sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

G:\GIS\MA\ManchesterMA\avproj\20150720_SurveyLocations.mxd

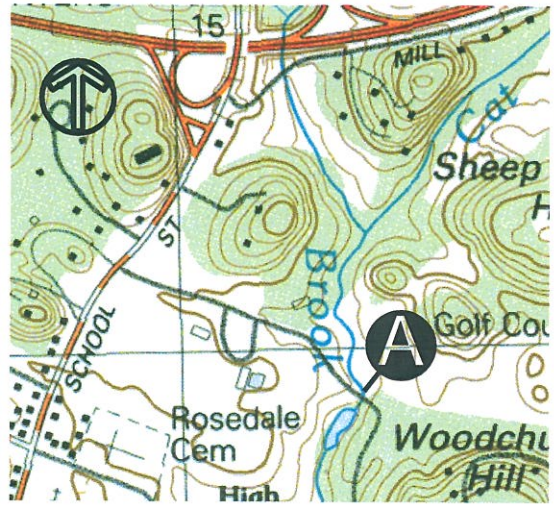
LOCATION 1 - A

FIELD SKETCH

PRIVATE
ROAD



SAWMILL
BROOK



DATE OF SURVEY: 8-24-07; TIME: 1:30PM

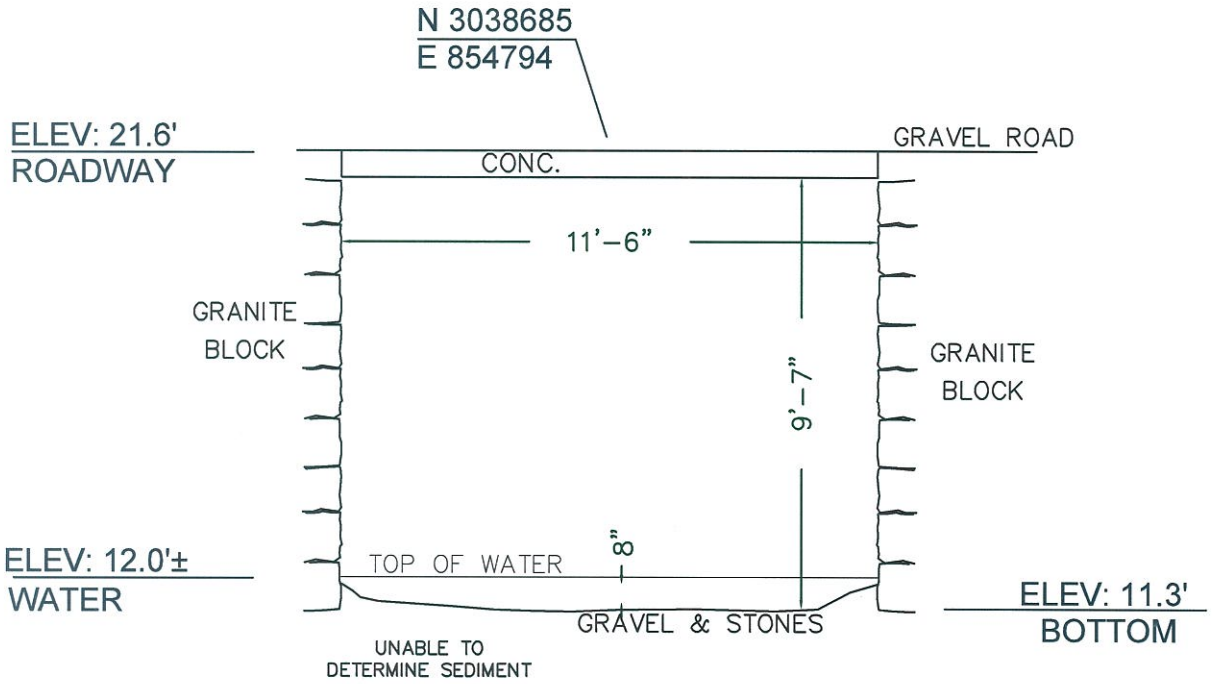
SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

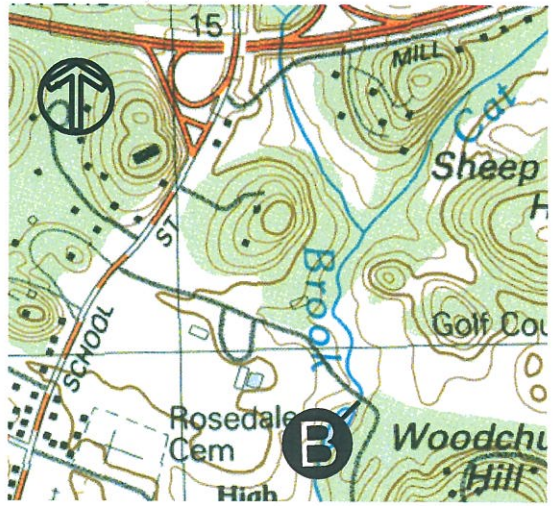
LOCATION 1 - B

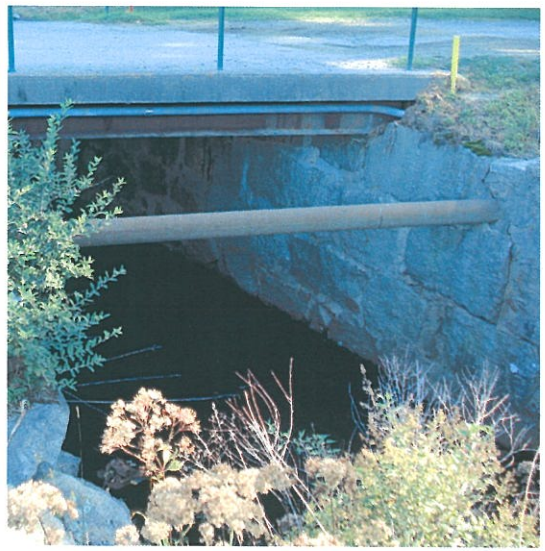
FIELD SKETCH

PRIVATE
ROAD



SAWMILL
BROOK





DATE OF SURVEY: 8-24-07; TIME: 2:30PM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 2 - A

FIELD SKETCH

MILL
STREET

N 3041145
E 856103

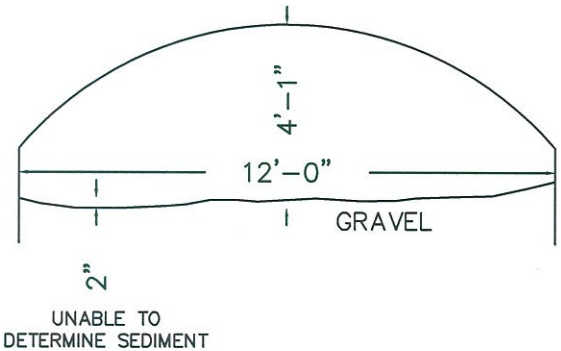
ELEV: 40.4'

PAVED ROAD

CONC.

CONC.

CONC.



ELEV: 33.7'±

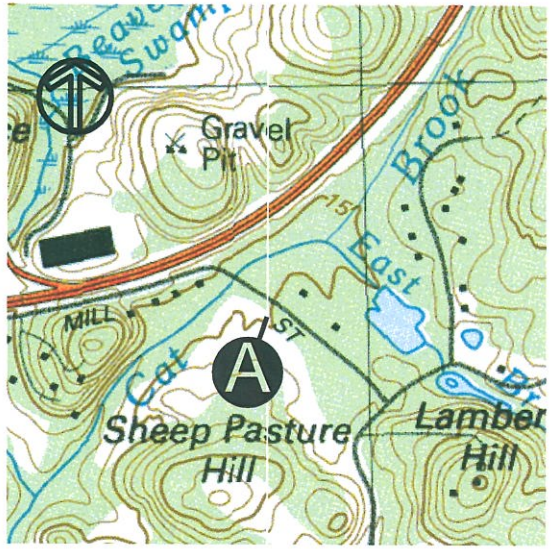
ELEV: 33.5'

UNABLE TO
DETERMINE SEDIMENT

CAT
BROOK

DATE OF SURVEY: 8-24-07; TIME: 3:30PM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 2 - B

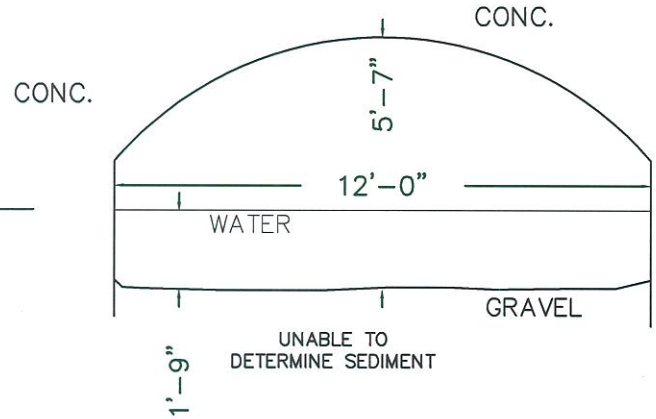
FIELD SKETCH

MILL
STREET

N 3041173
E 856103

ELEV: 40.5'
ROADWAY

PAVED ROAD



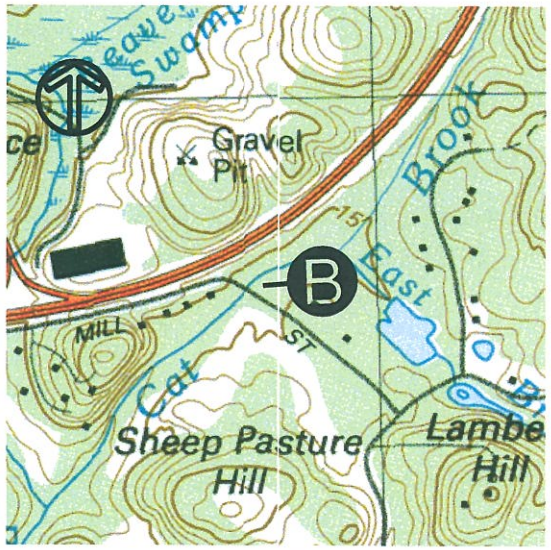
ELEV: 33.4'±
TOP WATER

ELEV: 31.7'
BOTTOM

SAWMILL
BROOK

DATE OF SURVEY: 8-24-07; TIME: 4:00PM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 3 - A

FIELD SKETCH

FOREST
LANE

N 3040714
E 857263

ELEV: 48.5'
ROADWAY

PAVED ROAD

GRANITE
STONES

GRANITE
STONES

4'–6"

4"

ELEV: 44.5'±
TOP WATER

WATER

2'–4"

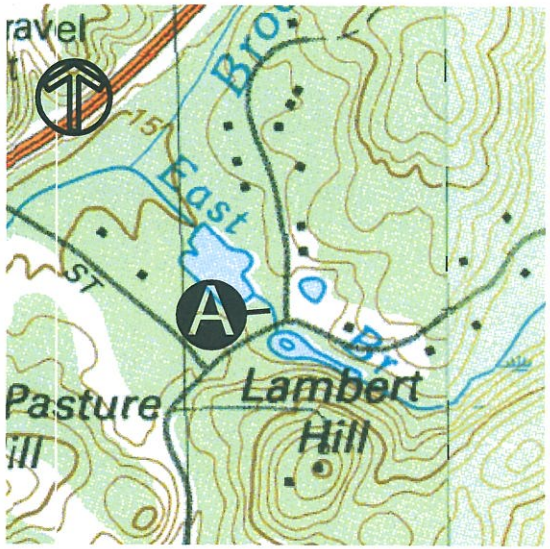
ELEV: 43.9'
BOTTOM

7"

GRANITE
STONES

UNABLE TO
DETERMINE SEDIMENT

EAST CAT
BROOK



DATE OF SURVEY: 8-27-07; TIME: 9:00AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

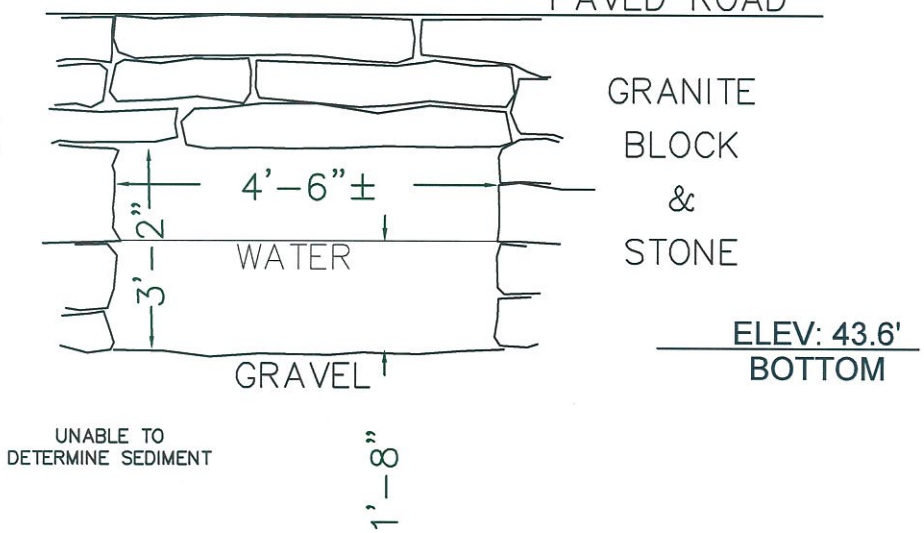
SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 3 - B

FIELD SKETCH

FOREST
LANE

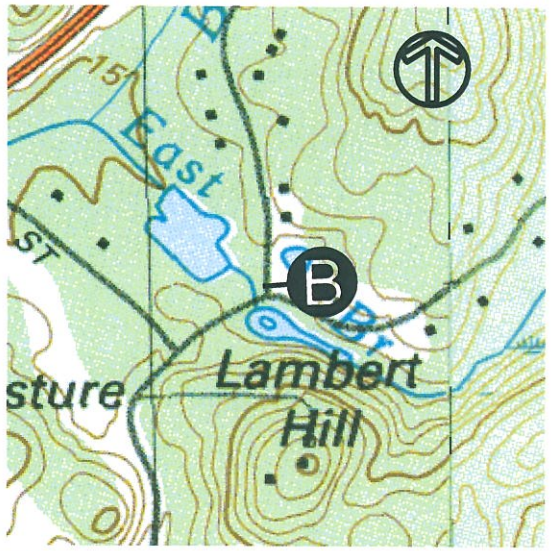
N 3040713
E 857276



EAST CAT
BROOK

DATE OF SURVEY: 8-27-07; TIME: 8:30AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 4 - A

FIELD SKETCH

FOREST
STREET

N 3040633
E 857401

ELEV: 47.9'
ROADWAY

PAVED ROAD

24" HDPE
(TYP)

ELEV: 44.4'±
TOP WATER

WATER

DRY

ELEV: 44.3'
BOTTOM

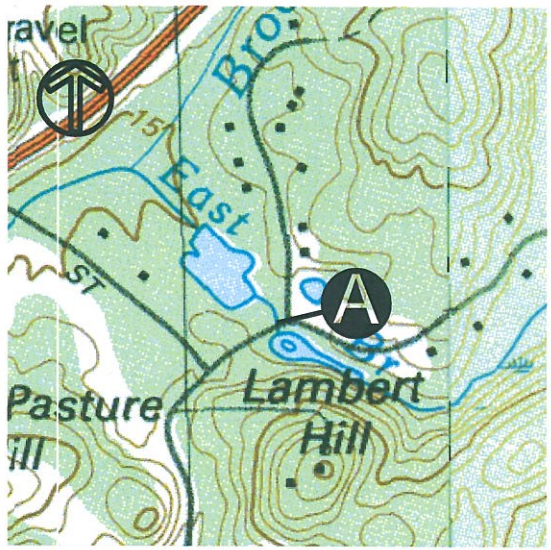
INV=44.5 INV=44.4 INV=44.4

SEDIMENT: 0.1'±

EAST CAT
BROOK

DATE OF SURVEY: 8-27-07; TIME: 9:00AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 4 - B

FIELD SKETCH

FOREST
LANE

N 3040603
E 857409

ELEV: 47.3
ROADWAY

PAVED ROAD

24" HDPE
(TYP)

ELEV: 44.6'±
TOP WATER

WATER

DRY

DRY

ELEV: 44.3'
BOTTOM

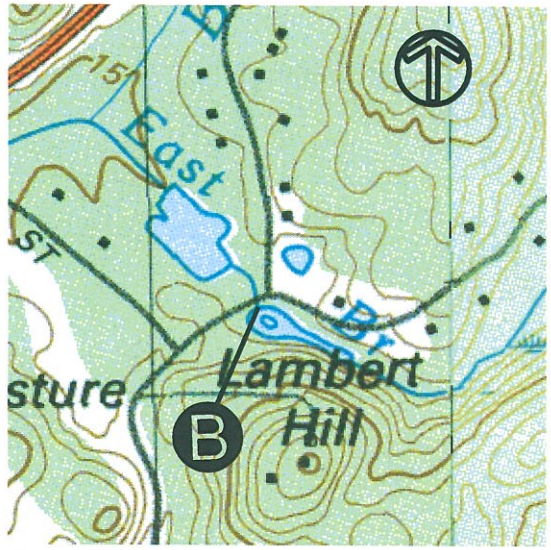
INV=44.4 INV=44.3 INV=44.3

WATER: 0.1' DEEP
SEDIMENT: 0.4' DEEP

EAST CAT
BROOK

DATE OF SURVEY: 8-27-07; TIME: 9:30AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 5 - A

FIELD SKETCH

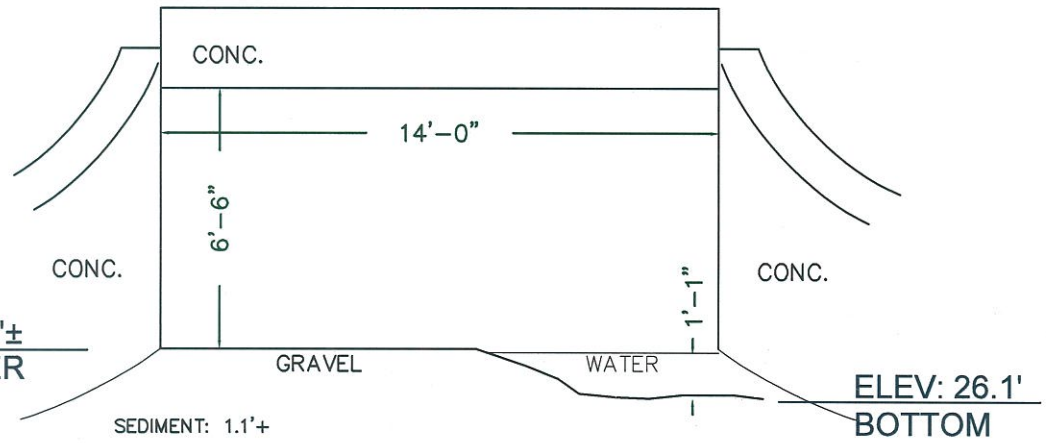
ROUTE
128

N 3041038
E 854308

ELEV: 44.6'
ROADWAY

ROUTE 128 "SOUTHBOUND"

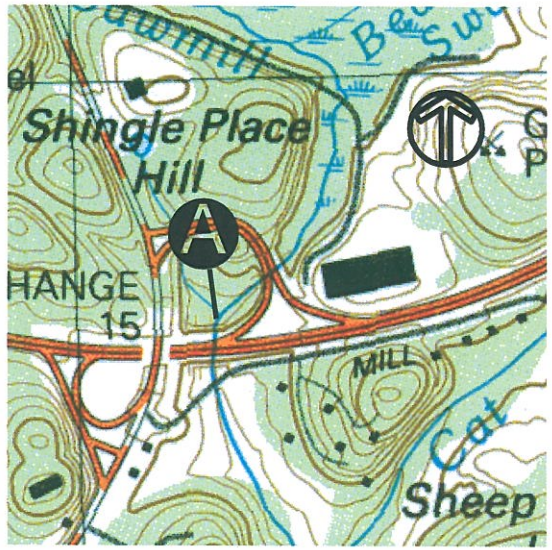
PAVED ROAD



ELEV: 27.2'±
TOP WATER

ELEV: 26.1'
BOTTOM

EAST CAT
BROOK



DATE OF SURVEY: 8-14-07; TIME: 1:00PM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 5 - B

FIELD SKETCH

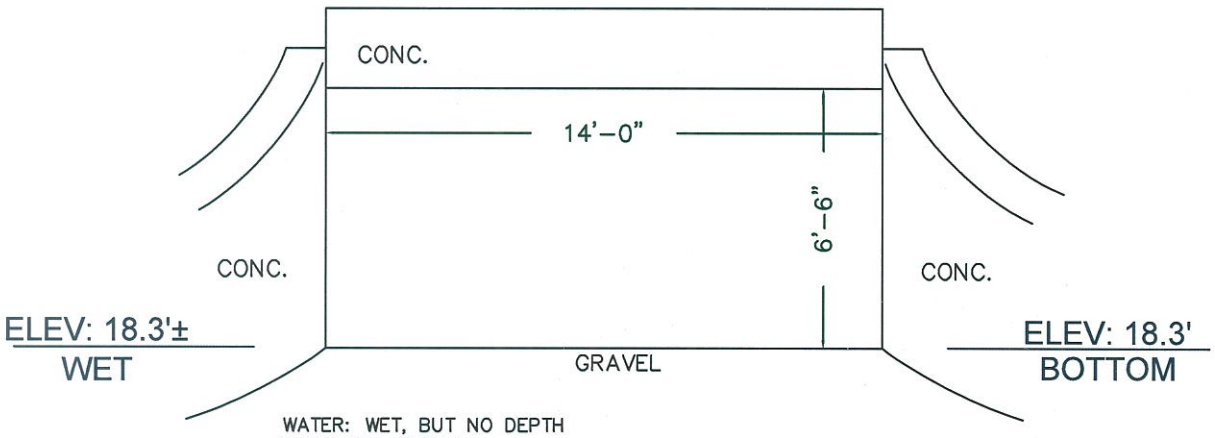
ROUTE
128

N 3040849
E 854272

ELEV: 45.5'
ROADWAY

ROUTE 128 "NORTHBOUND"

PAVED ROAD



ELEV: 18.3'±
WET

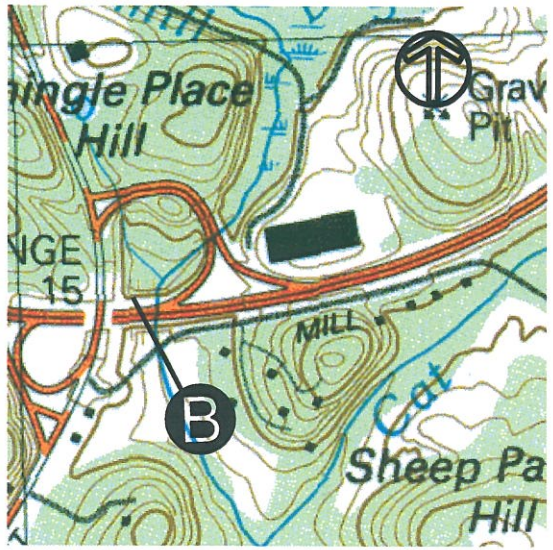
ELEV: 18.3'
BOTTOM

WATER: WET, BUT NO DEPTH
SEDIMENT: GRAVEL

SAW MILL
BROOK

DATE OF SURVEY: 8-14-07; TIME: 11:00AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 6 - A

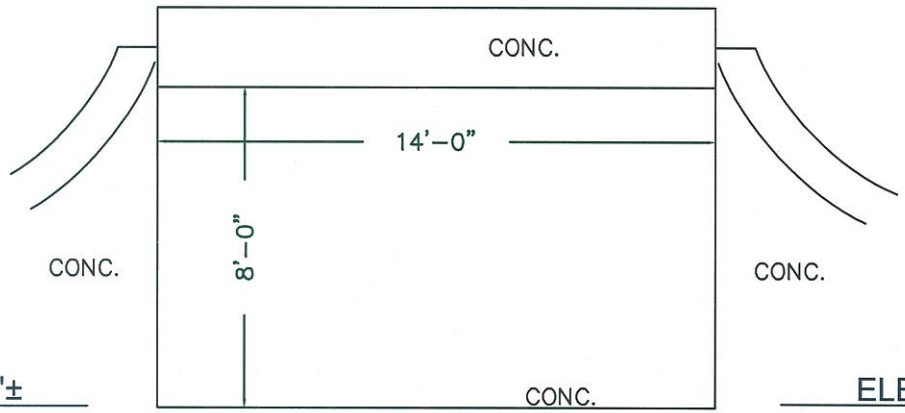
FIELD SKETCH

ROUTE
128
"RAMP"

N 3041408
E 854619

ELEV: 53.8'
ROADWAY

PAVED ROAD

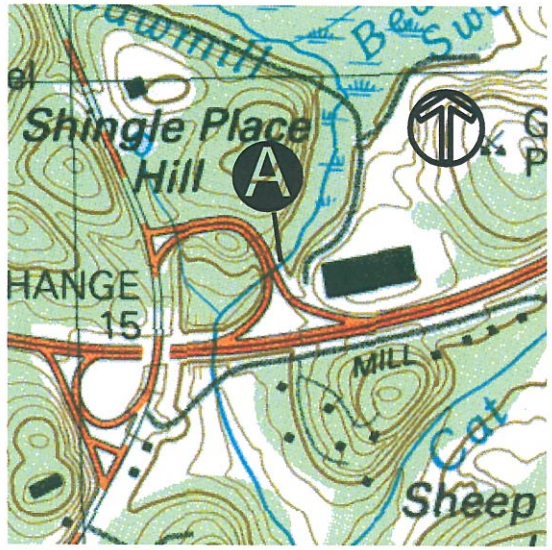


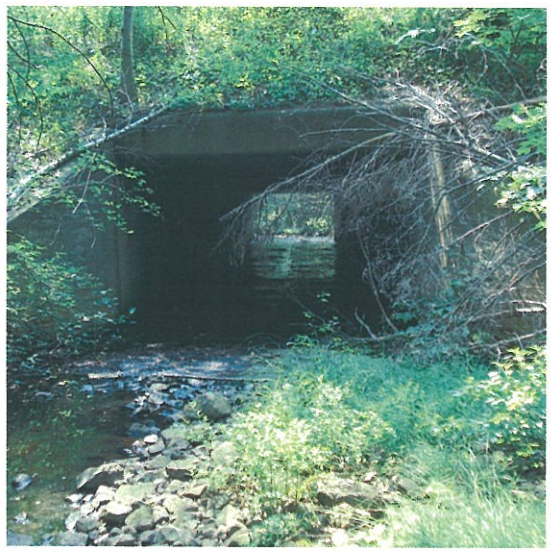
ELEV: 31.4'±
WET

ELEV: 31.4'
BOTTOM

NO SEDIMENT OBSERVED

SAW MILL
BROOK





DATE OF SURVEY: 8-13-07; TIME: 11:00AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 6 - B

FIELD SKETCH

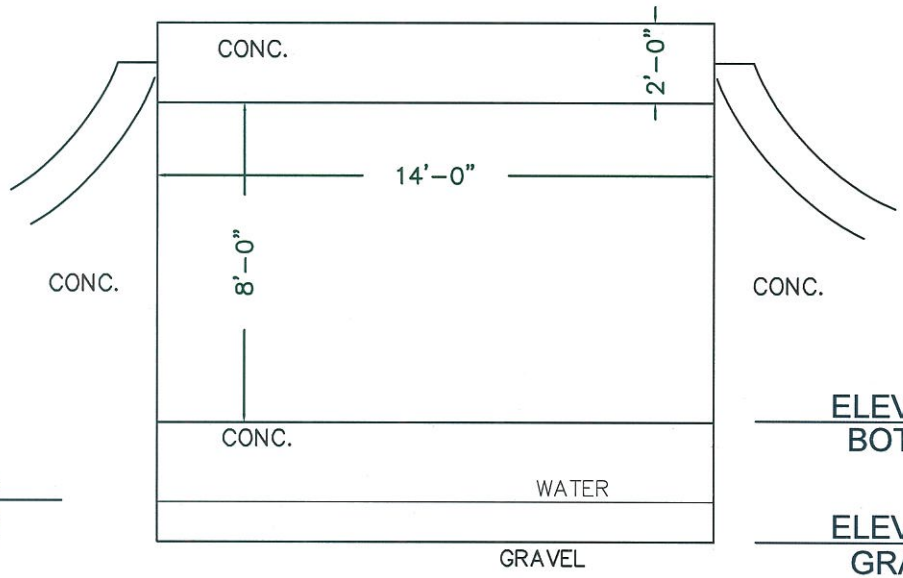
ROUTE
128
"RAMP"

N 3041330
E 854531

ELEV: 51.6'
ROADWAY

ROUTE 128 "RAMP"

PAVED ROAD



ELEV: 34.4'
BOTTOM

ELEV: 32.4'±
TOP WATER

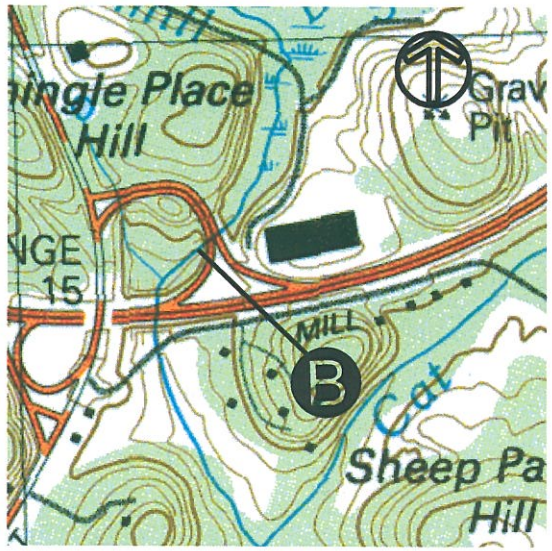
ELEV: 31.4'
GRAVEL

WATER: 1'±
UNABLE TO DETERMINE
SEDIMENT: GRAVEL

SAW MILL
BROOK

DATE OF SURVEY: 8-13-07; TIME: 2:00PM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

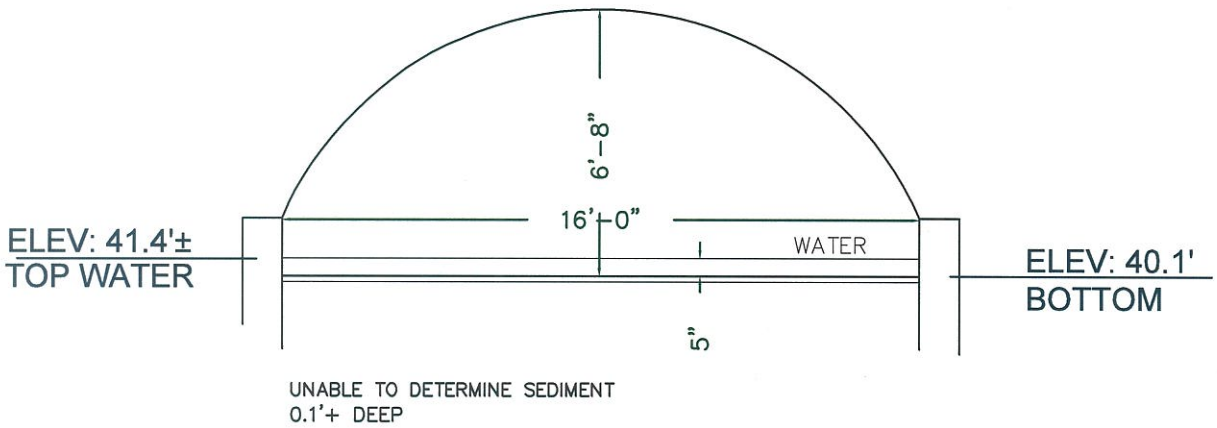
LOCATION 7 - A

FIELD SKETCH

SCHOOL
STREET

N 3042984
E 853376

ELEV: 50.1'
ROADWAY



ELEV: 41.4'±
TOP WATER

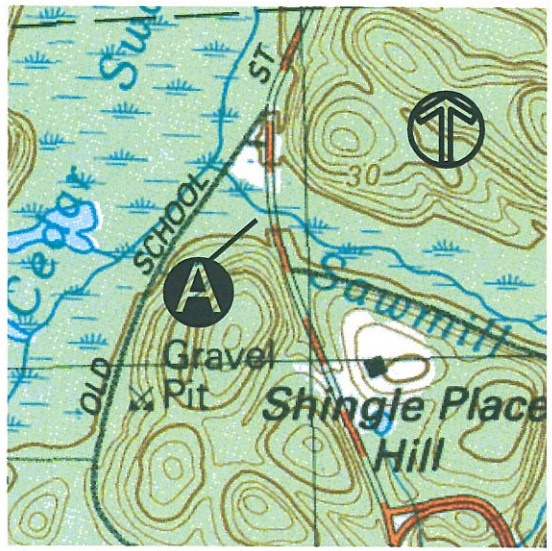
ELEV: 40.1'
BOTTOM

UNABLE TO DETERMINE SEDIMENT
0.1'+ DEEP

SAW MILL
BROOK

DATE OF SURVEY: 8-22-07; TIME: 10:00AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

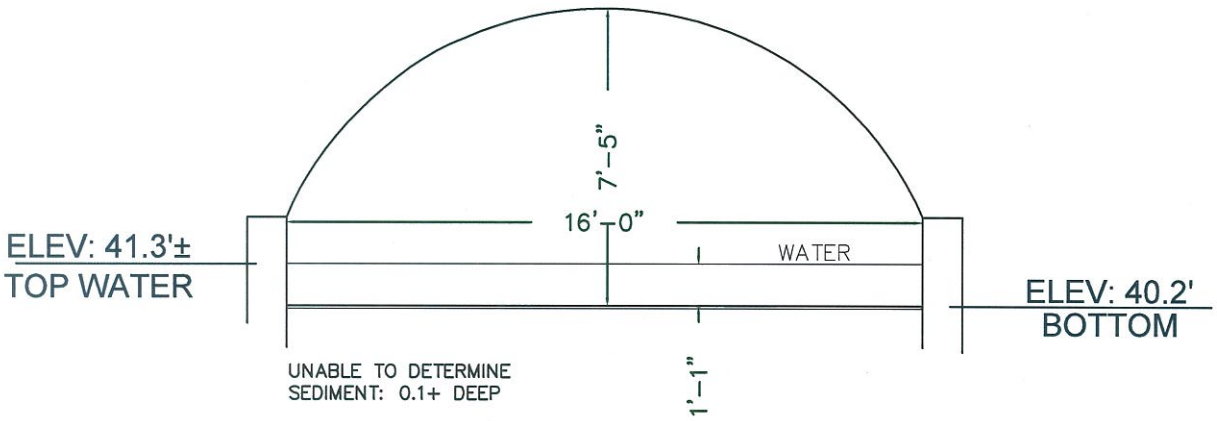
LOCATION 7 - B

FIELD SKETCH

SCHOOL
STREET

N 3042984
E 853430

ELEV: 48.9'
ROADWAY

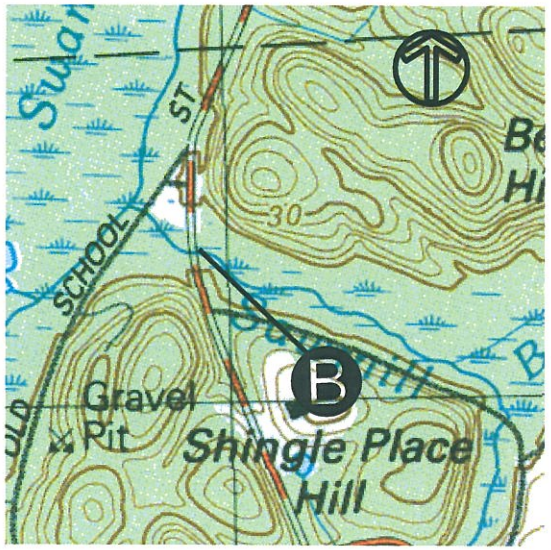


ELEV: 41.3'±
TOP WATER

ELEV: 40.2'
BOTTOM

UNABLE TO DETERMINE
SEDIMENT: 0.1+ DEEP

SAW MILL
BROOK



DATE OF SURVEY: 8-22-07; TIME: 9:00AM

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 8-1-A

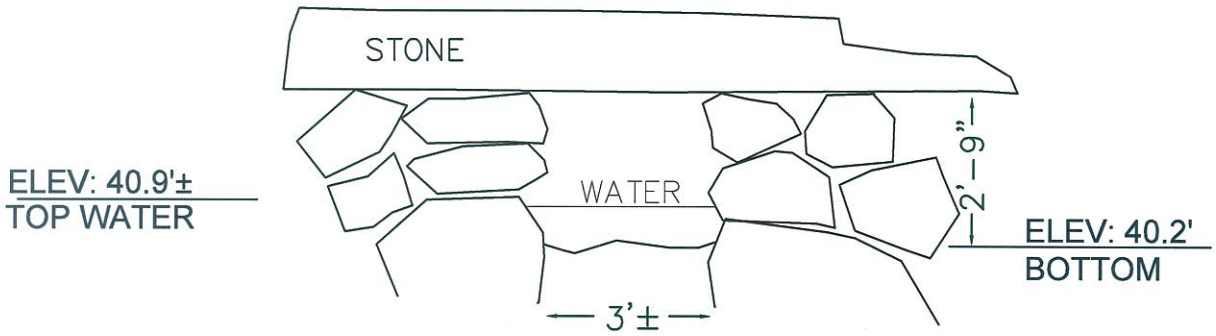
FIELD SKETCH

OLD SCHOOL STREET

N 3043293
E 853198

ELEV: 45.8'
ROADWAY

GRAVEL ROAD



ELEV: 40.9'±
TOP WATER

ELEV: 40.2'
BOTTOM

WATER DEPTH: 8"

OBSERVED SEDIMENT DEPTH: 8"±

SAW MILL BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 8-1-B

FIELD SKETCH

OLD SCHOOL STREET

N 3043258
E 853216

ELEV: 45.8'
ROADWAY

GRAVEL ROAD

STONE

ELEV: 39.4'±
TOP WATER

WATER

2'-3"

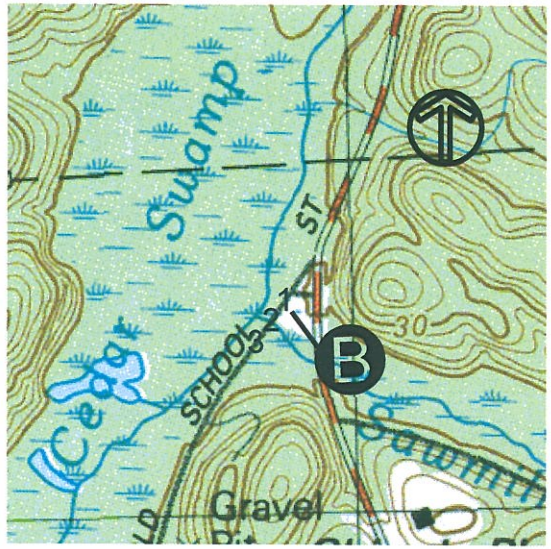
ELEV: 39.1'
BOTTOM

3'-0"

WATER DEPTH: 4"±

OBSERVED SEDIMENT DEPTH: UNABLE TO DETERMINE

SAW MILL BROOK



SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 8-2-A

FIELD SKETCH

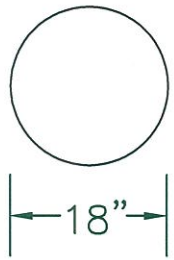
OLD SCHOOL
STREET

N 3043177
E 853128

ELEV: 45.4'
ROADWAY

GRAVEL ROAD

CLAY TYPE PIPE



DRY

ELEV: 41.4'
BOTTOM

WATER DEPTH: NONE OBSERVED

OBSERVED SEDIMENT DEPTH: NOT OBSERVED

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 8-2-B

FIELD SKETCH

OLD SCHOOL
STREET

N 3043160
E 853155

ELEV: 45.4'
ROADWAY

GRAVEL ROAD

STONES

CLAY TYPE PIPE

DRY

ELEV: 41.4'
BOTTOM

18"

WATER DEPTH: DRY

OBSERVED SEDIMENT DEPTH: PIPE PARTLY OBSTRUCTED

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 8-3-A

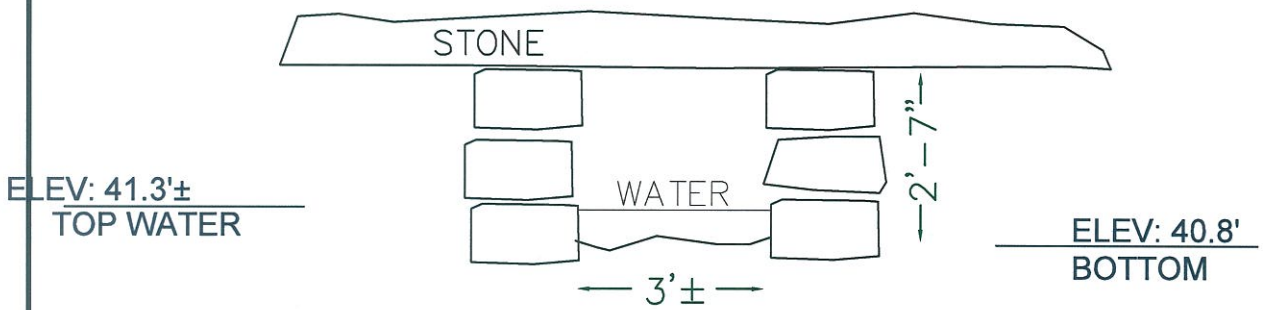
FIELD SKETCH

OLD SCHOOL STREET

N 3043063
E 853060

ELEV: 44.9'
ROADWAY

GRAVEL ROAD



ELEV: 41.3'±
TOP WATER

ELEV: 40.8'
BOTTOM

WATER DEPTH: 6"

UNABLE TO DETERMINE SEDIMENT

SAW MILL BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 8-3-B

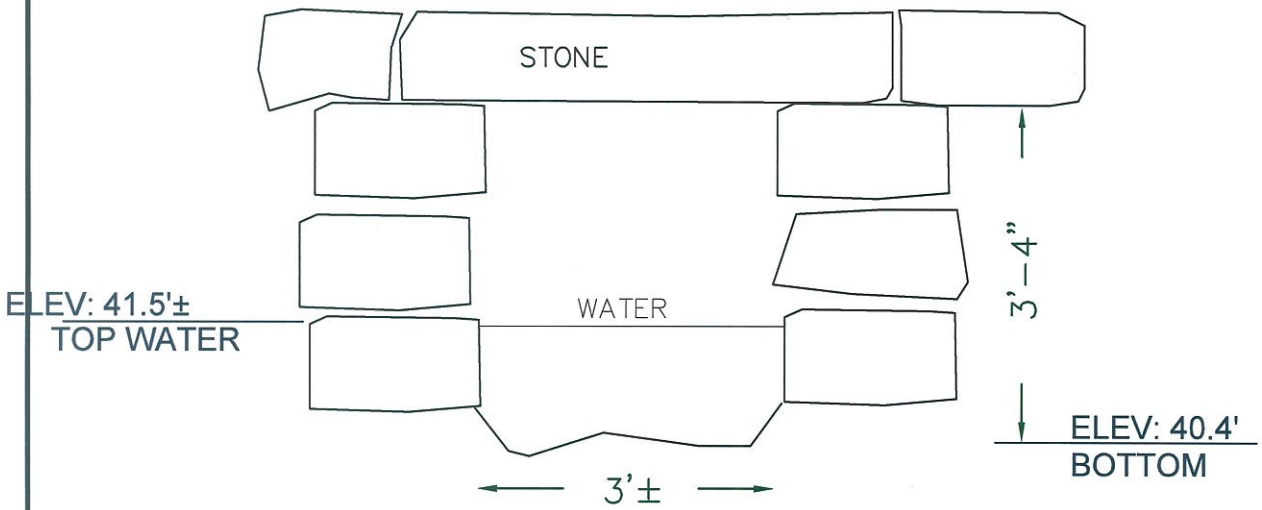
FIELD SKETCH

OLD SCHOOL
STREET

N 3043058
E 853097

ELEV: 45.0'
ROADWAY

GRAVEL ROAD



ELEV: 41.5'±
TOP WATER

ELEV: 40.4'
BOTTOM

WATER DEPTH: 6"

UNABLE TO DETERMINE SEDIMENT

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 9 - A

FIELD SKETCH

WINCHESTER
DRIVE

N 3041754
E 851916

ELEV: 47.1'
ROADWAY

5'–6"

ELEV: 42.2'±
TOP WATER

12'–0"

WATER

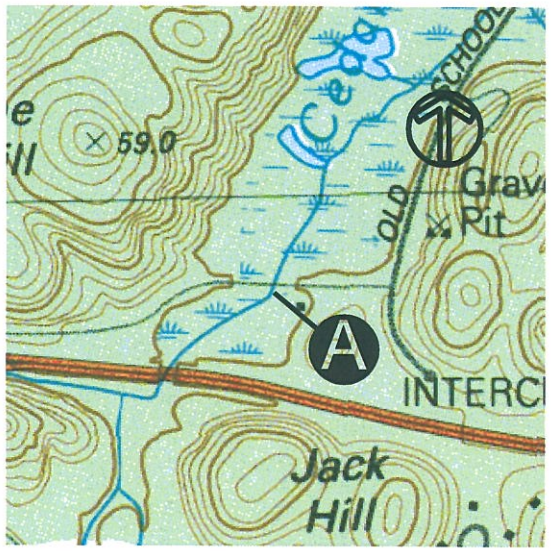
ELEV: 40.1'
BOTTOM

UNABLE TO DETERMINE SEDIMENT

2'–1"

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

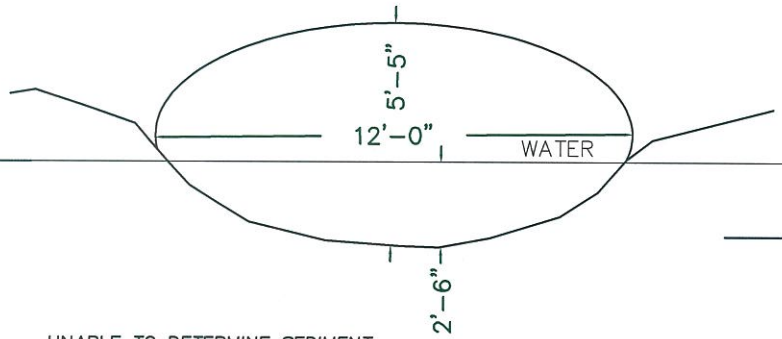
LOCATION 9 - B

FIELD SKETCH

WINCESTER
DRIVE

N 3041792
E 851918

ELEV: 47.1'
ROADWAY



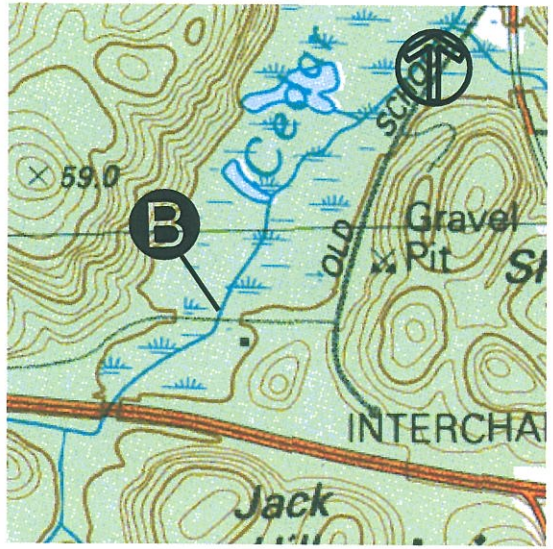
ELEV: 42.3'±
TOP WATER

ELEV: 39.8'
BOTTOM

UNABLE TO DETERMINE SEDIMENT

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

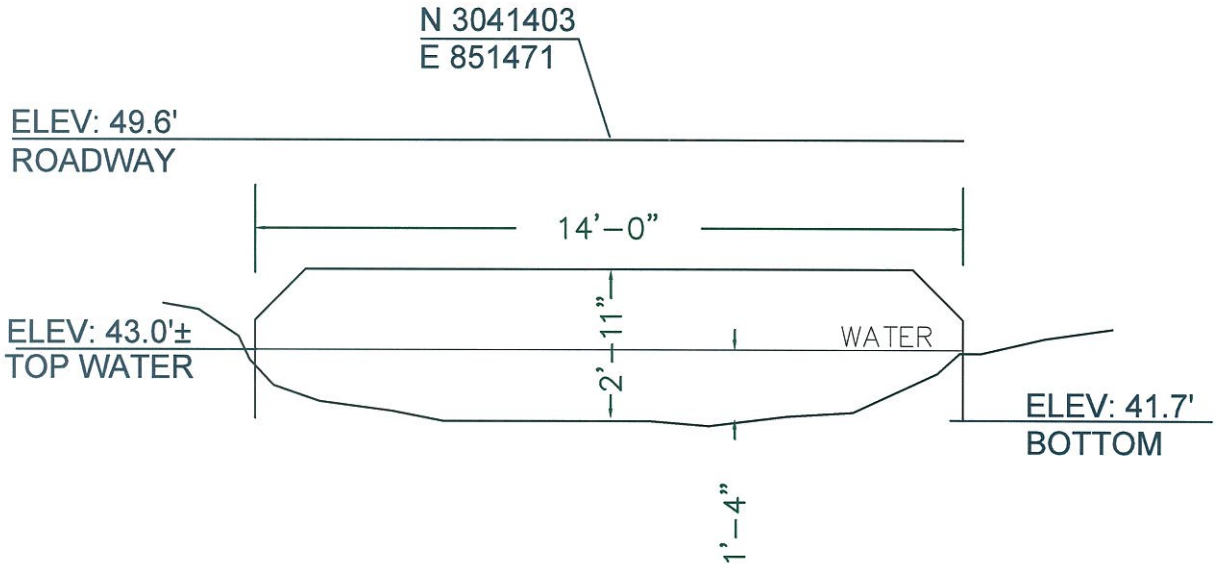


SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 10 - A

FIELD SKETCH

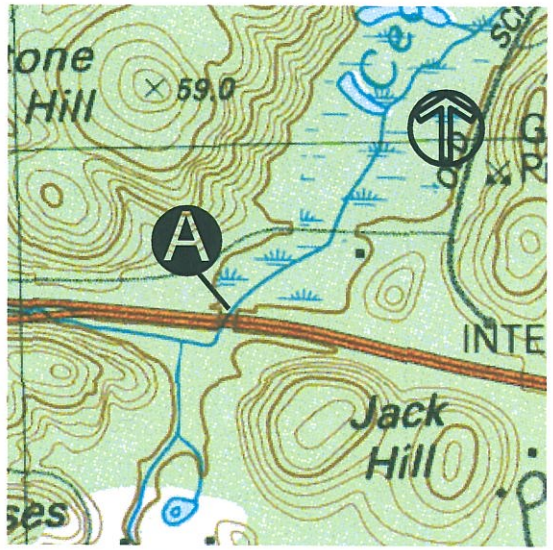
ROUTE
128



UNABLE TO DETERMINE SEDIMENT

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

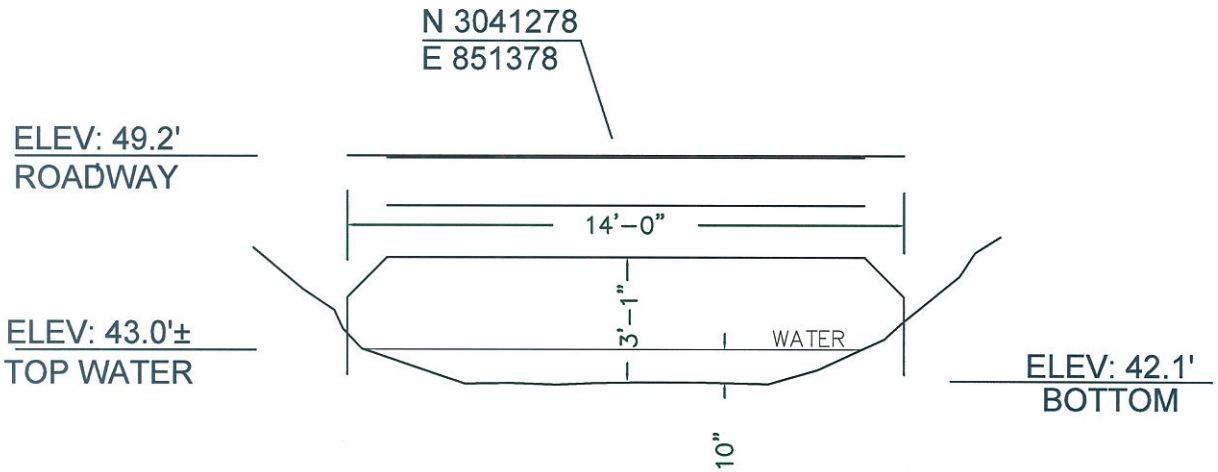


SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 1O - B

FIELD SKETCH

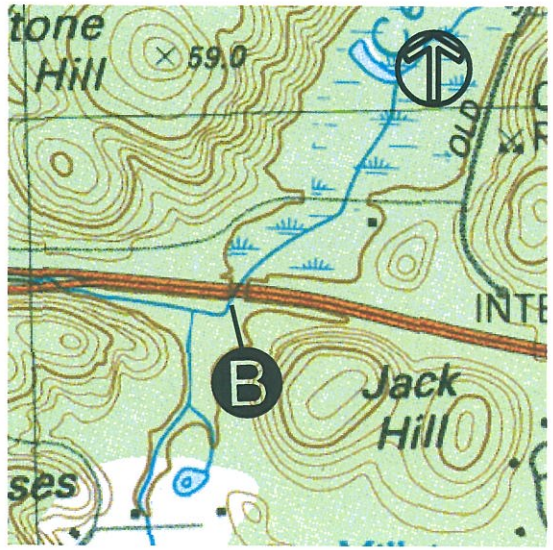
ROUTE
128



UNABLE TO DETERMINE SEDIMENT

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

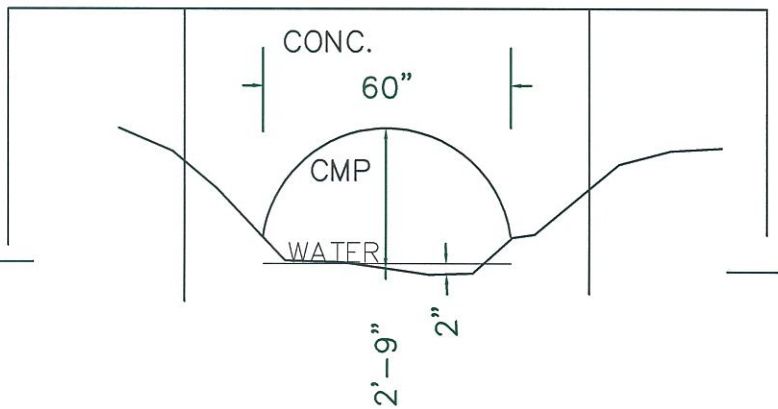
LOCATION 11 - A

FIELD SKETCH

THE
PLAINS

N 3039888
E 851008

ELEV: 51.8'
ROADWAY



ELEV: 46.2'±
TOP WATER

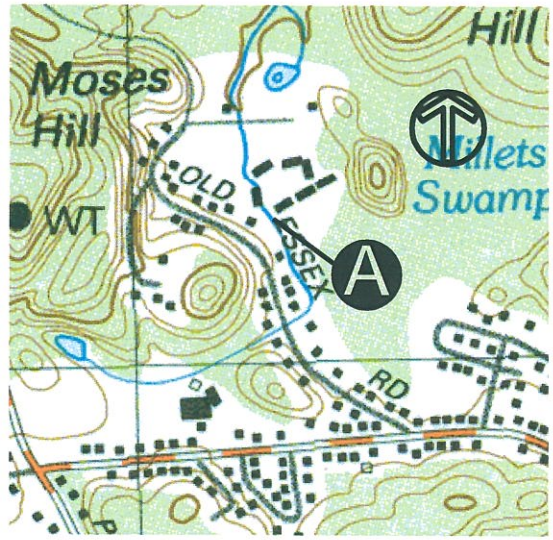
ELEV: 45.0'
BOTTOM

UNABLE TO DETERMINE SEDIMENT

ASSUMED INVERT: 43.4'±

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION

PREPARED FOR:
METCALF & EDDY, INC.

PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

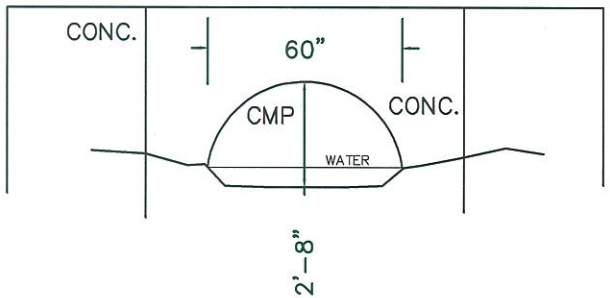
LOCATION 11 - B

FIELD SKETCH

THE
PLAINS

N 3039663
E 851094

ELEV: 51.2
GROUND



ELEV: 46.3'±
TOP WATER

ELEV: 45.8'
BOTTOM

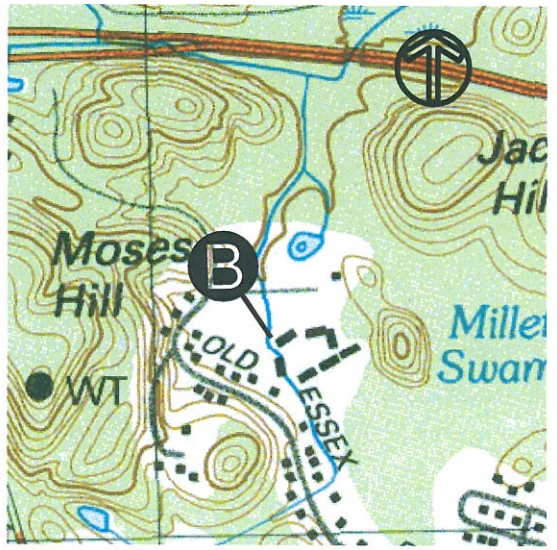
APPROXIMATE DEPTH OF WATER: 6"±

APPROXIMATE DEPTH OF SEDIMENT: 1.0'±

ASSUMED INVERT: 43.4'±

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

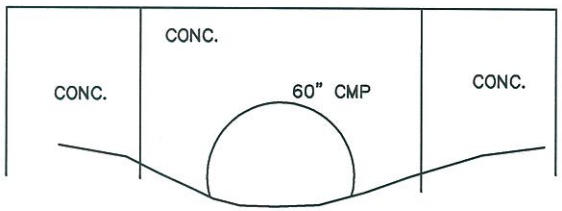
LOCATION 12 - A

FIELD SKETCH

MILLETS
LANE

N 3039547
E 851136

ELEV: 52.2'
ROADWAY



NO WATER
OBSERVED

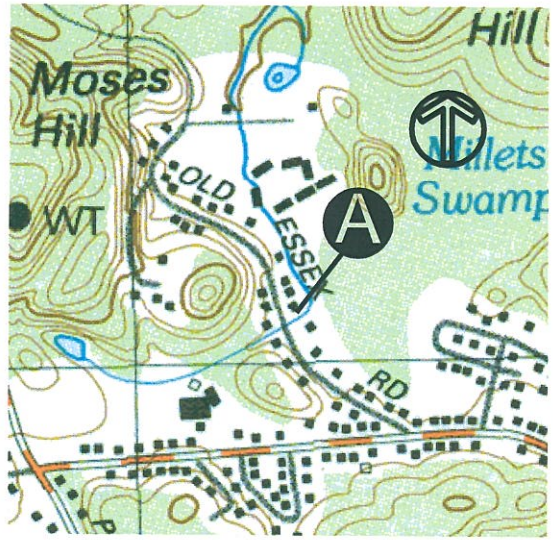
ELEV: 46.5'
BOTTOM

OBSERVED SEDIMENT: 1'+

ASSUMED INVERT (60" PIPE): 44.5'±

SAW MILL
BROOK

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 12 - B

FIELD SKETCH

MILLETS
LANE

N 3039463
E 851185

ELEV: 49.3
GROUND

VEGETATED
BANK

NO WATER
OBSERVED

30" CMP

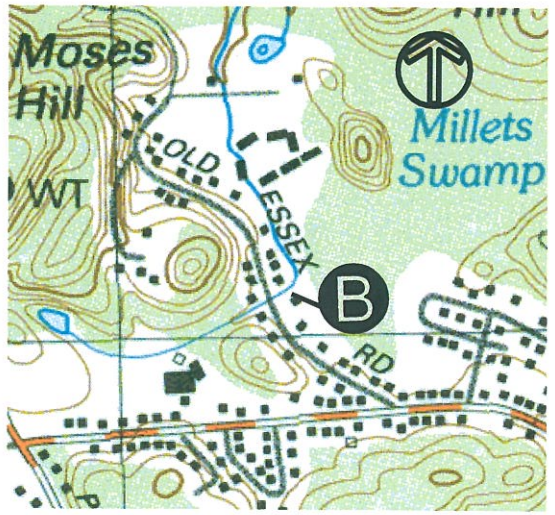
ELEV: 46.3'
INVERT

NO WATER OBSERVED

NO SEDIMENT OBSERVED

SAW MILL
BROOK

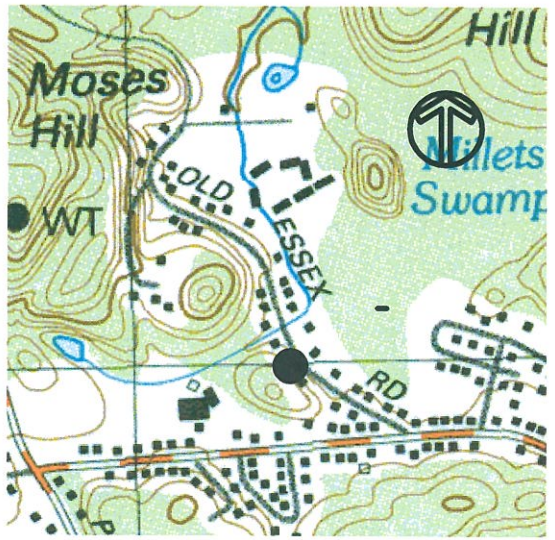
SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).



SKETCH DEPICTING:
CULVERT LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 13

FIELD SKETCH



NO. 30

NO. 32

N 3039084
E 851165

8" CMP
INV=51.5

6" CMP
INV=51.4

CATCH BASIN
(ROUND)
RIM=53.41

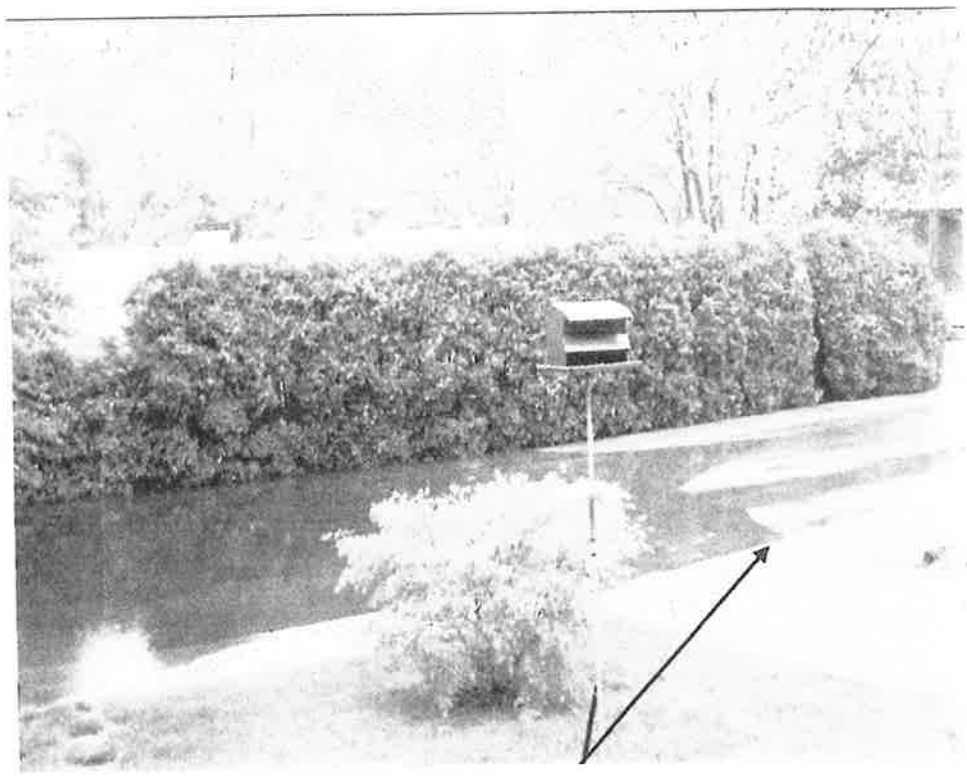
OLD ESSEX ROAD

SURVEY NOTE:
CULVERTS LOCATED AT SUB-METER ACCURACY. HORIZONTAL COORDINATES REFERENCE NAD 83 (FT); VERTICAL DATUM REFERENCE NGVD 29 (FT).

SKETCH DEPICTING:
CATCH BASIN LOCATION
PREPARED FOR:
METCALF & EDDY, INC.
PREPARED BY:
CORCORAN ASSOCIATES. INC.
520 MAIN STREET WALTHAM, MA 02452
TEL: 781.642.7002 FAX: 425.781.7008

LOCATION 14 Knights Road

NORTHING	EASTING	ELEVATION	DESCRIPTION
3038960	852003	49.56	FLOOD HIGH POINT
3038973	852008	49.48	FLOOD HIGH POINT
3038987	852010	49.13	FLOOD HIGH POINT

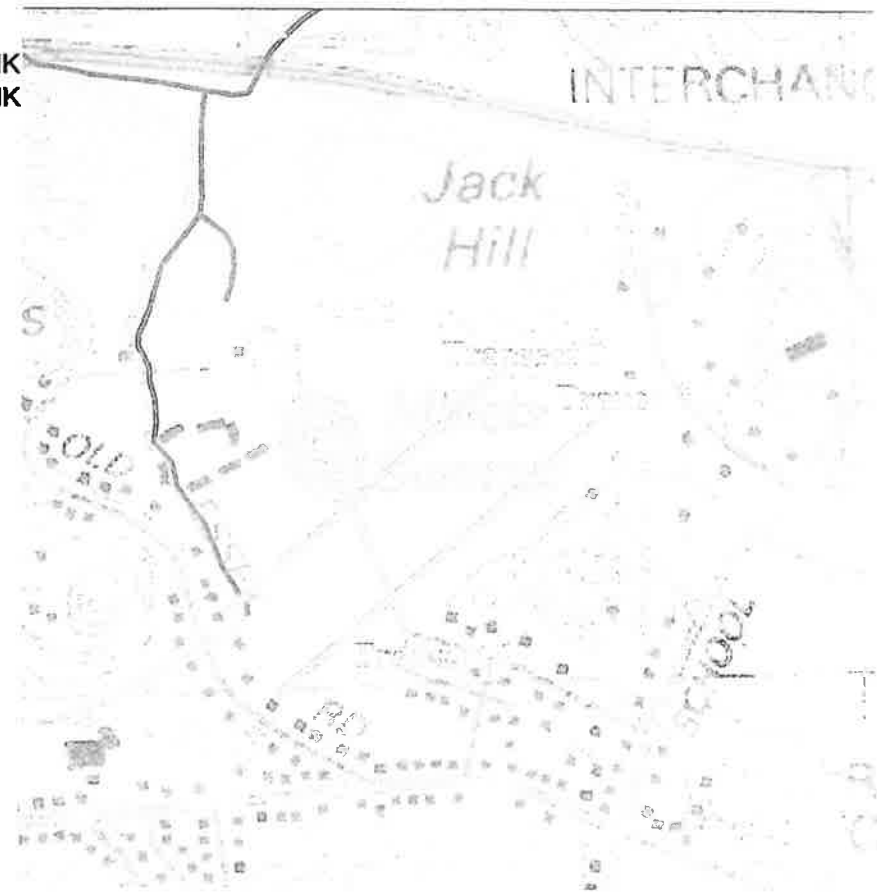


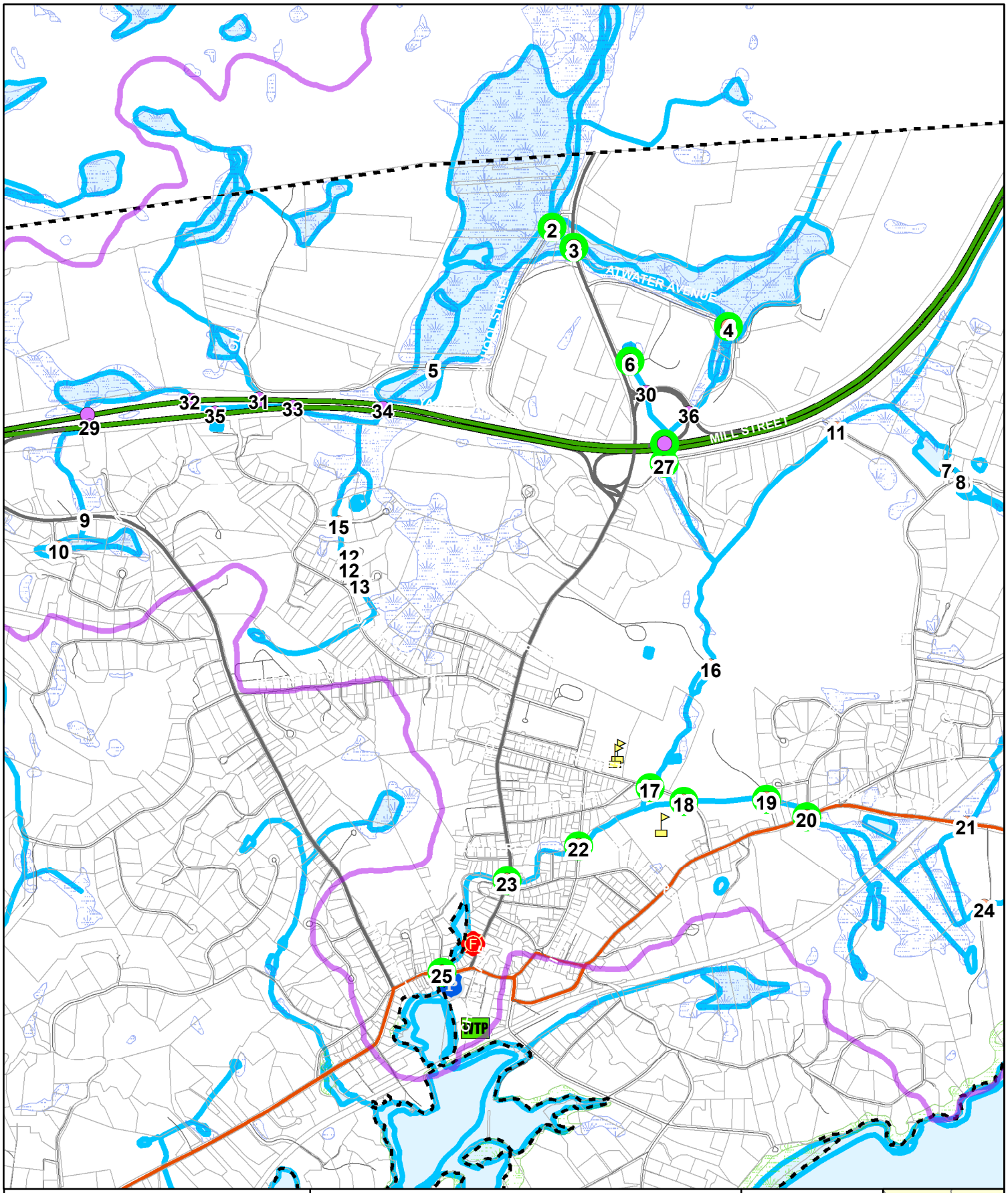
LOCATION 15 STREAM CHANNEL

NORTHING	EASTING	ELEVATION	DESCRIPTION
3039012	851913	45.8	INV 12" CMP
3039002	851897	46.2	CL CHANNEL
3038964	851868	46.0	CL CHANNEL
3038911	851863	46.1	CL CHANNEL

LOCATION 16 TRANSECTS

NORTHIN(	EASTING	ELEVATIO	DESCRIPTION
3039328	851413	49.0	GROUND
3039340	851573	50.0	GROUND
3039398	851727	49.4	GROUND
3039452	851845	49.5	GROUND
3039606	851753	51.0	GROUND
3039789	851817	49.4	GROUND
3039912	851988	49.5	GROUND
3040091	852198	54.6	GROUND
3038755	851494	54.8	GROUND
3038932	851611	48.9	GROUND
3039039	851651	48.9	GROUND
3039240	851795	49.1	GROUND
3039494	851953	49.7	GROUND
3039631	852103	49.9	GROUND
3039777	852260	49.8	GROUND
3039973	852400	49.6	GROUND
3039269	851299	49.7	GROUND
3039304	851855	49.9	GROUND
3039219	851877	49.2	GROUND
3039323	851937	51.9	GROUND
3039075	851961	49.9	GROUND
3039541	851681	50.1	GROUND
3039624	851715	52.1	GROUND
3039691	851673	73.7	GROUND
3039705	851899	48.9	GROUND
3040029	852140	49.6	GROUND
3040187	852255	77.0	GROUND
3040131	852162	52.5	GROUND
3039006	851639	48.6	TOP BANK
3039009	851642	47.4	BOTTOM BANK
3039016	851649	47.9	BOTTOM BANK
3039017	851649	49.1	TOP BANK
3039391	851898	49.5	GROUND





LEGEND

- Culvert Surveyed
- MassDOT Culvert
- Culvert
- Sawmill Brook Watershed
- Inland Wetlands
- Coastal Wetlands
- Waterbodies

SAWMILL BROOK
2015 CULVERT SURVEY

Manchester-by-the-Sea, MA

July 2015

Tighe&Bond
Consulting Engineers
Environmental Specialists

0 0.2
Miles
1 " = 1,333 '

NOTES

Data sources: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs.

G:\GIS\MA\ManchesterMA\avproj\20150720_SurveyLocations.mxd

Results of Doucet Survey, Inc. Land Surveying Services

STRUCTURE NUMBER	DESCRIPTION 1	DESCRIPTION 2	NORTHING	EASTING	ELEVATION	DSI POINT
3	UPSTREAM	SEDIMENT	3042982.7	853377.3	38.4	1001
3	DOWNSTREAM	SEDIMENT	3042984.2	853430.3	38.4	1002
3	CL ROAD	PAVEMENT	3042983.4	853403.8	48.1	5003
4	DOWNSTREAM	SEDIMENT	3042231.2	854902.9	37.7	1013
4	UPSTREAM	SEDIMENT	3042277.2	854911.6	37.7	1014
4	CL ROAD	PAVEMENT	3042254.2	854907.3	48.1	5004
17	UPSTREAM	SEDIMENT	3037433.7	854179.6	8.7	1025
17	DOWNSTREAM	SEDIMENT	3037396.9	854159.1	8.6	1026
17	CL ROAD	PAVEMENT	3037415.3	854169.4	17.3	5008
18	DOWNSTREAM	SEDIMENT	3037260.3	854509.3	8.2	1027
18	UPSTREAM	SEDIMENT	3037262.8	854596.7	8.2	1028
18	CL ROAD	PAVEMENT	3037261.6	854553.0	16.3	5009
19	DOWNSTREAM	CONC. BOTTOM	3037300.7	855378.8	8.9	1023
19	UPSTREAM	CONC. BOTTOM	3037294.4	855418.7	9.0	1024
19	CL ROAD	PAVEMENT	3037297.5	855398.7	15.6	5010
20	UPSTREAM	SEDIMENT	3037071.9	855822.9	10.7	1021
20	DOWNSTREAM	SEDIMENT	3037126.0	855799.1	10.7	1022
20	CL ROAD	PAVEMENT	3037098.9	855811.0	17.9	5011
22	UPSTREAM	SEDIMENT	3036833.8	853433.1	7.5	1015
22	DOWNSTREAM	SEDIMENT	3036843.4	853473.6	7.5	1016
22	CL ROAD	PAVEMENT	3036838.6	853453.3	16.0	5007
23	DOWNSTREAM	SEDIMENT	3036440.1	852687.3	3.1	1017
23	UPSTREAM	SEDIMENT	3036429.9	852721.6	3.6	1018
23	CL ROAD	PAVEMENT	3036435.0	852704.4	13.1	5006
25	IN - CL ARCH	SEDIMENT	3035516.1	852023.2	-0.4	1019
25	OUT - SPILLWAY-CEN.	CONC. BOTTOM	3035453.8	852018.6	-4.0	1020
25	IN - ARCH-EAST	SEDIMENT	3035515.9	852027.0	-0.2	5012
25	IN - ARCH-WEST	SEDIMENT	3035516.6	852019.0	-0.7	5013
25	WALL BOTTOM	SEDIMENT	3035517.0	852015.9	1.4	5014
25	WALL-TOP	GRANITE	3035517.0	852015.9	10.4	5015
25	OUT - SPILLWAY-WEST	CONC. BOTTOM	3035453.5	852017.2	-4.0	5016
25	OUT - SPILLWAY-EAST	CONC. BOTTOM	3035453.6	852020.0	-3.8	5017
25	CL ROAD	PAVEMENT	3035497.3	852021.8	10.6	5018

Results of Doucet Survey, Inc. Land Surveying Services

STRUCTURE NUMBER	DESCRIPTION 1	DESCRIPTION 2	NORTHING	EASTING	ELEVATION	DSI POINT
26	DOWNSTREAM	SEDIMENT	3040847.9	854275.3	17.5	1011
26	UPSTREAM	SEDIMENT	3041040.6	854307.4	17.8	1012
27	DOWNSTREAM	ON C.M.P.	3040714.7	854301.6	15.6	1009
27	UPSTREAM	ON C.M.P.	3040737.9	854279.7	16.2	1010
27	CL ROAD	PAVEMENT	3040726.3	854290.6	24.4	5005
2 - MIDDLE	UPSTREAM	SEDIMENT	3043176.2	853129.3	40.0	1005
2 - MIDDLE	DOWNSTREAM	SEDIMENT	3043159.4	853155.8	40.7	1006
2 - MIDDLE	CL ROAD	GRAVEL	3043167.8	853142.5	44.7	5000
2 - NORTH	UPSTREAM	SEDIMENT	3043294.0	853200.3	39.2	1003
2 - NORTH	DOWNSTREAM	SEDIMENT	3043258.4	853219.4	39.3	1004
2 - NORTH	CL ROAD	GRAVEL	3043276.2	853209.8	44.9	5002
2 - SOUTH	UPSTREAM	SEDIMENT	3043062.4	853060.7	39.5	1007
2 - SOUTH	DOWNSTREAM	SEDIMENT	3043056.6	853097.4	39.1	1008
2 - SOUTH	CL ROAD	GRAVEL	3043059.5	853079.1	39.1	5001

Tighe&Bond

APPENDIX E

Sawmill Brook Tidegate Evaluation Meeting with DMF

TO: Attendees

ATTENDEES:

Mary Reilly, Town of Manchester-by-the-Sea	Brad Chase, Division of Marine Fisheries
Ed Clark, Division of Marine Fisheries	Ben Gahagan, Division of Marine Fisheries
Jennie Moonan, Tighe & Bond	Joe Persechino, Tighe & Bond
Duncan Mellor, Tighe & Bond	

FROM: Jennie Moonan, Tighe & Bond

DATE: June 17, 2015

On Thursday **June 11, 2015**, from 11:00 AM to 11:45 AM Tighe & Bond and Town staff met with representatives from Division of Marine Fisheries (DMF) to discuss options for alternative configurations for the existing Tide Gate at the mouth of Sawmill Brook. The following summarizes the key discussion items:

- The current configuration of the tide gate is bottom opening, which is not great for fish passage (anticipated fish: Rainbow Smelt, American Eel). The head pressure causes velocities that restrict the fish from passing through the tide gate opening.
- DMF Staff believe the fish are able to swim over the top of the tide gate during high tides.
- Currently, the Town opens the tide gate sometime in April and keeps it open (for a few weeks) as needed per the recommendations of the Stream Team. There was a letter agreement between the former DPW Director and DMF detailing operations of the tide gate for fish passage. Due to changes in Town staff, these practices are no longer followed.
- Staff would like to see this project result in an improvement to fish passage.
- Ideally, the tide gate would be removed.
- A configuration where the gate was replaced with a structure that opened from the top, instead of from the bottom, would also improve fish passage but may require more operation and maintenance effort on behalf of the Town. Generally butterfly type gates work better for fish passage.
- The anticipated fish (smelt) spawn upstream of the tide gate in flowing fresh water riffle complexes, so the bottom material inside of the culvert itself isn't that important to spawning, however, a natural bottom is ideal for the culvert/tidegate. DMF Staff generally see smelt spawning begin at the School Street culvert. The impoundment pond is not expected to be suitable for smelt spawning due to the lack of flow.

- DMF document provides additional detail on Sawmill Book: http://www.mass.gov/eea/docs/dfg/dmf/publications/tr30-smelt-spawning-habitat.pdf

- Rainbow smelt are not "jumpers" and therefore cannot jump over the tide gate or weirs and need to wait for the tide to rise to a level above the obstruction to get past it.

- The peak flow velocities the smelt can handle is about 1.2 meters/second for spawning with a recommended range of 0.4 to 0.8 m/s.

- A hydraulic evaluation of the tide gate is required to determine velocities.

- DMF recommended looking at the dam removal and associated construction at Water Street in Plymouth. At this site, a rock ramp was installed instead of a tide gate. Removing the tide gate and installing a rock riffle ramp from the mouth of the river up to the upstream pond may allow for hydraulic control. However, this is a costly alternative. Creation of a rock riffle complex in the pond may be beneficial for smelt.

- Another alternative to consider is creating a notch in the top of the tide gate that allows fish to swim through at approximately 60% of the high tides.

- Note that the work shown on the plans from CLE Engineering, Inc. for repair to the tide gate and seawall from March 2, 2000, was completed.

J:\M\M1476 Manchester MA Hydro Study\Task 2-Stream Crossing Survey\2015-06-11 Tide Gate Meeting\2015.06.15 Tide Gate DMF Meeting Notes.docx

Sawmill Brook Central St Seawall, Tide Gate & Culvert Observations

TO: Mary Reilly, Grants Administrator

FROM: Duncan Mellor, PE, Tighe & Bond

COPY: Dave Murphy, PE, Tighe & Bond

DATE: June 23, 2015

The Sawmill Brook culvert under Central Street was observed on June 11, 2015 as part of an in-water walk-through to view existing conditions of the seawall, tide gate structure, culvert and stream bed/weirs. Discussions with the Massachusetts Division of Marine Fisheries just prior to the walk-through had indicated a preference to remove or modify the tide gate structure and perhaps the culvert weirs, to increase the times when Rainbow Smelt might have favorable tide conditions to pass these stream obstructions. The observations will be used to inform alternative designs that consider improvements to fish passage, stormwater drainage, and protection from storm surge. Based on a review of documents available from the Town, our understanding is that the tide gate was originally installed in the early 1900's for the purpose of creating a skating pond in the downtown area.

Observations

Fish coming from the harbor at low tide will encounter rock riffles and bedrock below the tide gate structure (Photo 1). As the tide rises these natural impediments will become submerged and no longer hinder fish passage at a water level about 2 feet above Mean Low Water (MLW), (CLE, 2000. Existing Conditions and Proposed Repairs to Tide Gate and Seawall).

Photo 1 Looking upstream (low tide) toward tide gate and Central St culvert

The tide gate structure is comprised of two orthogonal concrete walls approximately 9 feet high, a bottom opening gate of cast iron or cast steel (gate and tracks), and an overhead actuator motor/controller galvanized steel platform (Photo 1). There is some corrosion/erosion metal loss at the bottom of the gate tracks, including the bottom seating wedge guides (Photo 2). The tide gate is operational and was opened to drain the impoundment for the culvert observation. The tide gate opening is 5.9 feet and the open height of the gate at the time of observations was 2.75 feet, with the invert 10 inches to 18 inches above the stream bed.

Photo 2 Corrosion/erosion of low tide gate tracks

The concrete walls of the tide gate structure appear to be gravity walls with indications of prior concrete repair and overlays, including the repairs circa 2000 (Photo3).

Photo 3 View of tide gate from inside culvert

During the walk-through it was noted that there is significant water seepage (flow) coming from the stone culvert side wall supporting the south side of Central Street when the tide gate is closed and ponding water in the culvert (Photo 4). This seepage flow in a dam structure is not desirable and can cause loss of soils under the street. Previously, a shotcrete surfacing (pneumatically applied concrete, previously referred to as "Gunite") was applied to this stone wall and the culvert; however it has failed, particularly in the tidal zone. The circa 2000 repairs indicated this wall was to be repointed with non-shrink grout. The shotcrete and repointing have not stopped the seepage problems and are not recommended here for seepage control.

Photo 4 Water seepage (flow) coming from the stone culvert side wall

The downstream end of the stone arch culvert is about 5 feet upstream from the south edge of the sidewalk. At this point there is a weir 2.7 feet high rising from the bedrock stream bed (Photo 5). This weir has a concrete face, but it appears to be just an overlay on rock filled timber cribs behind. The east side seawall from the harbor to the culvert has had a concrete overlay repair that restricts the culvert opening by about 2 feet on the eastern side at this weir, but it does not continue inside the arch culvert more than 2 to 3 feet. The typical base width of the stone arch culvert is about 16 feet.

Photo 5 Downstream culvert weir looking upstream

Proceeding upstream inside the culvert from the south weir is several feet of boulder rock riffles with horizontal transverse timbers that may be rock filled timber cribs (Photo 6). It is not known if these cribs support the arch culvert, or if they are inside the culvert from an earlier dam, or perhaps stream bed scour protection.

Photo 6 Apparent rock filled timber cribs forming stream bed at south end of arch culvert

At about half distance inside the arch culvert is a second weir with apparent bedrock outcrop at the western side of the culvert (Photo 7). This weir has a total height of about 4 feet (pool below) causing about a 17 inch rise in water level at the weir. The weir has a broad partially sloping crest of concrete (6.1 feet down from top of arch), which might be armor over a buried water and/or sewer main.

Photo 7 Mid length weir inside culvert, bedrock left

The upstream end of the arch culvert has a gate open pool depth of about 11 inches over a cobble, gravel with sand bed. The culvert height from stream bed is about 6.8 feet.

The stone arch culvert was observed to have two transverse open stone joints. The straight transverse joint about 6 feet inside from the south end appears to be a culvert extension, perhaps associated with a past road widening. The transverse joint 4 feet inside from the north end is not completely straight and appears to have been caused by movement of the outer 4 feet of culvert stonework resulting in separations between adjacent stones (Photo 8). The northwestern corner of the stone arch culvert is missing foundation support, likely caused by stream scour, and the stones above appear to be settling and separating.

Safety concerns related to the stone arch culvert were summarized in a separate memo to the Town dated June 18th, 2015 and located in Appendix E.

Photo 8 Separation and settlement of culvert arch stones, upstream, northwestern corner

Photo 9 Stream channel upstream from culvert looking south with dark staining on walls indicating normal gate closed high water level

Assessments

The existing tide gate structure has a top of wall elevation just above mean higher high water level, making this a significant obstruction to Rainbow Smelt passage on many high tides. Tidal water levels will rise over these walls on spring high tides (full moon or new moon) and during higher than predicted tides associated with atmospheric low pressure or wind setup, and such conditions will periodically allow smelt to swim over the walls when the tide gate is closed. This tide gate wall overtopping on spring high tides and storm surge tides does indicate that the tide gate is not effective in preventing seawater flooding. Recent preliminary topographic survey indicates Central Street at this location is within about 1 foot of tidal flooding, based on recorded high tides from the storm of 1978 (NOAA Boston tide record at 93% height correction for Manchester). The frequency of tidal flooding of the roadway will be increasing based on the current mean sea level rise relative to land (including land subsidence) of 0.92 feet per 100 years recorded in Boston (NOAA), and also based on forecast predictions of an increasing rate of relative sea level rise (IPCC).

This tide gate is a bottom opening gate, which is not suitable to partial opening for smelt passage due to the head pressure and high flow velocities associated with a limited the gate opening trying to maintain the impoundment pond. Full opening of the gate during smelt migration is feasible, though velocities during rainfall events would need to be checked relative to smelt swimming speeds.

Even with the tide gate open to allow for fish passage, there are two more weirs inside the stone arch culvert. Since the smelt are not able to jump up weirs, the tide will need to rise to at least 2/3 of mean high tide to allow smelt to swim upstream past these weirs.

As noted by the Massachusetts Division of Marine Fisheries experts, the bottom opening tide gate and culvert weirs are obstructions to smelt passage for most of the tide range, and delays in fish passage waiting for a rising tide makes them susceptible to predation. Fish passage can be improved if the tide gate and culvert weirs are removed, perhaps with a substitution using rock riffles in this area. The existing stone arch culvert does have some structural deterioration and the use of the roadway as a dam when the tide gate is closed also results in undesirable seepage. There are opportunities at this tide gate and culvert to improve fish passage while also addressing culvert deterioration and dam seepage. The stone filled timber cribs inside the culvert form a "natural" bottom to the culvert, which is desirable for fish and aquatic life, but they may also be hydraulically connected to the seepage from the dam face wall. Grouting of the crib voids would be one approach to reducing dam seepage, however this may not be desirable for habitat. Removal of the tide gate and the impoundment reduces dam hydrostatic surcharge and seepage as observed during the field investigation, so tide gate removal can offer fish passage improvements and resolution of dam seepage problems.

Next steps to define site constrains and opportunities

- Complete upstream culvert data collection and HECRAS stream modeling
- Obtain new survey elevation data
- Obtain FEMA 100-year flood revisions
- Consider further evaluation of dam hydrostatic surcharge and seepage issues

J:\M\M1476 Manchester MA Hydro Study\Task 2-Stream Crossing Survey\Task 2 deliverables\Appendix E\Sawmill Brook Central Tide Gate Evaluation Memo_Final.doc

Sawmill Brook Central St Culvert Observations

To: Gregory Federspiel, Town Administrator, Manchester-by-the-Sea

Carol Murray, PE, Interim Public Works Director, Manchester-by-the-Sea

Through: David Murphy, PE, Tighe & Bond

FROM: Duncan Mellor, PE, Tighe & Bond

COPY: Gabrielle Belfit, Tighe & Bond

DATE: June 18, 2015

The Sawmill Brook culvert under Central Street was observed on June 11, 2015 as part of an in-water walk through to view existing conditions of the tide gate structure, culvert and stream bed/weirs as part of a study to consider fish passage to and from the sea to upstream spawning habitat. Discussions with the Massachusetts Division of Marine Fisheries just prior to the walk-through had indicated a preference to remove or modify the tide gate structure and perhaps the culvert weirs, to increase the times when Rainbow Smelt might have favorable tide conditions to pass these stream obstructions.

During this walk-through it was noted that there is significant water seepage (flow) coming from the stone culvert side wall supporting the south side of Central Street when the tide gate is closed and ponding water in the culvert. This seepage flow in a dam structure is not desirable and can cause loss of soils under the street.

Photo 1 Water seepage (flow) coming from the stone culvert side wall

The stone arch culvert was observed to have two transverse open stone joints. The straight transverse joint about 6 feet inside from the south end appears to be a culvert extension,

perhaps associated with a past road widening. The transverse joint 4 feet inside from the north end is not completely straight and appears to have been caused by movement of the outer 4 feet of culvert stonework resulting in separations between adjacent stones. The northwestern corner of the stone arch culvert is missing foundation support, likely caused by stream scour, and the stones above appear to be settling and separating.

Photo 2 Separation and settlement of culvert arch stones, upstream, northwestern corner

Photo 3 Northwestern corner arch stones unsupported

The separation and settlement of the upper section of stone arch culvert is a structural concern and may lead to unpredictable collapse of the northern 4 feet of culvert, potentially leading to progressive failure along the culvert due to the unreinforced nature of the stone rubble construction.

Recommendations:

It is recommended that the sidewalk over the separated portion of culvert be closed immediately and the condition of the culvert be monitored for additional closures of the roadway at least until interim stabilization can be completed.

Tighe&Bond

Offices are located
throughout New England.

www.tighebond.com