

Cape Elizabeth Culvert and Habitat Assessment Study

March 22, 2019



This report was prepared for the Town of Cape Elizabeth by Sebago Technics, Inc., the Wells National Estuarine Research Reserve, the Casco Bay Estuary Partnership and the Town of Cape Elizabeth under award CZM NA17NOS4190116 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.



This report has been assembled with substantial contributions from the following:

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Executive Summary

In early 2017, Jake Aman, representing the Wells National Estuary Research Reserve (WNERR), met with the Cape Elizabeth Public Works Director and Town Planner to talk about culverts. Jake shared aerial photos of culverts located in the Spurwink Marsh where scouring of adjacent habitat areas was evident. He inquired if the town was considering any culvert replacements, in which case WNERR and The Nature Conservancy might be able to partner with the town to promote a habitat sensitive replacement. The outcome of the meeting was a jointly sponsored assessment of major town culverts, including those located in the Spurwink Marsh.

The resulting Culvert and Habitat Assessment Study, funded with a grant from the Maine Coastal Program, is the first town infrastructure evaluation concentrating on culvert infrastructure. Incorporating habitat impacts into the study modernized the town's more traditional approach to infrastructure planning and broadened the perspective for managing stormwater.

The elements of the study were organized by a stakeholder group including town representatives, civil engineers, and habitat experts. Collaboration by these groups promoted sharing of information, broadening of perspectives and more nuanced problem solving.

A comprehensive data base was developed by field visits to the 16 most significant culverts. Data was collected for each culvert using a form designed for the project. A subset of 6 culverts were selected for preliminary hydraulic analyses, conceptual replacement and cost estimates. All culvert analyses included a habitat impact assessment. A discussion about possible road removal also was initiated, and needs further data collection and evaluation.

The assessment identified as the priority for replacement a culvert that was not a high priority prior to the study. The culvert, located at Willow Brook (rather than the typical location under a road) is in poor condition. It is located 200' upstream of the Spurwink Marsh (rated high value for wildlife habitat). Immediately above the culvert are two sewer lines. If there is structural failure of the culvert, in addition to impacts from inevitable stormwater flooding, there may also be impacts from structural failure of the sewer lines.

The study has created several valuable products. It has created a data base for municipal capital improvement planning for culverts. It has identified an immediate infrastructure priority. It has meshed traditional infrastructure management with a multi-level habitat assessment. More broadly, the study has created a culvert assessment model that will guide future infrastructure planning in Cape Elizabeth and is easily adaptable for other municipalities.

Methodology

Initiation of Study

The Town of Cape Elizabeth applied for grant funding to perform an assessment of culverts following a meeting with Jake Aman, Wells National Estuarine Research Reserve (WNERR). Jake shared with Public Works Director Robert Malley and Town Planner Maureen O'Meara an analysis of aerial photos showing scouring adjacent to selected Cape Elizabeth culverts. A Coastal Zone Management Grant in the amount of \$15,000 to support a \$20,500 study was awarded in September 28, 2017.

Culvert Study Assessment Group

Upon receipt of project funding, the Town of Cape Elizabeth contracted with Sebago Technics, Inc. and Steve Harding, project manager, to perform the culvert assessment. (Steve Harding has served as the Town Engineer for over 2 decades and the town currently has contracted his services through Sebago Technics, Inc.)

A stakeholders group was formed consisting as follows:

Robert Malley, Public Works Director
Steve Harding, Town Engineer
Jake Aman, Wells National Estuarine Research Reserve
Jeremy Bell, The Nature Conservancy
Matt Craig, Casco Bay Estuary Partnership
Maureen O'Meara, Town Planner
Kate O'Brien, Susan Adamowicz and others from the U.S. Fish and Wildlife Service

The group met five times and at times also included Slade Moore, Bioconserve; Jami Fitch, Town of Scarborough Sustainability Coordinator; Mike Shaw, Town of Scarborough Public Works Director; Shane Kelly, Sebago Technics, Inc; Rick Meek, Sebago Technics Inc; and Joe McLean, Acadia Civil Works. (See Appendix 1 for meeting notes)

Completion

The study was completed in March, 2019. The study and final report are structured as five Tasks. Additional work immediately commenced on a follow-up study focusing on the Sawyer Road culvert (Culvert 13), which required more complex analyses due to significant tidal influence.

Task 1

Task 1 included a kick-off meeting with town staff and representatives from the Wells National Estuarine Research Reserve (WNERR), The Nature Conservancy (TNC), Casco Bay Estuary Partnership (CBEP), and the United States Fish and Wildlife Service (USFWS).

At the May 24, 2017 meeting, the list of 16 culverts to be assessed was approved. The list was developed using the Public Works Director's knowledge of existing conditions and age of culverts, consultation of the 2015 Sea Level Rise Assessment Floodplain maps led by Jake Aman (WNERR), Habitat studies noted by Matt Craig (CBEP), and comments from group members. The list of culverts to be assessed include:

1. Shore Road @ Pond Cove
2. Shore Road @ Dyer Pond Road
3. Ocean House Road (Route 77) @ Trout Brook
4. Spurwink Avenue @ Pollack Brook
5. Spurwink Avenue @ Spurwink River
6. Spurwink Avenue (Jordan Farm Pond Outlet)
7. Spurwink Avenue - Southwest of Purpoodock Drive
8. Spurwink Avenue @ Trout Brook
9. Mitchell Road @ Pond Cove Brook
10. Old Ocean House Road @ Alewife Brook
11. Ocean House Road (Route 77) @ Alewife Brook (MDOT)
12. Eastman Road @ Trout Brook
13. Sawyer Road @ Spurwink River
14. Sawyer Road North of #1270
15. Willow Brook @ Sewer Pipes Crossing
16. Scott Dyer Road @ Willow Brook

Group members agreed on the division of tasks to evaluate each culvert. In order to develop a standard database, the committee agreed to create a culvert evaluation form to collect data on the 16 culverts. The bulk of this report resides in the culvert assessment forms, which are included in Appendix 2.

Task 2

Task 2 included a field assessment of culverts by the Public Works Director, Town Engineer, WNERR, and CBEP.

Each of the 16 culverts were evaluated with field visits and review of online databases. A culvert form was completed for each culvert capturing field conditions and summarizing habitat impacts with reference to additional information available from online sources. Field visits were conducted in the spring/summer of 2018. (See Appendix 2)

Habitat Impact Assessment Methodology

Habitat and aquatic species data were used to evaluate potential, ongoing or future impacts at each culvert and to identify design considerations for future replacement of the crossing structure. Data was accessed from the Maine Stream Habitat Viewer (MCP 2018), the Sea Level Rise/Storm Surge Dataset (MGS 2018), and the Potential Tidal Marsh Migration Map (MNAP 2018). Some additional data was collected in the field to help identify restriction of tidal flow at several tidally influenced culverts in the Spurwink Marsh.

Several of the culverts assessed for this project have been investigated under previous planning efforts, including the Trout Brook Management Plan (CCSWCD 2012), the Cape Elizabeth Sea Level Rise Vulnerability Assessment (Harbison 2015), and Sea Level Rise and Casco Bay's Wetlands: A Look at Potential Future Impacts (Bohlen et al. 2013). Information and recommendations from these reports have been incorporated into the analysis and recommendations for the current study.

The habitat and species data sets analyzed for this assessment include a mix of remote sensing, field assessment, and habitat modeling data. These sources for this data provide disclaimers that the data is intended to aid in planning, but the accuracy is not guaranteed, nor is the data intended as a regulatory tool. That being the case, this data represents the best available information on habitat and species in Cape Elizabeth and its watersheds. Available relevant habitat data include:

- Sea Level Rise elevation predictions
- Marsh Migration predictions
- Alewife habitat
- Eastern Brook Trout habitat
- Anadromous Rainbow Smelt habitat
- Tidal Marsh
- Habitat Connector
- Threatened, endangered, and rare species
- Non-native species

- Tidal waterfowl and wading bird habitat
- Inland waterfowl and wading bird habitat
- State ecological focus area
- Stream crossing survey data

Stream crossings were assessed for the occurrence habitat values at each location, as well as the degree of impact for each value. Sea level rise and Marsh Migration impacts were tied to predicted increases in the elevation of tidal flooding derived from LiDAR datasets and tidal observations, and these methodologies are outlined on the data websites. Habitat and species values were essentially presence/absence information derived from various state datasets. More detail is available from the Maine Stream Habitat Viewer website. The occurrence of a habitat value at any given stream crossing provides an indication that there may be specific impacts that should be addressed ranging from general degradation of stream health to individual species habitat requirements.

Field Assessment Highlights

Out of the 16 stream crossings evaluated, 13 had some type of available habitat information associated with them. Six of the crossings are vulnerable to sea level rise impacts, and priority fish habitat was a consideration for seven crossings. The crossings associated with the most habitat values were those in the Spurwink Marsh. The habitat issues at these sites are complex and further study is needed to assess the full impact of the crossings on tidal marsh habitat, and to determine how best to address those impacts. Discussion of site-specific habitat values and associated design recommendations are included in the Culvert Assessment Forms (Appendix 2).

The Culvert Summary Table (Appendix 3) identifies habitat values present at each culvert location. Sea level rise (SLR) or marsh migration values are based on the lowest elevation SLR scenario that affects the culvert.

References

- Bohlen, C., M. Stelk, M. Craig, C. Gerber. 2013. Sea Level Rise and Casco Bay's Wetlands: A Look at Potential Future Impacts. Casco Bay Estuary Partnership. URL <https://www.cascobayestuary.org/publication/sea-level-rise-casco-bays-wetlands-look-potential-impacts-cape-elizabeth-edition/>
- Cumberland County Soil and Water Conservation District. 2012. Trout Brook Watershed Management Plan. URL https://www.capeelizabeth.com/government/rules_regs/reports/Trout%20Brook%20Watershed%20Mgmt%20Plan%20-%20TextOnly.pdf

- Harbison, R. 2015. Cape Elizabeth Sea Level Rise Vulnerability Assessment. Greater Portland Council of Governments. 42 pp.
- Maine Coastal Program. 2018. Maine Stream Habitat Viewer. Maine Department of Marine Resources. URL <https://webapps2.cgis-solutions.com/MaineStreamViewer/>
- Maine Geological Survey. 2018. Sea Level Rise/Storm Surge. Maine Department of Agriculture, Conservation, and Forestry. URL https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml
- Maine Natural Areas Program. 2018. Potential Tidal Marsh Migration Map. Maine Department of Agriculture, Conservation, and Forestry. URL https://www.maine.gov/dacf/mnap/assistance/marsh_migration.htm

Task 3

Task 3 included selection of a subset of culverts for hydraulic analyses by the group. Sebago Technics Inc. performed the analyses, supplemented by additional habitat analysis as needed. Discussion of conceptual improvements begins.

The group selected 6 culverts for conceptual hydraulic analysis at the July 31, 2018 meeting. Early in the discussion, the group agreed that any hydraulic analysis of the Sawyer Road culvert (#13) would be significantly complicated by tidal influence. The project budget would not be sufficient to include these culverts. The recommendation was to seek separate funding to focus on Sawyer Rd (Additional funding was provided in December, 2018 and that study is ongoing). Two additional tidally influenced culverts (#1, Shore Road @ Pond Cove and #5, Spurwink Avenue @ Spurwink River) were also not included in the group to be analyzed due to the level of complexity required to complete the assessment which would be beyond the level of funding in this study.

The following culverts were selected for hydraulic analysis:

- #2, Shore Road @ Dyer Pond Road
- #3, Ocean House Road (Route 77)@ Trout Brook
- #8, Spurwink Avenue @ Trout Brook
- #9 Mitchell Road @ Pond Cove Brook
- #12 Eastman Road @ Trout Brook
- #15 Willow Brook @ Sewer Pipes Crossing

Hydraulic Analysis Methodology (Sebago Technics)

Hydraulic analyses of these culverts were conducted and used to propose improvements. HY-8, version 7.5 software, prepared for the Federal Highway Administration, was utilized to automate the culvert hydraulic computations.

The primary criteria applied was to incorporate a culvert sized to a minimum of 1.2 times the bank-full width of the contributing stream and to provide a headwater to culvert depth ratio (H_w/D) less than or equal to one during the 100-year storm peak flow event.

Appendix 4 includes supplemental hydraulic information for the six culverts that were analyzed as part of this study.

As demonstrated in Appendix 4, Figure 1, for each culvert, H_w/D is less than or equal to 1.0, except Culvert #8. The feasible depth of Culvert #8 is limited by the available cover. In order to meet the H_w/D of less than or equal to one, this culvert would need to be several times wider than modeled, which was considered to not be practical.

Figure 2, for each culvert, depicts the headwater elevations and total discharge during the modeled recurrence intervals (2-year, 5-year, 10-year, 25-year, 50-year and 100-year storm events).

Figure 3, for each culvert, displays the crossing properties (the physical characteristics) used to model the culvert. The source data for the bank full width is Streamstats, a website produced by the U.S. Geological Survey, and or field measurements as indicated.

Figure 4, for each culvert, represents the peak flow data used in the model. The source data for the peak flow values is Streamstats, a website produced by the U.S. Geological Survey.

Figure 5, for each culvert, represents a cross-section of the stream channel and associated flood plain. Data points were interpolated from aerial mapping of each site.

Hydrology and Habitat impacts (WNERR)

Impacts to habitat at the six culverts chosen for hydraulic analysis varied greatly. By necessity, the high-value tidal sites were not included due to the need for more rigorous engineering study where tidal flow and sea level rise are factors influencing design recommendations. The remaining sites with high habitat value were primarily associated with Eastern Brook Trout habitat (3,8,12), or tidal marsh and sea level rise (15). The culverts located in the Trout Brook watershed all appear to be undersized and may be barriers to fish passage for brook trout at various life stages. The Willow Brook tidal crossing is vulnerable to sea level rise impacts, and currently is restricting upstream tidal flooding based on depth data collected upstream and downstream of the culvert. The structure is undersized and is a barrier to aquatic organism passage at mid to low tides.

Habitat issues at stream crossings vary based on a range of factors, and not all sites require the same level of ecological design to achieve habitat and species goals. Guidelines have been developed for design of *non-tidal* stream crossings that minimize impacts to stream habitat. These principles should be incorporated into future design at priority stream crossings to the greatest extent possible.

There is minimal guidance available for designing *tidal* stream crossings that minimize impacts to habitat. To achieve the best outcomes for habitat and aquatic species at these crossings, design should be informed by study of tidal flow and modeling of channel geometry and sea level rise. Recommended references include:

- The Maine Stream Smart Program has developed extensive resources to assist road managers with implementation of ecological crossing design which can be accessed on the program website:

<https://www.maineaudubon.org/projects/stream-smart/>

- The U.S. Forest Service developed the Stream Simulation program to provide detailed methods for designing and implementing ecologically friendly stream crossings. Stream Simulation seeks to replicate conditions in nearby reference reaches to achieve the minimal impact on stream habitat.

<https://www.fs.fed.us/eng/pubs/pdf.StreamSimulation/>

- For tidally influenced stream crossings, tidal inundation and sea level rise are likely to be the primary design considerations. The Nature Conservancy has developed guidelines for assessing the impact of tidal crossings on habitat and prioritizing structures for replacement.

<https://www.nature.org/content/dam/tnc/nature/en/documents/nh-tidal-crossing-assessment-protocol.pdf>

Task 4

Task 4 included group members conducting additional field assessment as necessary to refine conceptual improvements. The Town Engineer would then prepare cost estimates and group members may also identify projects that have habitat restoration potential, and corresponding funding

Appendix 3 is the Culvert Summary Table, which lists all culverts and includes recommended replacement priorities and costs.

Below is a Hydraulic Analysis Culverts Summary Table of 6 culverts showing recommended replacement and cost.

Hydraulic Analysis Culverts Summary Table					
No	Location	Existing Type	Existing Size	Proposed Replacement	Cost estimate
2	Shore Rd @ Dyer Pond Rd	AP	36 - inch	9' Span X 5' Rise X 72' Length Concrete Box Culvert	\$280,000.00
3	Ocean House Rd @ Trout Brook	P	8'-2" W by 5'-9" T	10' Span X 5' Rise X 96' Length Concrete Box Culvert	\$320,000.00
8	Spurwink Ave @ Trout Brook	AP	5'-0" W by 3'-8" T	12' Span X 4' Rise X 56' Length Concrete Box Culvert	\$270,000.00
9	Mitchell Rd @ Pond Cove Brook	CMP	48 - inch	12' Span X 5' Rise X 64' Length Concrete Box Culvert	\$315,000.00
12	Eastman Rd @ Trout Brook	PVC	10-inch	3' X 48' Length RCP	\$90,000.00
15	Willow Brook @ Sewer Pipes Crossing	CMP	3'-0" W by 4'-0" T	11' Span X 5' Rise X 56' Length Concrete Box Culvert	\$275,000.00

Conceptual, order of magnitude cost estimates are provided in FY 2018 dollars. Estimates are for materials, construction and a 25% contingency. The estimated cost assumes a 100-foot project area length for each culvert. Stream restoration upstream and downstream outside of the immediate area surrounding the proposed culvert is not included within this estimate. Estimates do not include final design and potential permitting costs. Video inspection of the culvert prior to final design should also be done and is not included in cost estimate.

The group agreed that Culvert #15, Willow Brook, is a high priority for replacement. The culvert is in poor condition and also supporting two public sewer pipes. The culvert is located 200 feet (est.) upstream of the Spurwink Marsh, rated high value for wildlife by the Maine Department of Inland Fisheries and Wildlife. Failure of the culvert might also result in failure of the sewer lines, with a resulting catastrophic discharge of sewerage into the marsh.

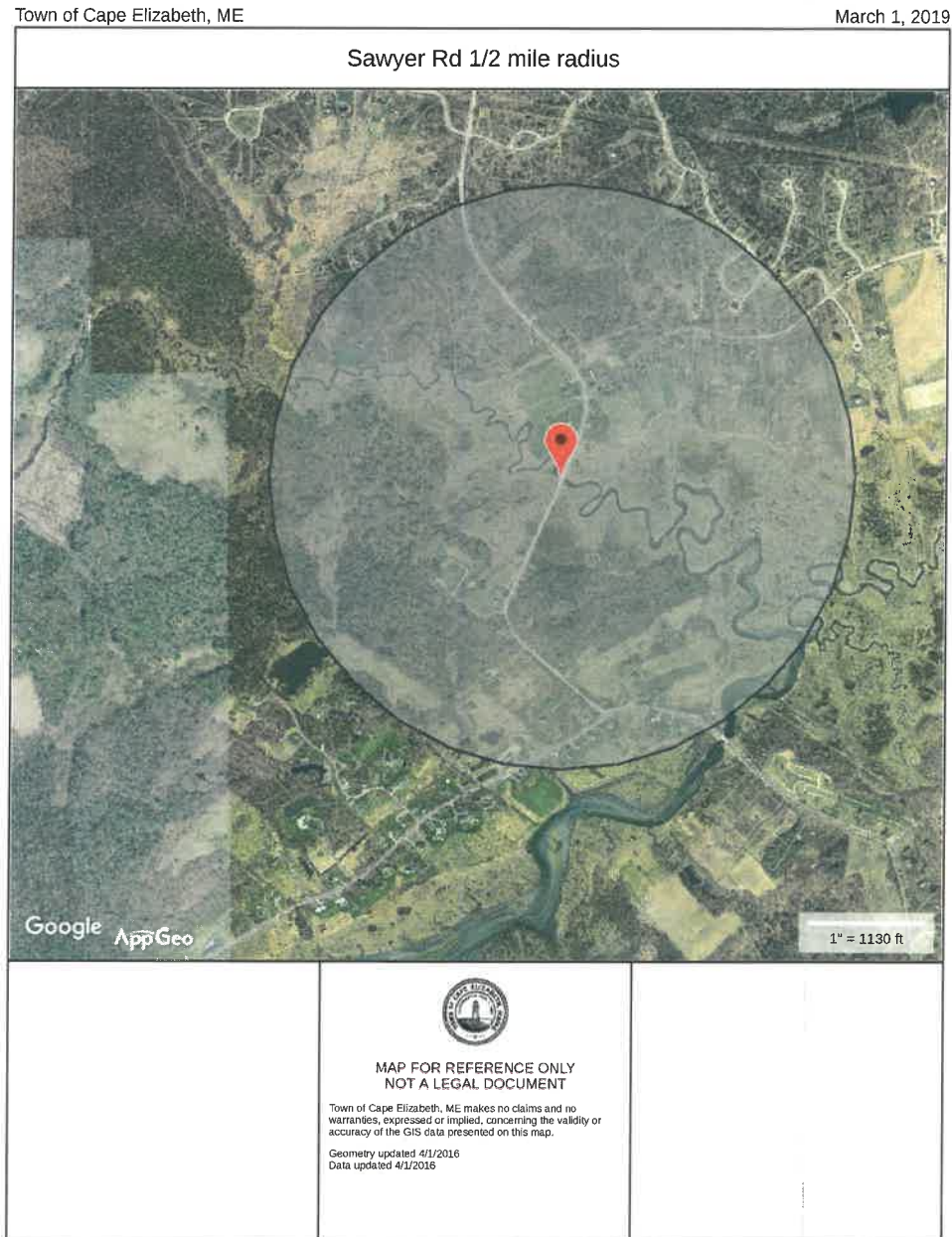
Task 5

Task 5 includes a final report of the culvert assessment study. The group reviews the final assessment conclusions and the Town Planner arranges for presentation of the results.

This report is the final report and includes the conclusions of the group. Presentation of the report will be made to the Conservation Committee, Planning Board, and Town Council in 2019.

Road Removal Analysis

The grantor included in the study scope an analysis of possible removal of the portion of Sawyer Road located in the Spurwink Marsh. The Sawyer Road culvert (#13) was not included in the hydraulic analyses due to the complexity of incorporating tidal influence. This culvert is now the subject of a separate study. The results of the ongoing study should be incorporated into any analysis of possible removal.



For this report, possible road removal discussions considered the following elements:

Property Access: There are no properties which would lose sole vehicular access if the portion of Sawyer Rd located in the marsh is discontinued. Approximately 80 homes are located within 1/2 mile of Sawyer Rd where it crosses the marsh, with 30± located in Scarborough and 80± located in Cape Elizabeth. These homes are located in relatively remote sections of their respective communities and consequently have limited vehicular access options.

Vehicular, Pedestrian and bicycle Circulation: The Town of Cape Elizabeth and Town of Scarborough abut the Sawyer Rd section crossing the marsh. For Scarborough residents who travel regularly to the City of South Portland or Portland, removal of Sawyer Road will increase trip lengths. Approximately 1,100 vehicles travel this corridor daily. This does not include the numerous cyclists and runners that use Sawyer Rd.

For Cape Elizabeth residents, fewer trips head south. A larger issue for Cape Elizabeth is its modest town-wide road network. There are only three major north-south directional roads within the town and Sawyer Road is one of them. As recently as October, 2017, Cape Elizabeth emergency personnel were using Sawyer Road to reach the southern part of town when trees blocked Route 77 (at Old Ocean House Rd).



Route 77 closure October 2017, resulting in access to southern end of town limited to Sawyer Rd.

Emergency Evacuation: Prior to weather emergencies and during non-storm emergencies, Sawyer Road is an important evacuation and road circulation route. The road network east and west of the south end of Sawyer Rd remains vulnerable to flooding and storm surge during emergencies. On the north side of Sawyer Rd, the elevation quickly increases so that evacuees are above flooding levels.

Habitat Impact: Sawyer Road includes approximately 1,200' linear feet of 22' wide road base within the bed of the marsh. Portions of the road routinely flood

during king tides and storm surge events. It is expected that flooding events will increase with sea level rise and climate change. Scouring adjacent to culverts is evident, resulting in habitat loss. With no action, it is likely that the roadway and its culverts will eventually fail. Because the culverts are constricting tidal movement, upstream areas are not currently subject to sea water inundation and have significant freshwater wetland conditions. With roadway / culvert failure, these areas will be flooded with salt water. In the short term, this will result in damage to the freshwater flora and fauna. Longer term, the area will likely convert to a salt-water habitat that may exist if Sawyer Road is not constricting tidal flow.

Utilities

There are no utilities in the right-of-way of Sawyer Road so this would not be a factor in determining whether or not to remove the road.

Next Steps

Additional evaluation of the portion of Sawyer Road located in the marsh is needed. The separate, ongoing study of Sawyer Road should produce valuable data. That study also includes both municipalities (Cape Elizabeth and Scarborough) as partners. In addition to a better understanding of how water moves within the marsh, a public outreach effort to abutters and other stakeholders will be needed to further evaluate the sustainability of Sawyer Road within the marsh.

Appendix 1

Meeting Notes

May 24, 2018

July 31, 2018

September 26, 2018

November 28, 2018

January 7, 2019

Meeting Notes
Culvert Assessment Study
May 24, 2018

Attendance: Susan Adamowicz, USFWS, Jake Aman WNERR, Steve Harding STI, Bob Malley ToCE, Kate O'Brien USFWS, Maureen O'Meara ToCE

The group reviewed the status of work completed by Task.

Task 1 - completed

Task 2 - Field Assessments

Jake and Matt Craig, CBEP, deployed some equipment last fall and will need to collect the bulk of data this spring. They are collecting data at Spurwink Ave and Sawyer Rd, using water loggers on both sides of the culverts. They are working on longitudinal profiles. Jake will need to use a 15' long stadia rod as some pools are quite deep. He has borrowed better quality equipment that he will need to relinquish and will have access to in September. Data collection will need to be completed now with equipment available. That includes static GPS. He will collect permanent edges, road crest. He is interested in collecting data at Alewife Brook at Old Ocean House Rd.

Data will be represented based on Highest Annual Tide.

Bob said that the Sawyer Rd culvert has holes in the pipe, erosion in the wings and was last replaced in 1992. He has a report from MDOT and will send that report to Maureen.

Jake asked about what data to collect. He will be capturing the elevation of the marsh surface, track upland edge.

Susan asked about agricultural berms and upstream subsidence. We can use plant community similarities to extrapolate elevations, with the focus being the inundation elevation. There is concern that restoring the area to full tide flooding with stress plants too much. We want to nourish plants with sediment but not too much water.

Steve and Bob will conduct field assessments of the 16 culverts. Detailed hydraulics will be done for 6 culverts. From the original list, those are:

1. Shore Rd @ Pond Cove
3. Ocean House Rd @ Trout Brook
5. Spurwink Ave @Spurwink River
8. Spurwink Ave @ Trout Brook

9. Mitchell Rd @ Pond Cove Brook
13. Sawyer Rd @ Spurwink River

The group agreed that we need to merge the gis data gathered by engineering and natural resources. Jake is working in Arcgis and can provide shape files, spreadsheet in coordinates.

Kate mentioned the damage done to roads during flooding and that we may need to consider "fair weather" roads. The culvert evaluation should be done using a standard metric/survey form. Who may have that?

The group also discussed the need to consider road removal. A metric for this would be helpful. Suggestions includes a UNH program underway to assess roads (Jennifer Sitecy ?) The metrics should include if road is sole access for property, traffic volume, road connectivity.

The Town of Scarborough should be brought into the conversation.

Action Items for Next Meeting: July 31st, 9:00 a.m., Cape Public Works

- Create metric evaluation form for culverts: Steve, Maureen
- Field visit all culverts: Steve and Bob, Jake and Matt
- MDOT Sawyer Rd culvert report: Bob to send to Maureen
- Look at how gis data will be merged: Jake and Steve (data is not expected to be merged for meeting)
- Contact Scarborough: Maureen

Please let Maureen know if there are any omissions or errors in the action items.

Original list of culverts

1. Shore Rd @ Pond Cove
2. Shore Rd @ Dyer Pond Rd
3. Ocean House Rd @ Trout Brook
4. Spurwink Ave @#522
5. Spurwink Ave @Spurwink River
6. Spurwink Ave (Jordan Farm Pond Outlet)
7. Spurwink Ave - SW of Purpoodock Dr
8. Spurwink Ave @ Trout Brook
9. Mitchell Rd @Pond Cove Brook
10. Old Ocean House Rd @ Alewife Brook
11. Route 77 @Alewife Brook (MDOT)
12. Eastman Rd @ Trout Brook
13. Sawyer Rd @ Spurwink River
14. Sawyer Rd North of #1270
15. Willow Brook
16. Scott Dyer Rd @ Willow Brook

Meeting Notes
Culvert Assessment Study
July 31, 2018

Attendance: Jake Aman WNERR, Steve Harding STI, Bob Malley ToCE, Matt Craig CBEP, Maureen O'Meara ToCE

1. The group met at Cape Elizabeth Public Works Department. It was agreed that Maureen would contact Mike Shaw, Scarborough Public Works Director and Angela Blanchette, Scarborough Engineer, about the studies on Sawyer Rd.
2. Steve Harding had completed the culvert evaluation form. He and Bob Malley have conducted field visits of all 16 culverts and are finalizing the culvert forms. Bob Malley said the field visits were worthwhile. The culvert at Willow Brook at the sewer line is in poor condition. Matt Craig asked about settling at Scott Dyer Rd and Bob responded that section of Scott Dyer Rd is funded for full depth reconstruction in 2019. Matt asked about erosion at Willow Brook. Steve Harding explained that a sidewalk will be installed erosion will be addressed as part of construction. He may take shots in frozen and non-frozen conditions. Bob explained that south of Scott Dyer Rd there is a 12" interceptor and 16" force main. Bob will share MDOT Sawyer Rd culvert report with Maureen.
3. Data collected by STI and Jake still needs to be merged on GIS. Jake will do some high level habitat analysis and get ready for more detailed work in a future grant.
4. Trout Brook culvert was reconditioned in 1983. Almost all culverts have state unique identifier. Only public sites are shown online. Jake mentioned a map viewed on the MDMR website. You can search by town, road, pipe dimensions. Lidar can be used to get elevation depth.
5. The group reviewed the culvert list for next level hydraulic analysis. Culvert #1 (Shore Rd @ Pond Cove) was not included due to the tidal influence which will require more detailed analysis to be useful. There is also some potential for this to be included in other studies. The committee discussed each culvert, eliminating those with tidal influence. Final culverts selected for hydraulic analyses are:
 - #2, Shore Rd @ Dyer Pond Rd
 - #3, Ocean House Rd @ Trout Brook
 - #8, Spurwink Ave @ Trout Brook
 - #9 Mitchell Rd @ Pond Cove Brook (hanging culvert)
 - #12 Eastman Rd @ Trout Brook
 - #15 Willow Brook @ sewer line
6. The group discussed how to define flooding. Bob said the town has to track flooding for hazard mitigation funding by storm event. Steve suggested using MDOT criteria, then dial back to concept level. It was agreed to continue to

collect data on tidally influenced culverts to include in the report as a base for future studies. Jake offered to do some freshwater habitat assessment, such as at Trout Brook. After discussion, it was agreed to use the town Normal High Water Line definition, which is HAST +3' vertical feet.

7. The group discussed Sawyer Rd. This area is heavily influenced by tides and needs an order of magnitude level of analysis not proposed for this study. Jake suggested that a separate study could focus on Sawyer Rd. He has cost estimates for this from Wright-Pierce (Joe McClain). Steve asked about the road removal feasibility analysis. It was agreed that this analysis would be done for this study, as required by the grant contract. The analysis will look at transportation access for private properties, town connectivity and evacuation needs, as well as other factors to be identified. If the study recommends replacing Sawyer Rd, it was agreed that the Complete Streets policy should apply. This would be a road section with 2 11' wide lanes and 2 5' wide bike lanes. We will try to use drones to fly over to get better resolution than lidar. Jake reviewed his data on Sawyer Rd shows a deep scour pool (15').
8. Next meeting is scheduled for **Wednesday, September 26th, beginning at 2 p.m.** at Cape Elizabeth Public Works. Work to be discussed at the next meeting:
 - Contact with Scarborough representatives - Maureen
 - Culvert evaluation forms completed - Steve
 - Data merged on GIS - Steve and Jake
 - High level habitat analysis - Jake
 - Elevation depth using lidar, other sources - Jake and Steve
 - Begin hydraulic analyses - Steve
 - MDOT Sawyer Rd culvert report to Maureen - Bob
 - Preliminary Sawyer Rd remove/replace evaluation - Maureen, Bob, Steve
 - Collect storm event flooding data at culverts(?) - Bob

Meeting Notes
Culvert Assessment Study
September 26, 2018

Attendance: Jake Aman WNERR, Jeremy Bell TNC, Jami Fitch Town of Scarborough, Steve Harding STI, Bob Malley ToCE, Matt Craig CBEP, Maureen O'Meara ToC

1. The group met at the Cape Elizabeth Public Works Department. The group welcomed Jeremy Bell, whose schedule had precluded him from attending earlier meetings, and Jami Fitch, representing the Town of Scarborough. The group agreed the July 31, 2018 notes were acceptable.
2. Bob Malley mentioned that as part of the Sawyer Rd Hazard Mitigation Plan, we do some record keeping on overtopping. Maureen said the Scarborough Police Department might also have records. Jake noted the Cape Elizabeth Vulnerability Assessment report and Steve Harding reminded the group that the evaluation must also look at a road removal option. Jake noted that Pete Slovinsky wanted the road removal option included in the grant study. The road removal option should look at: access for properties, connectivity, evacuation, traffic volume, vulnerability and habitat impacts.
3. There was general discussion that, if the road will not be abandoned, then it will likely need to be rebuilt. Matt Craig asked if we can talk about road design and the group agreed. The group discussed what water design level to use. The town has adopted Highest Astronomical Tide plus 3' vertical. There was concern this was too high, and maybe waiting for the results of the Sawyer Rd culvert companion study would be advisable. Bob and Maureen supported compliance with the Complete Streets policy, which means that a bike lane should be included.
4. Matt mentioned the desirability of getting a sea level rise analysis. Water from Scarborough will be minimal if there is no change from Black Point Rd. Steve Harding thought it would be reasonable to include Black Point Rd.
5. The group discussed the status of the culvert report. We have a culvert form, data for the form, photos and a location map. Completion of the forms is underway and the hydraulic analysis will be done by the end of November.
6. The group agreed that the habitat data and the engineering data will not be merged, but rather shown separately, due to concerns with technical compatibility, etc. Jake agreed that he can share elevations and there is no need for lidar at this concept level. Steve explained that Shane and Rick will be picking up data for the hydraulic analyses. They will be collecting the orthometric height for road surface and will need a reference if the site is wooded. Steve will use 1.2 bankwidth and will need that data. Matt suggested using Stream stats online. Jake said the habitat viewer may have bank width in the attribute table, but the data will be less reliable on smaller streams

7. Matt Craig asked if there will be field visits to evaluate habitat? Jake said the online habitat viewer should be sufficient.
8. The committee zeroed in on the Sawyer Marsh and wants several factors included in study analysis, including: natural disaster consequences, weighting of criteria, resilience factor, tidal restoration with the road and focus on immediate risks. Bob noted the Scarborough piece is important because there is a gas line under Black Point Rd. Evacuation of Scarborough Beach should include population numbers and seasonal fluctuation.
9. The committee talked about possible funding sources. Matt mentioned the water bond passed last year that might be available next spring and Jami mentioned the transportation bond.
10. Matt recommended developing longitudinal profiles, upstream and downstream, and the report should collect this data. The top 5-10 streams could have this, with 1-2 days of work. Jake said this would not add much to the overall cost. Matt suggested that Alex Abbot has done habitat surveys and maybe CBEP can fund it. Bob suggested using King tides to show frequency of overtopping. It was agreed this would be saved for the Sawyer Rd study.
11. For the next meeting, the culvert forms will be completed, the hydraulic analyses for the selected culverts would be done and we will discuss conceptual improvements. Jake will pull stream data from the viewer. Prior to the meeting, a draft of how to evaluate road removal will be pulled together for group review.

Hydraulic analyses:

- #2, Shore Rd @ Dyer Pond Rd
- #3, Ocean House Rd @ Trout Brook
- #8, Spurwink Ave @ Trout Brook
- #9 Mitchell Rd @ Pond Cove Brook (hanging culvert)
- #12 Eastman Rd @ Trout Brook
- #15 Willow Brook @ sewer line

12. The next meeting is scheduled for November 28th at 2:00 p.m. in the Cape Elizabeth Public Works Department.

Meeting Notes
Culvert Assessment Study
November 28, 2018
2 p.m., Cape Elizabeth Town Hall

Attendance: Jake Aman WNERR, Jami Fitch Town of Scarborough, Steve Harding STI, Shane Kelly, STI, Rick Meek, STI, Bob Malley ToCE, Matt Craig CBEP, Maureen O'Meara ToC, Michael Shaw, Scarborough Public Works Director

1. The September 26, 2018 meeting notes were accepted. The group agreed to review the culvert forms (information collection form developed for this project) and then move to the Sawyer Rd culvert project at 3:15 p.m.
2. Steve Harding began with a town map showing the location of each culvert by number assigned. The committee discussed the physical condition, habitat impacts and improvements going forward. Bob will edit draft forms and provide markup for Steve to revise. Bob's knowledge of flooding experience will be especially helpful.
3. Jake explained how he is adding the habitat evaluation to the form. He is using a spreadsheet of habitat data that includes 10+ criteria. He is using the stream habitat viewer for the 6 culverts that will have hydraulic analysis.
4. Steve asked what habitat elements should he be factoring into the design of proposed improvements? Jake referenced the Maine streamstart program, and noted that some culverts, such as Eastman Rd @ Trout Brook, may not need to be designed for fish passage. Matt encouraged that site specific information should be included for selected culverts, such as the one at Willow Brook. It was agreed that Jake would compile the habitat analysis in the forms and then pass them to Matt for additional info as needed.
5. Reviewing culvert #2, Shore Rd @ Dyer Pond Rd, Shane described using a habitat connectivity design per MDOT specs. If you add in road related items such as the sidewalk, headwall replacement, etc, there could be significant cost implications. With no extensive flooding, there is no immediate need to replace. It is undersized, and probably should be replaced with a 9' wide structure, embedded. He suggests that the culvert has useful life remaining, so the town should consider replacing culverts with less useful life first. Bob noted there is a downstream culvert, so the size should stay the same. The group noted flooding history (some), possible option to adjust weir, and potential flooding of adjacent trails.
6. Culvert #3, Ocean House Rd @ Trout Brook, is not in bad shape. Shane recommends the culvert stay on the list, but is not critical for replacement. It is not severely undersized and almost at 1.2 bankfull width now. If replaced, you must consider retaining wall costs and underground utilities. Replacement probably would be a 10' box embedded 2'. Cover is a factor. Jake noted that velocity should be considered as there is a sediment wedge

downstream. When replaced, it should be upsized for wildlife passage with dry banks inside the pipe, which could reduce road kill. Raccoons are ok with long dark pipes, but fish are less willing. Rusting at the outlet was noted, but not a structural concern at this time as the bottom is still there. It was agreed this is not a high priority for replacement at this time although the group agreed there is some uncertainty in how the infrastructure and habitat conditions are jointly evaluated.

7. Culvert #8, Spurwink Ave @ Trout Brook, Bob noted that the town maintains it although it is also located in South Portland. Matt noted the stains on the pipe are low and Shane said it is only 10 years old and aluminum may have different coloration. The culvert skews across the road and the stream right turns into the culvert. Shane said this culvert was difficult to access in the field and also difficult to measure downstream. They used the bank full measurement from streamstats. He would recommend a 9' concrete box culvert due to lack of cover. There is no flooding history, no erosion noted and a low priority for replacement.
8. Culvert #9, Mitchell Rd @ Pond Cove Brook, has to be evaluated together with the culvert installed under Hobstone Rd (private). Steve noted the pump station, gravity sewer and water, with the sewer under the culvert. The headwall is falling apart, pipe corroded, with a hanging culvert. Bob offered that the culvert may date to 1975 with the sewer installation. Shane recommends replacement and the work should also address the middle area between the town and the Hobstone culvert. Matt suggested a longitudinal profile from upstream of the Hobstone culvert. The middle area should be restored to a natural state. It does not have lots of habitat value in its current condition. Jake noted this has potential as a habitat connector. This culvert is the second highest priority for replacement.
9. Culvert #12, Eastman Rd @ Trout Brook, Shane recommended this needs more investigation and Steve noted the lack of a channel. Jake said this is mapped eastern brook trout habitat and when replaced, it should be upsized and embedded.
10. Culvert #15, Willow Brook @ sewer line, the group agreed is in poor condition and the top priority for replacement. The culvert has structural damage. Bob said there is a 12' sewer interceptor line and an 8"-10" sewer force main located above the culvert. If the culvert fails, support of the sewer lines is compromised and result in a break, discharging into a high value marsh. Matt said the sizing should consider tidal influence and sea level rise.
11. The group reviewed a draft spreadsheet intended to capture significant elements of the culverts at a glance. The group will fill in the spreadsheet using data from the forms.
12. The group agreed to meet on December 17th to review a draft report and wrap up the study.

Meeting Notes
Culvert Assessment Study
January 7, 2019
2 p.m., Cape Elizabeth Town Hall

Attendance: Jake Aman WNERR, Steve Harding STI, Bob Malley ToCE, Matt Craig CBEP, Maureen O'Meara ToC

1. This meeting was rescheduled from December 17, 2018. Meeting notes from November 28, 2018 were not available. Maureen confirmed that an extension was granted by the state from the end of 2018 for an additional 90 days. She would like to complete the report by the end of January.
2. Maureen distributed a first draft of the final report. The report will feature the culvert assessment forms, which are getting final revisions. The group agreed the forms and the summary spreadsheet will be the bulk of the report.
3. Cost estimates are needed and will be provided only for hydraulic analysis group. It was agreed the cost estimates would be in 2018 dollars and include a 25% contingency. Not included are permitting and design costs. Steve will prepare a summary table of the hydraulic analysis culverts and also a brief summary of how the hydraulic analyses were done. It was made clear that this information is very high level and final design would be needed for each culvert replacement.
4. Maureen drafted a Sawyer Road alternatives analysis for group review. The analysis is hampered by the removal of Sawyer Rd from this study and the focus of individual study that is just starting. The grant requires an analysis, however, so some effort has been made. Steve offered to provide traffic counts from the state database. Matt suggested that utilities should be one of the elements evaluated and it was confirmed that there are no utilities in the road. A map will be included in the analysis and a list of abutters will be provided. It was agreed that a recommendation needs to wait for the next study to conclude.
5. The group revised the summary spreadsheet. The video inspection column will be replaced with a habitat evaluation column and the need for video inspection will be noted in the report. Jake will provide this information.
6. The group discussed Task 4, which sets priorities. The report should include a statement that the town may take advantage of funding opportunities to replace a lower priority culvert. Potential other funding sources were identified, including the NOAA Coastal Resiliency grant (1:1 funding) and the state water bond.
7. The group agreed that Jake would review the habitat info in the culvert forms and forward the final version to Steve by January 18th. Steve will add revisions to the forms provided by Bob, as well as cost estimates. He will also provide a brief summary of the hydraulic analyses. He estimates completing

his edits by January 25th and then provide a memory stick to Maureen. Maureen will finalize report and submit to state by end of January, 2019. No additional meetings will be held.

8. Jake asked how habitat concerns are factored into replacement design? Steve said that the replacements are conceptual designs and he expects habitat to be incorporated into final culvert design.

Appendix 2
Culvert Assessment Forms



SOUTH PORTLAND

CASCO BAY

SCARBOROUGH



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75 John Roberts Rd. - Suite 1A
South Portland, ME 04106
Tel: 207-260-2380

TITLE FOR: SITE LOCATION MAP
TOWN OF CAPE ELIZABETH CULVERT ASSESSMENT

SCALE: 1" = 3,500'

DATE: 10/16/2018

LOCATION: Cape Elizabeth, ME 04107

INFORMATION: ESRI Basemap
Maine Office of GIS Town Boundaries 2017



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
www.sebagotechnics.com

Culvert Inspection Form

City/Town: Cape Elizabeth

Project ID: 17125

Date:	June 6, 2018	Culvert No:	1
Name and Location of Road Crossing:	Shore Road – Collector 1.26 miles northeast of the Shore Road/Route 77 Intersection		
Stream Name:	Pond Cove Brook	Tributary To:	Pond Cove, Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	There is a pedestrian bridge and vegetation growing near the multiple culverts' inlets that makes maintenance work on the inlet side of the culvert difficult. The proximity of the ocean periodically pushes rocks and debris into the culverts which have to be manually removed. Two original culverts were installed in 1992 by the MDOT originally and then a third culvert was added by the Town later to address flooding concerns which have since dissipated. The third culvert was replaced and upgraded in 2015.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	3 – 36"	Approximate Length:	60 Feet
Does roadway have a history of flooding?	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No There has been past flooding activity here, however, most recent flooding action has been due to severe coastal storms which restrict the culverts' flow and push debris into the culverts and onto the roadway surface.		
Bed material within culvert:	None		
Tidal Influence?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Approximate Elevation at Road Centerline:	12 Feet		

Additional Observations:	There also has been some discussion about removing the embankment upstream of the culverts to open tidal action through the culvert and allow the upstream area to return to its historical saltwater environment.		
Is the culvert hanging?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is there evidence of high water above the top of the culvert?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:			
Culvert Structure:			
Culvert lining?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Condition inside culvert:		<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems	
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is water seeping along the outside of the culvert (piping)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:	At the time of the inspection, rocks were lodged in the culverts along with debris restricting the flow capacity. Since the inspection, the rocks have been removed in the fall of 2018, however, rocks frequently are lodged within the culverts due to the ocean's wave actions. A possible improvement would be to install a bar screen on the culvert inlet to restrict debris from entering the pipe. These screens would need to be removable to allow maintenance access inside of the pipes. Consideration would also need to be given as to the potential for damage to occur with rocks and other debris being slammed against the bar grates.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		

Inlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
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EC condition at inlet? <input type="checkbox"/> good <input checked="" type="checkbox"/> fair <input type="checkbox"/> poor	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a
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Vegetation removal needed?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
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Culvert Outlet

Outlet Type:	<input checked="" type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall
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Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at outlet? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
---	---	---

EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor Outfall areas is a rocky coastline	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a
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Vegetation removal needed?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Habitat & Fish Passage

Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>The development of Shore Road with culverts in Pond Cove Brook and a small earthen dam upstream of the culverts has altered the natural habitat. These modifications result in restricted tidal exchange into the upstream wetlands and impounded freshwater. These hydrological alterations have resulted in conversion of tidal wetlands to freshwater wetland communities. The National Wetlands Inventory classifies the wetlands immediately upstream of the road crossing as intertidal, but modified by a human-made structure that obstructs the inflow and outflow of water.</p> <p>https://www.fws.gov/wetlands/data/mapper.html</p> <p>This culvert is identified in the Maine Stream Habitat Viewer as #8225. The culvert is identified in the viewer as a barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Tidal Marsh, Habitat Connector, and Tidal Waterfowl and Wading Bird Habitat.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p>
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	<p>The culvert is subject to inundation under a 1 ft or greater Sea Level Rise scenario delineated by Maine Geological Survey.</p> <p>https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml</p> <p>The upstream wetlands and low-lying adjacent uplands could support salt marsh migration in response to sea level rise, according to a 2013 study by the Casco Bay Estuary Partnership.</p> <p>https://www.cascobayestuary.org/wp-content/uploads/2014/06/2013_cbep_slr_report_cape_elizabeth.pdf.pdf</p> <p>This site is subject to tidal flooding and is vulnerable to sea level rise. Due to the tidal influence at the site, it is recommended that future culvert design incorporate appropriate study of tidal flow under potential sea level rise conditions. The culvert is located within a state mapped habitat connector area.</p> <p>http://beginningwithhabitat.org/the_maps/map3-undev_habitat.html</p>
<p>Additional Notes:</p>	<p>In 2010, the Casco Bay Estuary Partnership documented this location as a habitat barrier with a classification of "severe". There has been past discussion of receiving a grant to study the hydrology of this tidally influenced area to determine if the culverts' upgradient area should be returned to its historical saltwater environment past.</p>

Sept 14/19

February 11, 2019

Signature

Date



Photo 1 (06-06-18): Facing southeast at the Shore Road culvert crossing with Pond Cove in the background.



Photo 2 (06-06-18): Facing south at the Shore Road Path footbridge directly adjacent to the inlets of the three cross culverts.



Photo 3 (06-06-18): Facing South. The presence of the footbridge directly over the culvert inlets and stone rip rap make inlet maintenance a challenge



Photo 4 (06-06-18): Facing west. Thick vegetation and berm controlling ponded water up gradient of the culvert inlets.



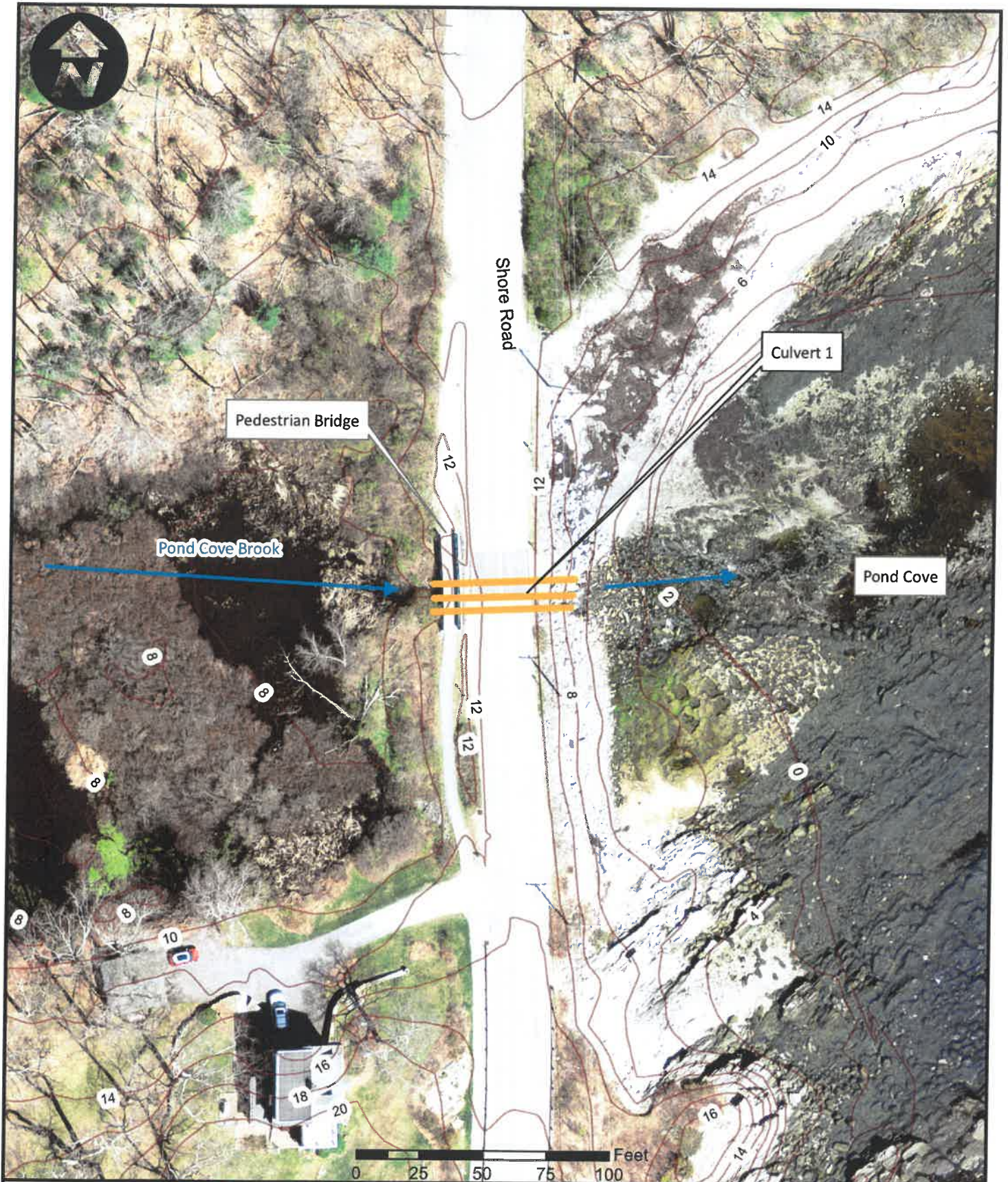
Photo 5 (06-06-18): Facing south along the rip rap armor of the oceanside outlet (west) side of Shore Road with Aluminum corrugated pipe outlet visible within the rock slope in the center of the photo.



Photo 6 (06-06-18): Looking east at hanging outlet of the three, 36-inch aluminum corrugated pipe outlets on the west side of Shore Road. Seaweed and other debris frequently compromise the culverts' capacity as exemplified by only the center culvert flowing freely despite all three culverts being installed at roughly the same elevations.



Photo 7 (06-06-18): Looking west at large rock and other ocean debris inside of northerly culvert. Being exposed directly to Casco Bay, ocean surges often push debris inside of these pipes creating an ongoing maintenance issue for the Town.



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Culvert Assessment - Culvert 1
Three, 36-inch Aluminum Culverts

SCALE: 1" = 50'

DATE: 10/15/18

LOCATION:

Shore Road @ Pond Cove
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
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Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 6, 2018	Culvert No:	2
Name and Location of Road Crossing:	Shore Road 0.4 miles south of the Fort Williams Park main entrance		
Stream Name:	Dyer Pond outflow	Tributary To:	Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	Culvert was replaced in 2010 and is in good physical condition. The inflow to the culvert is influenced by two upstream impoundments controlled via stainless steel weirs supported by concrete dams and the flow from a wetland area that drains through a culvert under the nearby Dyer Pond Road. The down gradient properties of the Delano Park neighborhood are sensitive to additional flow and flooding.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	36"	Approximate Length:	50 Feet
Does roadway have a history of flooding?	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No There has been past flooding activity during the extreme rainfall event of October 1996, however, the installation of the retaining wall has provided more flooding protection for the roadway.		
Bed material within culvert:	None		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	46 Feet		
Additional Observations:			
Is the culvert hanging?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		

Additional Observations:			
Culvert Structure:			
Culvert lining?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Condition inside culvert:		<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems	
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
		Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is water seeping along the outside of the culvert (piping)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:	Culvert inlet headwall is part of a large concrete block Stonestrong retaining wall system installed in 2012 as part of the Shore Road Path project. Retaining wall is in good condition.		
Culvert Inlet			
Inlet Type:	<input checked="" type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input checked="" type="checkbox"/> Concrete Headwall (Large Concrete Block - Stonestrong Retaining Wall) <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	

Vegetation removal needed?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Culvert Outlet		
Outlet Type:	<input checked="" type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall	
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at outlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor Outfall areas is a rocky coastline	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Habitat & Fish Passage		
Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This crossing was assessed for fish passage in 2008 by the Casco Bay Estuary Partnership, and assigned ID #9132. In a 2010 report based on the 2008 assessment data, the US Fish and Wildlife Service and Casco Bay Estuary Partnership classified the crossing as a potential barrier to fish passage. The 2008 data and photos are available from Casco Bay Estuary Partnership but are presumed to no longer be relevant because after the new culvert was installed in 2010, the crossing was not re-assessed for fish passage. The crossing is not identified in the Maine Stream Habitat Viewer.</p> <p>While no specific habitat values are identified for the location of the culvert in the state habitat data layers, in general any future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p>	

Additional Notes:	Upstream impoundments and downstream developed areas, however, limit the potential gain for habitat or fish passage enhancement.
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Sty Hg

February 11, 2019

Signature

Date



Photo 1 (06-06-18): Facing northeast at Shore Road crossing of the Dyer Pond outflow. Culvert crossing coincides with the pavement crack across the surface of Shore Road.



Photo 2 (06-06-18): Inlet of 36-inch corrugated aluminum cross pipe with a cast-in-place concrete collar and base set within a large concrete block "Stonestrong" retaining wall. Inlet is on the west side of Shore Road.



Photos 3 (06-06-18): Inlet of submerged culvert on west side of Shore Road.



Photos 4 (10=22-18): Looking west at an overhead view of the inlet of culvert on Shore Road.



Photo 5 (10-22-18): Looking west the heavily vegetated up gradient flow to the inlet of culvert on Shore Road.



Photo 6 (06-06-18): Impoundment area with concrete and steel wall with a v-notch weir remotely located upstream of the Shore Road culvert. Two impoundments flow in series and then combine with the outflow from the nearby Dyer Pond Road culvert to discharge into the Shore Road culvert.



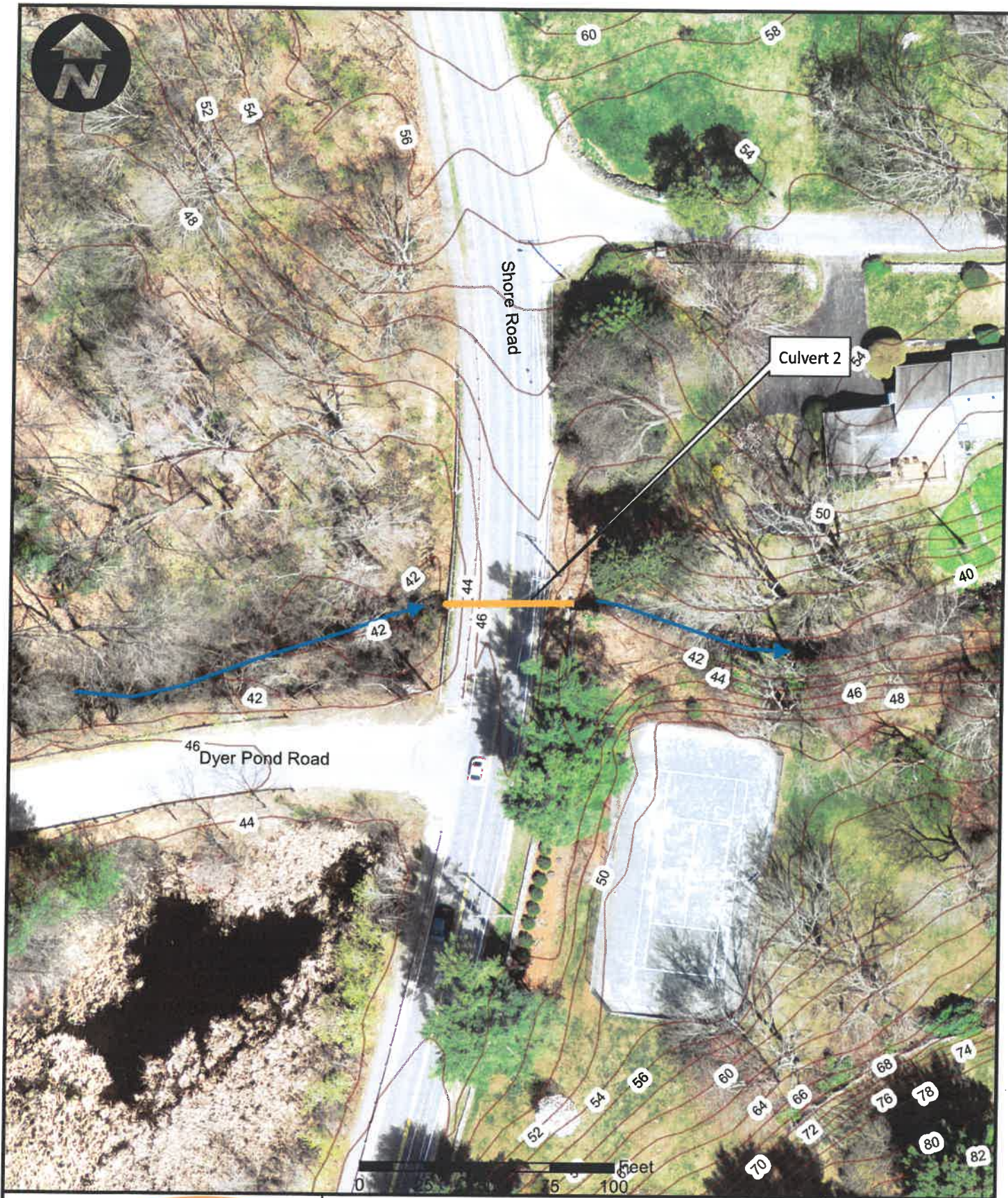
Photo 7 (06-06-18): Submerged outlet of culvert on the east side of Shore Road. Loose stones on headwall of outlet with smaller diameter green polyvinylchloride (pvc) pipe discharging well above the outlet invert elevation of the cross culvert.



Photo 8 (06-06-18): Overhead view of culvert outlet with rip rap plunge pool apron area. Stone lined plunge pool dissipates energy of the outfall and reduces the velocity of the outflow to the receiving channel.



Photo 9 (10-22-18): Downstream view of channel from the culvert outlet rip rap plunge pool apron area on the east side of Shore Road. This flow travels to Casco Bay through the Delano Park neighborhood which is susceptible to high flow conditions.



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Culvert Assessment - Culvert 2
36-inch Corrugated Aluminum Culvert

SCALE: 1" = 50'

DATE: 10/15/18

LOCATION:

Shore Road @ Dyer Pond Road
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



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Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 6, 2018	Culvert No:	3
Name and Location of Road Crossing:	Ocean House Road (Route 77) – Arterial 0.18 miles north of the Spurwink Road @ Route 77 Intersection		
Stream Name:	Trout Brook - Urban Impaired Stream	Tributary To:	Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	Culvert was replaced in 1983 by MDOT and is in good physical condition.		

Description of Existing Culvert

Shape:	<input type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input checked="" type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input checked="" type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other Steel structural plate		
Size:	8-foot, 2-inch wide by 5-foot, 9-inch height	Approximate Length:	100 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No Culvert appears to have adequate capacity		
Bed material within culvert:	Yes, sediment and stone		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	62 Feet		
Additional Observations:	Culvert bottom is submerged and does not restrict stream flow		
Is the culvert hanging?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Additional Observations:	A concrete wingwall has been installed on the inlet south side of the pipe arch. Large stones provide the remainder of the headwall on the inlet side with mature trees lining the northern streambank near the inlet.		

Outlet has a flared culvert section and minimal rip rap providing a headwall.			
Culvert Structure:			
Culvert lining?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Condition inside culvert:		<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems	
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Cracks vertical/ horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is water seeping along the outside of the culvert (piping)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:		There is some undermining behind the wingwall on the inlet side of the culvert. The Interior of the pipe is corroded, but appears to be visually stable and in relatively good condition.	
Culvert Inlet			
Inlet Type:		<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input checked="" type="checkbox"/> Concrete Wingwall	
Inlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input checked="" type="checkbox"/> fair <input type="checkbox"/> poor <input type="checkbox"/> n/a	
Vegetation removal needed?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Culvert Outlet

Culvert Outlet		
Outlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall	
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at outlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor Outfall areas is a rocky coastline	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Habitat & Fish Passage		
Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is identified in the Maine Stream Habitat Viewer as #8296. The culvert is identified in the viewer as a potential barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Eastern Brook Trout Habitat. https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>This culvert appears to be undersized resulting in increased stream velocities that may inhibit movement by aquatic organisms. Future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design. https://www.maineaudubon.org/projects/stream-smart/</p>	
Additional Notes:	In 2010, the U.S. Fish and Wildlife Service - Gulf of Maine Coastal Program, in partnership with Casco Bay Estuary Partnership, documented this location as a barrier to fish passage with a classification of "potential" based on findings from the 2008 culvert survey. This finding utilized the same data as the Maine Stream Habitat Viewer cited above, but a different methodology for analyzing and classifying barriers. The Maine Stream Habitat Viewer classification is more recent, and the classification of "potential barrier" is current.	

Sgt Hg

February 11, 2019

Signature

Date



Photo 1 (06-06-18): Facing northeast at Ocean House Road (Route 77) crossing of the Trout Brook culvert.



Photo 2 (06-06-18): Looking at the submerged Inlet of 8 foot, 2-inch-wide by 5 foot, 9-inch-high steel plate pipe arch cross pipe with concrete wingwall on the south side of Trout Brook. Inlet is on east side of Route 77.



Photos 3 & 4 (06-06-18): Trout Brook, an Urban Impaired Stream, flowing to the culvert inlet on east side of Route 77. Photo 3 is taken adjacent to the inlet and shows eroded areas at the base of the mature trees lining the northern bank. Photo 4 depicts a more uniform and stable channel further upstream from the culvert inlet.



Photo 5 (06-06-18): Facing west at the east end of the concrete wingwall on the south side of the culvert inlet. Small diameter white pvc pipe is conveying groundwater flow directly into Trout Brook despite being a relatively dry weather period. Trout Brook receives surface flow and groundwater flow from residential neighborhoods and other developed areas in close proximity to the stream.



Photo 6 (06-06-18): Looking at the submerged outlet of 8 foot, 2-inch-wide by 5 foot, 9-inch-high steel plate pipe arch cross pipe. Rip rap stones are sparse, but provide a headwall.



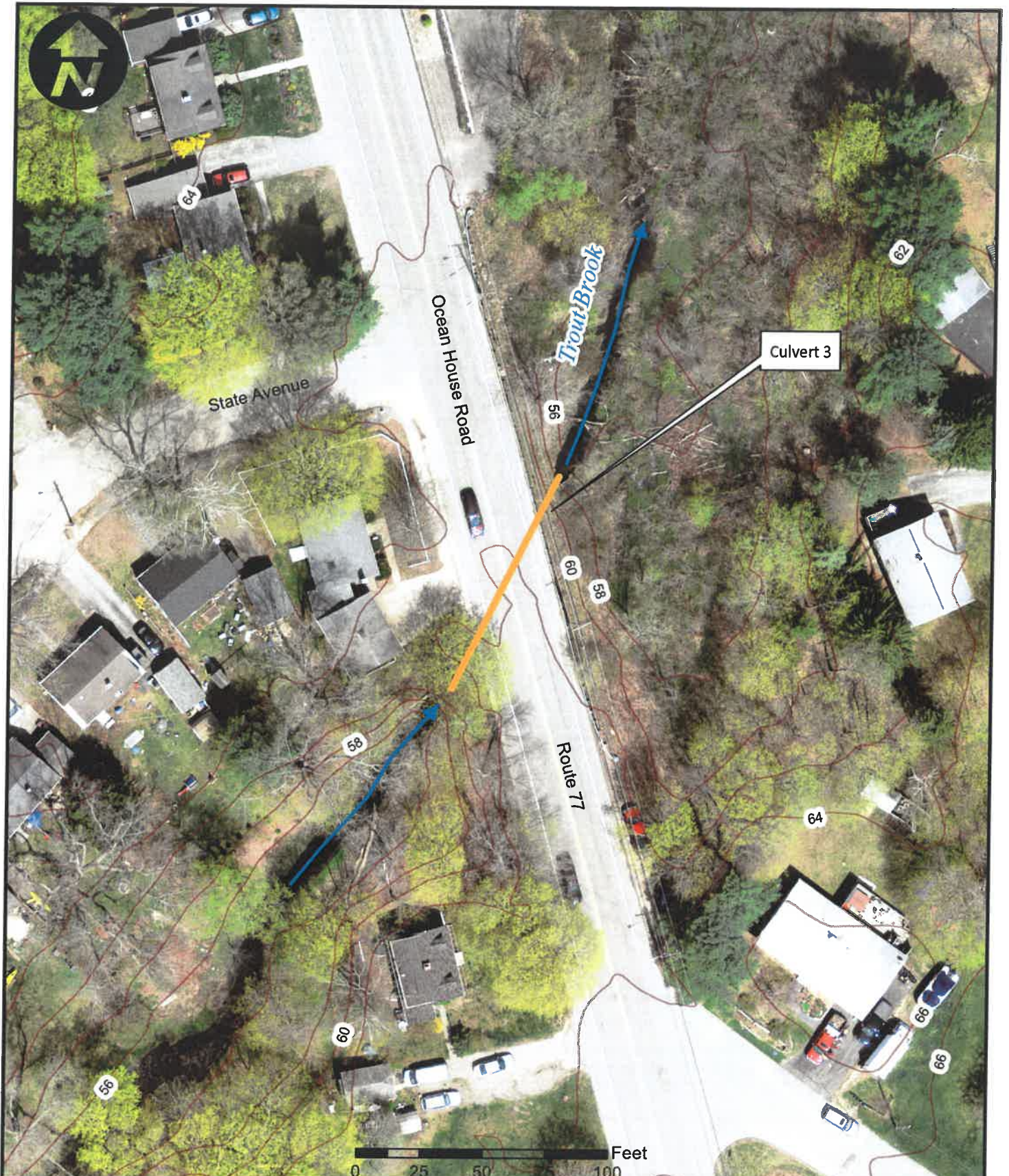
Photo 7 (06-06-18): Interior view of culvert from the outlet end on the west side of Route 77 toward the east side of Route 77 inlet. Corrosion evident along sidelines and invert of the pipe, however, the pipe alignment and integrity appear to visually be in good condition.



Photo 8 (06-06-18): Overhead view of culvert outlet with stones and vegetation in the outlet channel.



Photo 9 (06-06-18): Looking further downstream at the outlet of the steel plate pipe arch cross pipe. Vegetation and sediment deposits are present within this channel.



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Culvert Assessment - Culvert 3

8-Foot 2-inch Wide by 5-Foot 9-inch Tall Corrugated Metal Pipe Arch

SCALE: 1" = 50'

DATE: 10/15/18

LOCATION:
Ocean House Road @ Trout Brook
Cape Elizabeth, ME 04107

INFORMATION:
Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



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Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 6, 2018	Culvert No:	4
Name and Location of Road Crossing:	Spurwink Avenue – Rural Connector 0.16 miles northeast of Spurwink Road @ Route 77 Intersection		
Stream Name:	Pollack Brook	Tributary To:	Spurwink Marsh, Spurwink River & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	A corrugated metal pipe culvert in poor condition was replaced by a new culvert in 2005 and the existing culvert is in good physical condition. The inflow to the culvert is influenced by an impoundment controlled by concrete and wooden weir. The down gradient flow passes through a freshwater wetland before entering the saltwater Spurwink Marsh area.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input checked="" type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	36-inch	Approximate Length:	55 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No Culvert appears to have adequate capacity		
Bed material within culvert:	Yes, sediment and stone		
Tidal Influence?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (At outlet end of pipe)		
Approximate Elevation at Road Centerline:	16 Feet		
Additional Observations:	There is a 36-inch wide opening at the dam weir flowing to the culvert inlet. The inlet pipe is a 36-inch Corrugated metal pipe that transitions under Spurwink Avenue into the 36-inch HDPE pipe outfall culvert		
Is the culvert hanging?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		

Additional Observations:	Dam restricts flow to the culvert and creates an impoundment upgradient of the culvert.		
Culvert Structure:			
Culvert lining?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/ horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Is the culvert shape deflected?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (slight)
Is water seeping along the outside of the culvert (piping)?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Should the culvert be video inspected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional Observations:	Inlet headwall is grouted stone with a concrete lined inlet channel to the culvert inlet. No rip rap apron or headwall on the outlet end.		
Culvert Inlet			
Inlet Type:	<input checked="" type="checkbox"/> Riprap Apron - Concrete lined <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input checked="" type="checkbox"/> Yes - Dam <input type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair	

<input type="checkbox"/> poor	<input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a
Vegetation removal needed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Culvert Outlet	
Outlet Type:	<input type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> n/a
Constrictions/obstructions at outlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at outlet? <input type="checkbox"/> good <input checked="" type="checkbox"/> fair <input type="checkbox"/> poor Outlet does not contain a plunge pool	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a
Vegetation removal needed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Habitat & Fish Passage	
Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No This culvert is identified in the Maine Stream Habitat Viewer as #11369. The culvert is identified in the viewer as a barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Tidal Marsh, Habitat Connector, Tidal Waterfowl and Wading Bird Habitat, and the Scarborough Marsh Ecological Focus Area. https://webapps2.cgis-solutions.com/MaineStreamViewer/ The culvert is subject to increased inundation under a 1 ft or greater Sea Level Rise scenario delineated by Maine Geological Survey. https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml The culvert is within an area of potential marsh migration under a 1 ft or greater sea level rise scenario delineated by the Maine Natural Areas Program. https://www.maine.gov/dacf/mnap/assistance/marsh_migration.htm This site is not currently subject to tidal flooding but it is vulnerable to sea level rise. While the culvert may become tidally influenced, an upstream dam would likely block upstream salt water intrusion and therefore marsh migration, except

	under more extreme estimates for sea level rise. Due to likelihood of future tidal influence at this culvert, it is recommended that future culvert design incorporate appropriate study of tidal flow under potential sea level rise conditions as well as the potential impacts of increased tidal flooding to the upstream dam.
Additional Notes:	The Casco Bay Estuary Partnership did not assess this location because it is outside of the Casco Bay watershed.

Stacy Hg

February 11, 2019

Signature

Date



Photo 1 (06-06-18): Facing north at the surface of Spurwink Avenue at the crossing of the pond outlet pipe/culvert that discharges into Pollack Brook.



Photo 2 (06-06-18): Manmade pond impoundment on the south side of Spurwink Avenue.



Photo 3 (06-06-18): Concrete wall with wooden board weir outlet to pond impoundment on the south side of Spurwink Avenue.



Photo 4 (06-06-18): Closeup view of adjustable elevation wooden board weir outlet to pond impoundment on the south side of Spurwink Avenue.



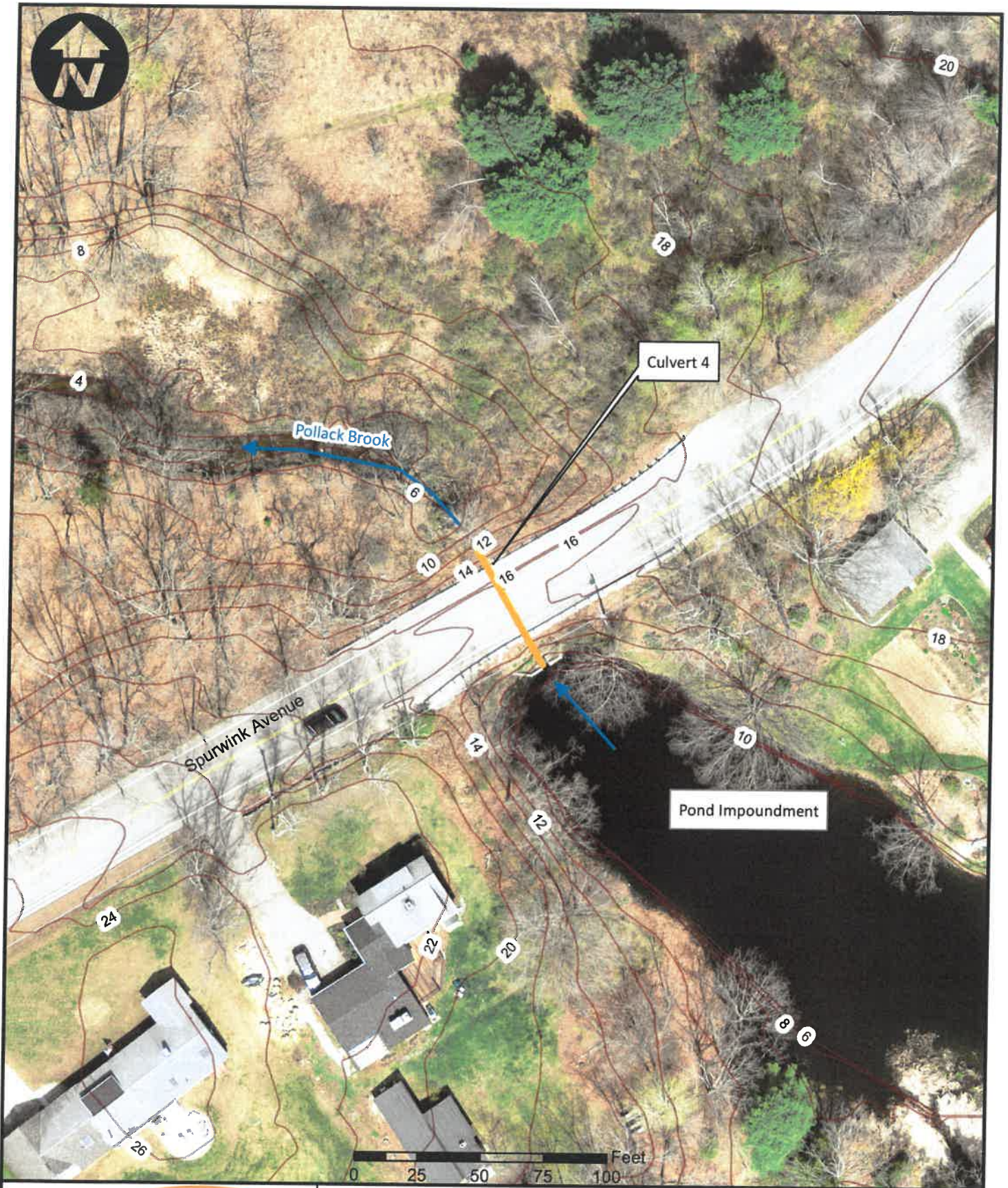
Photos 5 (06-06-18): 36-inch Corrugated Metal Pipe (CMP) Culvert inlet on south side of Spurwink Avenue. Pipe transitions into a 36-High Density Polypropylene (HDPE) under roadway. Grouted stone provides a headwall for the culvert inlet.



Photo 6 (06-06-18): Looking at the outlet of the 36-inch HDPE culvert on the north side of Spurwink Avenue. No formal headwall or apron at the outlet.



Photo 7 (06-06-18): Looking north down the Spurwink Avenue embankment at the outlet of the 36-inch HDPE culvert on the north side of Spurwink Avenue. Signs indicate the presence of the National Wildlife Preserve with the pink flagging tied to a survey pin.



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Culvert Assessment - Culvert 4
36-inch High Density Polyethylene Pipe

SCALE: 1" = 50'

DATE: 10/15/18

LOCATION:

Spurwink Avenue @ Pollack Brook
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



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Culvert Inspection Form

City/Town: Cape Elizabeth
Project ID: 17125

Date:	June 6, 2018	Culvert No:	5
Name and Location of Road Crossing:	Spurwink Avenue – Rural Connector 0.25 miles south of Scott Dyer Road @ Spurwink Road Intersection		
Stream Name:	Spurwink River	Tributary To:	Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	A new culvert was installed in 1987 by MDOT and the existing culvert is in good physical condition. The culvert experiences flooding only at high tides during an extreme weather event, however, this culvert was identified as being vulnerable in the 2015 Vulnerability Assessment for Sea Level Rise as prepared by the Portland Council of Governments.		
Description of Existing Culvert			
Shape:	<input type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input checked="" type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	6-foot wide by 5-foot high	Approximate Length:	75 Feet
Does roadway have a history of flooding?	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No Roadway floods in an extreme rainstorm event coinciding with a high tide		
Bed material within culvert:	None		
Tidal Influence?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Approximate Elevation at Road Centerline:	8 Feet		
Additional Observations:			
Is the culvert hanging?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		

Culvert Structure:

Culvert lining?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Condition inside culvert:		<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems	
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/ horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Is the culvert shape deflected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is water seeping along the outside of the culvert (piping)?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Should the culvert be video inspected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional Observations:	Some pulling apart of the last culvert section of pipe and the outlet collar. Additional rip rap would be beneficial at both the culvert inlet and outlet headwalls as well as along the embankment. Since the inspection, the inlet flared end of the culvert became dislodged in December 2018 and was temporarily removed by the Public Works Department. It is anticipated that the flared end will be reattached in the Spring of 2019 when field conditions are more suitable for the work.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input checked="" type="checkbox"/> Yes – Minor Pipe Separation <input type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input checked="" type="checkbox"/> Yes - some stones in channel <input type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a		
Vegetation removal needed?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Culvert Outlet

- Outlet Type:**
- Riprap Apron
 - Riprap Apron/Embankment
 - Concrete Headwall
 - Concrete Wingwall

- | | | |
|--|---|--|
| Outlet damaged?
<input type="checkbox"/> Yes
<input checked="" type="checkbox"/> No | Headwall undermining?
<input checked="" type="checkbox"/> Yes – Outlet sleeve pulling away
<input type="checkbox"/> No | Constrictions/obstructions at outlet?
<input type="checkbox"/> Yes
<input checked="" type="checkbox"/> No |
|--|---|--|

- | | |
|--|--|
| EC condition at outlet?
<input type="checkbox"/> good
<input checked="" type="checkbox"/> fair
<input type="checkbox"/> poor
Outlet should have rip rap | EC condition behind wingwall?
<input type="checkbox"/> good
<input type="checkbox"/> fair
<input type="checkbox"/> poor
<input checked="" type="checkbox"/> n/a |
|--|--|

- Vegetation removal needed?** Yes No

Habitat & Fish Passage

- Is Habitat and/or Fish a consideration:** Yes (if yes, please describe circumstances) No

This culvert is identified in the Maine Stream Habitat Viewer as #11285. The culvert is identified in the viewer as a barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Tidal Marsh, Habitat Connector, Tidal Waterfowl and Wading Bird Habitat, and the Scarborough Marsh Ecological Focus Area.

<https://webapps2.cgis-solutions.com/MaineStreamViewer/>

The culvert is subject to increased inundation under a 1 ft or greater Sea Level Rise scenario delineated by Maine Geological Survey.

https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml

The culvert is within an area of potential marsh migration under a 1 ft or greater sea level rise scenario delineated by the Maine Natural Areas Program.

https://www.maine.gov/dacf/mnap/assistance/marsh_migration.htm

This site is subject to tidal flooding and is vulnerable to sea level rise. The culvert has been documented by the Wells National Estuarine Research Reserve as a tidal restriction, which reduces tidal flooding upstream. The potential for upstream marsh migration under projected sea level rise scenarios could be impeded by the existing culvert. Due to the tidal influence at the site, it is recommended that future culvert design incorporate appropriate study of tidal flow under potential sea level rise conditions.

Additional Notes:	This site was not included in the 2010 US Fish and Wildlife Service/Casco Bay Estuary Partnership report on fish barriers because it lies outside of the Casco Bay watershed.
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Sept 14/13

February 11, 2019

Signature

Date



Photo 1 (06-06-18): Facing southwest at Spurwink Avenue crossing of the Spurwink River. Culvert is under tidal influence and the Spurwink Marsh is in the background.



Photo 2 (06-06-18): Submerged inlet of 6-foot wide by 5-foot high corrugated aluminum elliptical pipe with flared end and rip rap headwall. Additional headwall rip rap should be added to the headwall.



Photos 3 (06-06-18): Looking through the culvert from the inlet side, interior of the elliptical pipe appears visually to be in good condition, however, the flared end section appears to be pulling away from the last section of pipe.



Photo 4 (06-06-18): Inlet to culvert with channel of the Spurwink River upstream of the culvert. North bank of the channel is eroded due to the sharp bend in channel just upstream of the culvert location and may need to be bolstered with rip rap armor at some point in the future.



Photo 5 (06-06-18): Submerged outlet of the aluminum elliptical pipe with flared end and rip rap headwall. Additional rip rap would be desirable to bolster the area around the culvert.

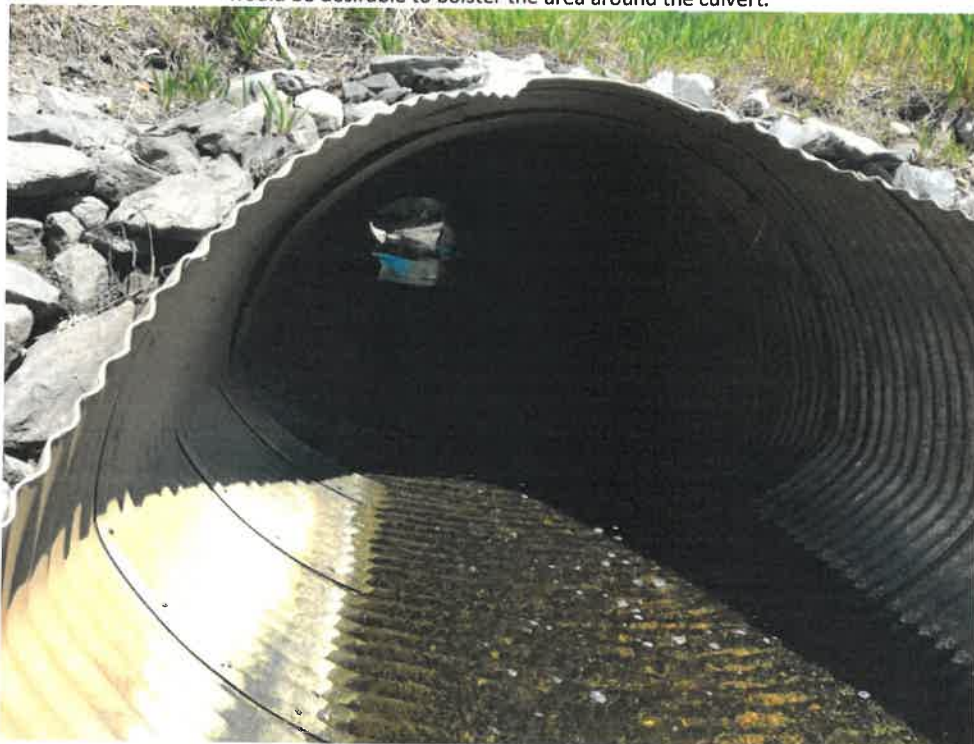


Photo 6 (06-06-18): Looking through the culvert from the outlet side, interior of the elliptical pipe appears visually to be in good condition, however, the flared end section appears to be pulling away from the last section of pipe.



Photo 7 (06-06-18): Overhead view of culvert outlet with stones in and beyond the flared apron area. Headwall stones around the culvert appear to be depleted of rip rap layers and should be replenished.



Photo 8 (06-06-18): Spurwink River channel downstream of culvert outlet flows through the Spurwink Marsh to the Atlantic Ocean.



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Culvert Assessment - Culvert 5
6-Foot Wide by 5-Foot Tall Elliptical Corrugated Aluminum Pipe

LOCATION:
Spurwink Avenue @ Spurwink River
Cape Elizabeth, ME 04107

SCALE: 1" = 50'
DATE: 10/15/18

INFORMATION:
Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
www.sebagotechnics.com

Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 6, 2018	Culvert No:	6
Name and Location of Road Crossing:	Spurwink Avenue – Rural Connector (located to the northeast of Route 77) 0.33 miles North of Wells Road @ Spurwink Road Intersection		
Stream Name:	Jordan Farm Pond Outlet	Tributary To:	Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	A new culvert was installed in 1992 by MDOT and visually appears to be in good physical condition.		

Description of Existing Culvert

Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	24-inch (galvanized)	Approximate Length:	45 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No		
Bed material within culvert:	None		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	50 Feet		
Additional Observations:	Very thick vegetation on both the inlet and outlet of the culvert made locating the culvert difficult. Vegetation should be removed from culvert ends and the immediate channel and additional rip rap added to stabilize end areas of the culvert.		
Is the culvert hanging?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		

Additional Observations:			
Culvert Structure:			
Culvert lining?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/ horizontal on sides/walls? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input checked="" type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input checked="" type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Is the culvert shape deflected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is water seeping along the outside of the culvert (piping)?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Should the culvert be video inspected?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Additional Observations:	It would be beneficial to video the interior of the pipe to confirm its condition.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input type="checkbox"/> <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input checked="" type="checkbox"/> Yes – by thick vegetation <input type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair		EC condition behind wingwall? <input type="checkbox"/> good <input checked="" type="checkbox"/> fair	

<input type="checkbox"/> poor		<input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Culvert Outlet			
Outlet Type:		<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall	
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at outlet? <input checked="" type="checkbox"/> Yes – by thick vegetation <input type="checkbox"/> No
EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Habitat & Fish Passage			
Is Habitat and/or Fish a consideration: <input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No		<p>This culvert is identified in the Maine Stream Habitat Viewer as #11333. The culvert is identified in the viewer as a barrier to aquatic organism passage. While no specific habitat values are identified for this culvert in the state habitat data layers, in general any future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p>	
Additional Notes:		In 2010, the Casco Bay Estuary Partnership did not document this location as a habitat barrier.	

Step 14g

Signature

Date



Photo 1 (06-06-18): Facing north at pavement surface of the Spurwink Avenue culvert crossing for the Jordan Pond outflow. Culvert crossing coincides with the pavement crack across the surface of Spurwink Avenue in the center of photo.



Photo 2 (06-06-18): Inlet of 24-inch corrugated aluminum cross pipe with a rip rap creating a headwall and apron. Inlet is on the west side of Spurwink Avenue and very thick vegetation made locating the culvert difficult.



Photos 3 (06-06-18): Hanging culvert outlet on east side of Shore Road of the 24-inch corrugated aluminum pipe.



Photo 4 (06-06-18): Culvert outlet on east side of Shore Road with very thick vegetation around the culvert and in the downstream channel.



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75 John Roberts Rd. - Suite 4A
South Portland, ME 04106
Tel. 207-260-2100

Culvert Assessment - Culvert 6
24-inch Aluminum Corrugated Pipe

SCALE: 1" = 50'

DATE: 10/15/18

LOCATION:
Spurwink Ave @ Jordan Farm Pond Outlet
Cape Elizabeth, ME 04107

INFORMATION:
Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



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South Portland, ME 04106-6963
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Culvert Inspection Form

City/Town: Cape Elizabeth
Project ID: 17125

Date:	June 6, 2018	Culvert No:	7
Name and Location of Road Crossing:	Spurwink Avenue – Rural Connector 0.3 miles south of the Spurwink Road @ Route 77 Intersection		
Stream Name:	Unnamed Tributary to Trout Brook	Tributary To:	Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	A new culvert was installed in 2013 and is in excellent condition. Culvert is within the Trout Brook Watershed which is an Urban Impaired Stream.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input checked="" type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	30-inch	Approximate Length:	60 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No		
Bed material within culvert:	No		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	75 Feet		
Additional Observations:			
Is the culvert hanging?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is there evidence of high water above the top of the culvert?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional Observations:	Inlet and outlet areas are stable with stone headwalls. Downstream channel turns abruptly (90-degrees) to the north just beyond the culvert outlet which tends to scour the opposite bank. Channel should be monitored to determine whether it		

	would be beneficial to rip rap armor the outside bank and/or introduce a rip rap lined plunge pool to dissipate the energy and erosive velocities at the culvert outfall.		
Culvert Structure:			
Culvert lining?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/ horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Is the culvert shape deflected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is water seeping along the outside of the culvert (piping)?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Should the culvert be video inspected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional Observations:	Culvert appears to be in very good condition. Access to the inlet and outlet areas of the culvert is good and does not need to be cleared of vegetation at this time.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input type="checkbox"/> <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	

Vegetation removal needed?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Culvert Outlet

Outlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall
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Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at outlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a
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Vegetation removal needed?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Habitat & Fish Passage

Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is identified in the Maine Stream Habitat Viewer as #8457. The culvert is identified in the viewer as a potential barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Eastern Brook Trout Habitat.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>This culvert appears to be undersized resulting in increased stream velocities that may inhibit movement by aquatic organisms. Future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p> <p>Trout Brook supports wild Eastern Brook trout, despite increasing development within the watershed. Habitat connectivity is critical for maintaining trout populations. While the stream at this culvert is relatively small, it is important to recognize the value of this habitat for Eastern Brook Trout. Small and ephemeral streams are important for brook trout reproductivity. Future culvert design should allow for passage by weaker swimming fish and include a natural channel bottom within the culvert.</p>
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Additional Notes:	In 2010, the U.S. Fish and Wildlife Service - Gulf of Maine Coastal Program, with funding from the Casco Bay Estuary Partnership, documented this location as a barrier to fish passage with a classification of "potential" based on findings from the 2008 culvert survey. This finding utilized the same data as the Maine Stream Habitat Viewer cited above, but a different methodology for analyzing and classifying barriers. The Maine Stream Habitat Viewer classification is more recent, and the classification of "potential barrier" is current.
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Stacy Hg

February 11, 2019

Signature

Date



Photo 1 (06-06-18): Facing south at pavement surface of the Spurwink Avenue culvert crossing for an unnamed tributary to Trout Brook. Culvert crossing coincides with the pavement crack across the surface of Spurwink Avenue in the center of photo.



Photo 2 (06-06-18): Nearby sign indicating that the culvert is within the Trout Brook Watershed which is which is an Urban Impaired Stream.



Photo 3 (06-06-18): Inlet of 30-inch High Density Polyethylene (HDPE) cross pipe with a rip rap creating a headwall and apron. Inlet is on the east side of Spurwink Avenue. Access to the culvert and the area around the inlet is relatively clear of vegetation.



Photo 4 (06-06-18): Facing east at the inlet of 30-inch HDPE cross pipe and the vegetated channel upstream of the culvert crossing.




Photo 5 (06-06-18): Culvert outlet on west side of Spurwink Avenue with a rip rap headwall around the culvert.



Photo 6 (06-06-18): Facing west at the stone headwall for the outlet of 30-inch HDPE cross pipe and the channel downstream of the culvert crossing. The downstream channel turns to the north (i.e., the right in this photo) as it approached the vegetation beyond the visible pool of water beyond the outlet of the culvert.



 WWW.SEBAGOTECHNICS.COM 75 John Roberts Rd. - Suite 4A South Portland, ME 04106 Tel. 207-260-2100	Culvert Assessment - Culvert 7 30-inch HDPE Culvert		SCALE: 1" = 50' DATE: 10/16/18
	LOCATION: Spurwink Ave SW of Purpoodock Dr Cape Elizabeth, ME 04107	INFORMATION: Maine Office of GIS 2017 Orthoimagery Maine Office of GIS 2006 Lidar derived contours	



75 John Roberts Road
Suite 4A
South Portland, ME 04106-6963
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Culvert Inspection Form

City/Town: Cape Elizabeth
Project ID: 17125

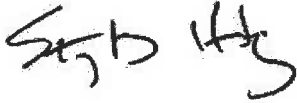
Date:	June 6, 2018	Culvert No:	8
Name and Location of Road Crossing:	Spurwink Avenue – Rural Connector 1 mile south of the Spurwink Road @ Sawyer Road Intersection		
Stream Name:	Trout Brook – Urban Impaired Stream	Tributary To:	Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E. sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	A new culvert was installed in 2008. Corrosion is visible along invert of the pipe, however, the culvert appears to be in good condition. The water flow curls into the culvert from the side so additional rip rap armor needs to be added on the south side of the upstream bank along the turn.		
Description of Existing Culvert			
Shape:	<input type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input checked="" type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	60-inches wide by 44-inches tall	Approximate Length:	50 Feet
Does roadway have a history of flooding?	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No Only in extreme weather events		
Bed material within culvert:	No		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	50 Feet		
Additional Observations:			
Is the culvert hanging?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Additional Observations:			

Culvert Structure:			
Culvert lining?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/ horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Is the culvert shape deflected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is water seeping along the outside of the culvert (piping)?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Should the culvert be video inspected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional Observations:			
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input type="checkbox"/> <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a		

Vegetation removal needed?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Culvert Outlet			
Outlet Type:		<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall	
Outlet damaged?	Headwall undermining?	Constrictions/obstructions at outlet?	
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at outlet?		EC condition behind wingwall?	
<input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		<input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Habitat & Fish Passage			
Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No		
	<p>This culvert is identified in the Maine Stream Habitat Viewer as #8761. The culvert is identified in the viewer as a potential barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Eastern Brook Trout Habitat.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>This culvert appears to be undersized resulting in increased stream velocities that may inhibit movement by aquatic organisms. Additionally, low water depths within the culvert during low water periods may inhibit passage by larger fish. Future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p> <p>Trout Brook supports wild Eastern Brook trout, despite increasing development within the watershed. Habitat connectivity is critical for maintaining trout populations. Future culvert designs should prioritize fish and aquatic organism passage and utilize USFS Stream Simulation design standards as much as possible.</p> <p>https://www.fs.fed.us/eng/pubs/pdf/StreamSimulation/</p>		

Additional Notes:

In 2010, the US Fish and Wildlife Service, in conjunction with the Casco Bay Estuary Partnership, identified this location as a potential barrier to fish passage. This classification was based on the 2008 assessment data, which is also utilized by the Maine Stream Habitat Viewer described above.

A handwritten signature in black ink, appearing to read "S. H. H.", is written above the signature line.

February 11, 2019

Signature

Date



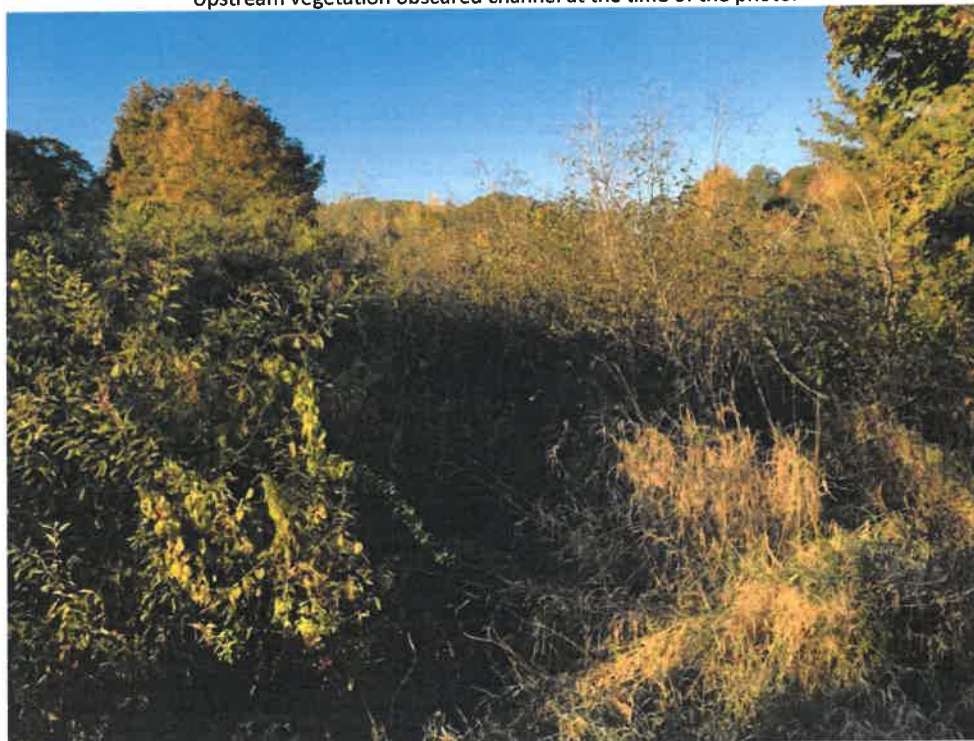
Photo 1 (06-06-18): Facing northeasterly at Spurwink Avenue crossing with Trout Brook which is an Urban Impaired Stream. Culvert crossing coincides with the pavement crack and change in pavement seam (which is also the South Portland municipal boundary) across the surface of Spurwink Avenue. Smaller blue sign indicates that the culvert is in the Trout Brook Watershed.



Photo 2 (06-06-18): Inlet of 60-inches wide by 44-inches tall corrugated aluminum elliptical cross pipe with rip rap apron and headwall. Flow curls into culvert abruptly after flowing southerly along and parallel to Spurwink Avenue.



Photos 3 (06-06-18): Culvert inlet on west side of Spurwink Avenue is submerged within the corrugated aluminum pipe. Upstream vegetation obscured channel at the time of the photo.



Photos 4 (10-22-18): Looking up gradient at the heavily vegetated area flowing to the culvert inlet on west side of Spurwink Avenue. Upstream vegetation obscured channel at the time of the photo.



Photo 5 (06-06-18): Culvert outlet on east side of Spurwink Avenue is submerged within the corrugated aluminum pipe. Downstream vegetation obscured channel at the time of the photo.



Photo 6 (06-06-18): Interior view of culvert taken from outlet to the inlet of culvert. Some corrosion visible along invert of pipe, however, the culvert appears visibly to be in good condition.



Photo 7 (06-06-18): Looking northeast at the flow from the culvert outlet on east side of Spurwink Avenue. Downstream vegetation obscured channel at the time of the photo.



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75 John Roberts Rd. - Suite 4A
South Portland, ME 04106
Tel. 207-200-2100

Culvert Assessment - Culvert 8
60-inch Wide x 44-inch Tall Corrugated Aluminum Elliptical Pipe

SCALE: 1" = 50'

DATE: 10/16/18

LOCATION:

Spurwink Ave @ Trout Brook
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
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Culvert Inspection Form

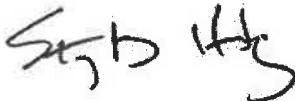
City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 6, 2018	Culvert No:	9
Name and Location of Road Crossing:	Mitchell Road – Collector 0.38 miles northeast of the Mitchell Road @ Route 77 Intersection		
Stream Name:	Pond Cove Brook	Tributary To:	Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	It is not readily known when the culvert was installed, but there is speculation that it was installed in the mid-1970s. The culvert is in fair condition overall, but the invert of the pipe is corroding and deteriorating.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input checked="" type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	48-inches	Approximate Length:	50 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No		
Bed material within culvert:	No		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	86 Feet		
Additional Observations:	This culvert is a strong candidate for replacement which would be a challenging project given the depth of the culvert and utility pipes consisting of water, gravity sanitary sewer, and a sanitary sewer force main crossing either above or below above the culvert. A sanitary sewer pump station is in proximity to the culvert location.		
Is the culvert hanging?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		

Additional Observations:			
Culvert Structure:			
Culvert lining?	<input checked="" type="checkbox"/> Yes – bituminous coated <input type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input checked="" type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/ horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Is the culvert shape deflected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is water seeping along the outside of the culvert (piping)?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Should the culvert be video inspected?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Additional Observations:	This culvert should be video inspected as part of the evaluation of its condition for additional evidence to decide upon its replacement. Stone headwall on outlet end is deteriorating and has many loose/dislodged stones.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input type="checkbox"/> Yes <input type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input checked="" type="checkbox"/> Yes - Large rock at pipe invert <input type="checkbox"/> No	
EC condition at inlet? <input type="checkbox"/> good <input checked="" type="checkbox"/> fair		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair	

<input type="checkbox"/> poor		<input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Culvert Outlet			
Outlet Type:		<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall	
Outlet damaged?		Headwall undermining?	Constrictions/obstructions at outlet?
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		<input checked="" type="checkbox"/> Yes -westerly of outfall <input type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
EC condition at outlet?		EC condition behind wingwall?	
<input type="checkbox"/> good <input checked="" type="checkbox"/> fair <input type="checkbox"/> poor		<input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Habitat & Fish Passage			
Is Habitat and/or Fish a consideration:		<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No	
		<p>This culvert is identified in the Maine Stream Habitat Viewer as #8461. The culvert is identified in the viewer as a potential barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Habitat Connector.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>This culvert appears to be undersized resulting in increased stream velocities that may inhibit movement by aquatic organisms. Additionally, low water depths within the culvert during low water periods may inhibit passage by larger fish. Future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p>	
Additional Notes:		In 2010, the U.S. Fish and Wildlife Service - Gulf of Maine Coastal Program, with funding from the Casco Bay Estuary Partnership, documented this location as a barrier to fish passage with a classification of "severe" based on findings from the	

2008 culvert survey. This finding utilized the same data as the Maine Stream Habitat Viewer cited above, but a different methodology for analyzing and classifying barriers. The Maine Stream Habitat Viewer classification is more recent, and the classification of "potential barrier" is current.

A handwritten signature in black ink, appearing to read "Sgt. Hg".

February 11, 2019

Signature

Date



Photo 1 (10-22-18): Facing southeast at Mitchell Road crossing of Pond Cove Brook. Road is in good condition with a sanitary sewer pump station located near the brook (left hand side of photo).



Photo 2 (10-22-18): Submerged inlet of 48-inch corrugated metal pipe with corroded invert and various stones blocking the inlet from reaching full flow capacity. The stone headwall needs to be reset.



Photos 3 (10-22-18): Looking through the culvert from the inlet side, interior of the pipe appears visually to be in a degraded condition with the invert of the pipe clearly corroded.



Photo 4 (06-06-18): Facing northwest from the Mitchell Road culvert toward the 3-feet tall by 4-feet wide elliptical culvert under nearby Hobstone Road with channel of the Pond Cove Brook upstream of the Mitchell Road culvert inlet.



Photo 5 (10-22-18): Facing southwest at discharge flow channel of Pond Cove Brook from elliptical culvert under Hobstone Road to the Mitchell Road culvert inlet.



Photo 6 (06-06-18): Hanging outlet of the aluminum elliptical pipe with flared end and rip rap headwall. Additional rip rap would be desirable to bolster the area around the culvert.



Photo 7 (06-06-18): Stone headwall at the outlet has deteriorated and has many loose and dislodged stones.



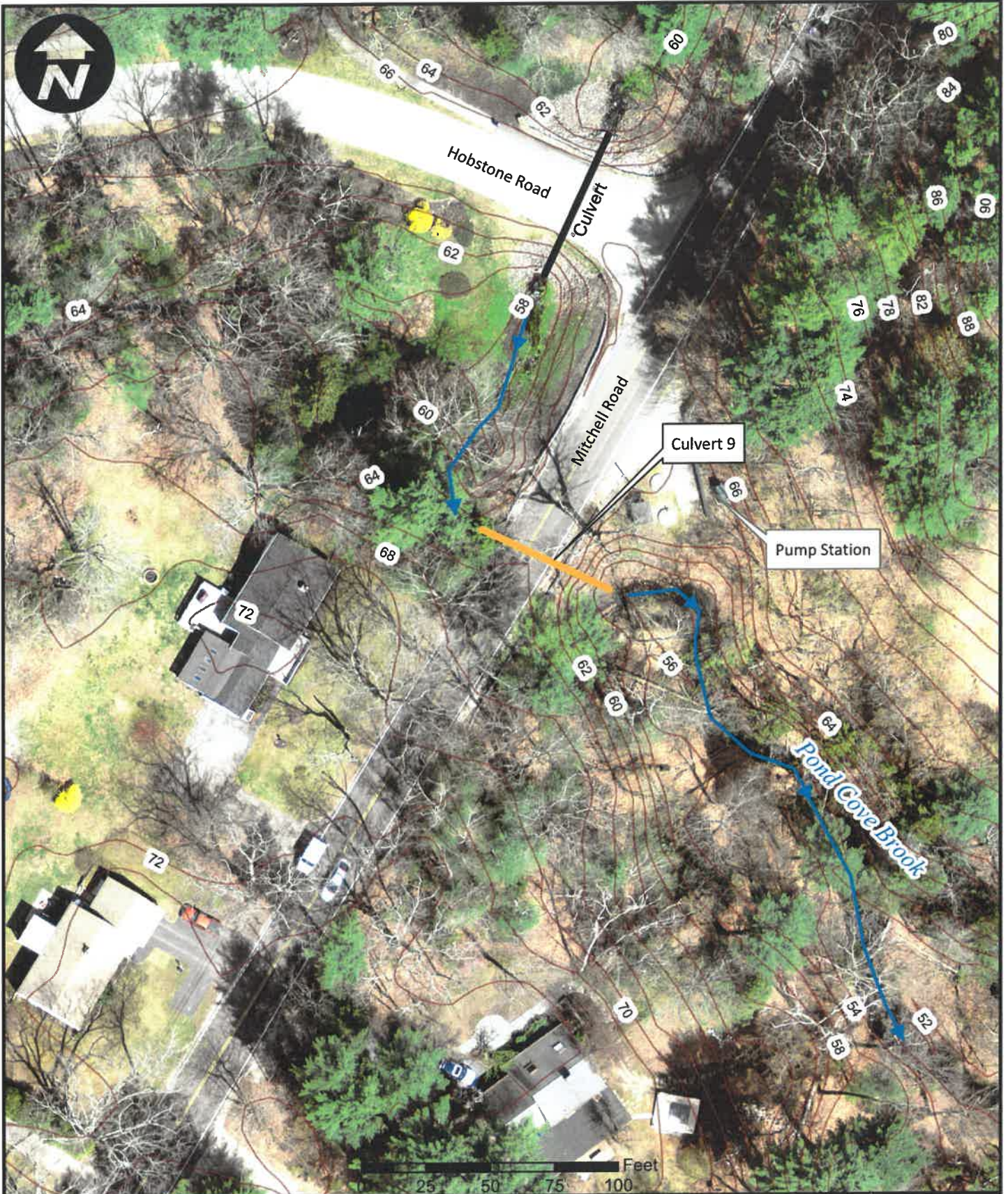
Photo 8 (10-22-18): Overhead view of culvert outlet with loose stones in the stone headwall.



Photo 9 (06-06-18): Downstream flow of Pond Cove Brook from the Mitchell culvert outlet flows through the ponded area upstream of the multiple Shore Road culverts which convey flow to Pond Cove and Atlantic Ocean.



Photo 10 (10-22-18): Facing south from the nearby pump station at the downstream flow of Pond Cove Brook from the Mitchell culvert outlet.



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South Portland, ME 04106
Tel. 207-260-2200

Culvert Assessment - Culvert 9
48-inch Corrugated Metal Pipe

LOCATION:
Mitchell Rd @ Pond Cove Brook
Cape Elizabeth, ME 04107

SCALE: 1" = 50'
DATE: 10/16/18

INFORMATION:
Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



75 John Roberts Road
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 South Portland, ME 04106-6963
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Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 20, 2018	Culvert No:	10
Name and Location of Road Crossing:	Old Ocean House Road – Rural Connector 0.63 miles southeast of the Old Ocean House Road @ Route 77 Intersection		
Stream Name:	Alewife Brook from Great Pond	Tributary To:	Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	Culverts were slip lined in 2008 and area in good physical condition. Original culverts were Corrugated Metal Pipes (cmp) and the slip lined culverts are HDPE with the main pipe's invert channel being a section of cmp to reduce the velocity of flow through the culvert. The inlet to one of the culverts was raised during the slip lining project so that the lower pipe acts as the primary flow carrier and its invert was lined with a section of corrugated metal pipe to reduce flow velocity through the pipe. The inflow has historically been affected by the use of stream flow for agricultural irrigation uses, however, the State of Maine replacement of an upstream culvert may affect the base flow now and the irrigation use has likely been curtailed due to the lower flow conditions of Alewife Brook in this area.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input checked="" type="checkbox"/> HDPE <input checked="" type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	2 - 48"	Approximate Length:	100 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No There has been no past flooding activity here primarily due to the controlled nature of the stream and the substantial height of the embankment and corresponding roadway elevation above the culvert.		
Bed material within culvert:	None, but invert of main culvert is lined with a section of corrugated metal pipe to reduce flow velocity through the pipe.		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	20 Feet		

Additional Observations:	Two culverts are in place; however, one is set at a lower elevation and carries the base flow of the stream with the second culvert in place as an overflow pipe to pass additional surface water in high flow events.		
Is the culvert hanging?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (westerly culvert only)	
Is there evidence of high water above the top of the culvert?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:	In 2008, the outlet of the pipe was inundated by installing concrete weir flow barriers downgradient of the culverts' outlet. These barriers have lower slotted weirs to control water level elevations and flow through the downstream section next to the culverts. These barriers were designed and permitted to create low velocity pool areas and allow for fish passage through the culverts.		
Culvert Structure:			
Culvert lining?	<input checked="" type="checkbox"/> Yes – easterly culvert at a lower elevation and its invert is lined with a section of corrugated metal pipe <input type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is water seeping along the outside of the culvert (piping)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:			
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input checked="" type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall		

Inlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor			EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a		
Vegetation removal needed?				<input checked="" type="checkbox"/> Yes (Minor clearing) <input type="checkbox"/> No	
Culvert Outlet					
Outlet Type:		<input checked="" type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall			
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Constrictions/obstructions at outlet? <input checked="" type="checkbox"/> Yes - Downstream weir walls <input type="checkbox"/> No	
EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor			EC condition behind wingwall? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input type="checkbox"/> n/a		
Vegetation removal needed?				<input checked="" type="checkbox"/> Yes (minor clearing) <input type="checkbox"/> No	
Habitat & Fish Passage					
Is Habitat and/or Fish a consideration:		<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is identified in the Maine Stream Habitat Viewer as #8764. The culvert is identified in the viewer as a potential barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Alewife Pond habitat.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>The culvert is subject to tidal inundation under a 6 ft or greater Sea Level Rise scenario delineated by Maine Geological Survey.</p> <p>https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml</p> <p>This culvert appears to be undersized resulting in increased stream velocities that may inhibit movement by aquatic organisms. Additionally, low water depths within the culvert during low water periods may inhibit passage by larger fish.</p>			

	<p>Future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p> <p>Alewife Brook supports a documented spawning population of alewives. Alewives are a federal and state species of concern. The culvert likely passes these fish upstream during spring flows, however during drier years there may be passage issues for alewives through both the culvert and the downstream fish passage structure that was designed to backwater the culvert. The majority of alewife habitat in the watershed is upstream of the culvert. Stream habitat connectivity is there for critical to maintaining alewife populations. Future culvert designs should prioritize fish and aquatic organism passage and utilize USFS Stream Simulation design standards as much as possible.</p> <p>https://www.fs.fed.us/eng/pubs/pdf/StreamSimulation/</p> <p>A 2016 Stantec connectivity assessment of Alewife Brook noted a backwater through the river left culvert at this site, and relatively low flow speeds through the culvert during the site visit. Higher velocities may occur during periods of higher flow and could hinder or prevent upstream fish passage. Fish passage may also be impacted by the smooth slip-lined plastic barrel culverts. A copy of the report is available from Casco Bay Estuary Partnership.</p> <p>Depending on the timeline for replacement of this culvert, consideration may need to be taken for future sea level rise impacts and the appropriate studies should be conducted.</p>
<p>Additional Notes:</p>	<p>In 2008, the culvert was installed with fish passage considerations per the environmental permits issued by the Maine Department of Environmental Protection and the U.S. Army Corps of Engineers. Monitoring associated with the project identified the presence of rainbow smelt in the lower reach of Alewife Brook.</p> <p>In 2010, the U.S. Fish and Wildlife Service - Gulf of Maine Coastal Program, with funding from the Casco Bay Estuary Partnership, documented this location as a habitat barrier with a classification of "potential". This finding is based upon the same data as the Maine Stream Habitat Viewer cited above.</p>

Stacy Hg

February 11, 2019

Signature

Date



Photo 1 (06-20-18): Facing southeast at Old Ocean House Road crossing of Alewife Brook. Culvert are located relatively deep in relation to the road surface elevation with a steep roadway embankment.



Photo 2 (10-22-18): Inlet of two 48-inch high density polyethylene liner pipes within the original corrugated aluminum cross pipes. Southerly culvert on the right-hand side conveys main flow of Alewife Brook with left-hand side culvert available for overflow capacity.



Photo 3 (10-22-18): Looking northerly through the inlet of one of the two 48-inch high density polyethylene liner pipes within the original corrugated aluminum cross pipes. The invert of the main carrying pipe is lined with a corrugated metal pipe section to reduce the velocity of flow through the pipe.



Photos 4 (10-22-18): Looking northwesterly from top of embankment at the upstream channel flowing to the two culverts inlets on the west side of Old Ocean House Road.



Photo 5 (06-20-18): Submerged outlet of main flow carrying culvert with corrugated metal pipe invert to slow the flow velocity through the pipe to allow fish passage.



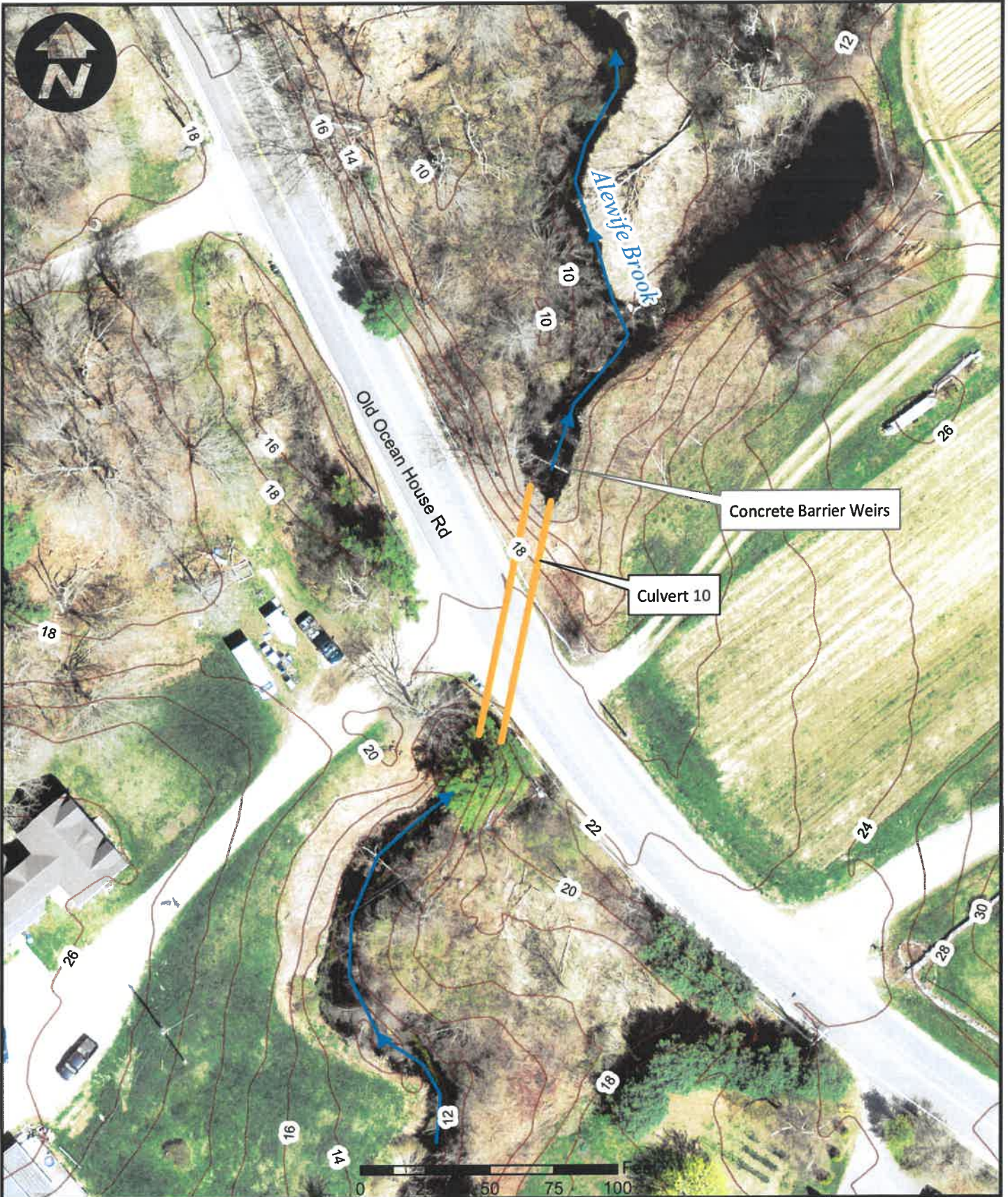
Photo 6 (06-20-18): Outlet of culverts on the east side of Old Ocean House Road. Outlet has a rip rap lined plunge pool and headwall. Concrete weir at outlet was installed to create a submerged outlet to allow alewife fish passage.



Photo 7 (06-20-18): Downstream channel of the culvert outlet flow with two concrete weir walls with slotted weirs to control elevation and flow from the culverts to dissipates energy of the outfall and reduce the velocity of the outflow to the receiving channel. The weirs also create pool areas within the channel.



Photo 8 (10-22-18): Looking northerly at the heavily vegetated downstream channel of Alewife Brook from the culvert outlet flow.



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South Portland, ME 04106
Tel. 207-260-2100

Culvert Assessment - Culvert 10
Two, 48-inch HDPE Pipes

SCALE: 1" = 50'

DATE: 10/16/18

LOCATION:

Old Ocean House Rd @ Alewife Brook
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



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Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 20, 2018	Culvert No:	11
Name & Location of Road Crossing:	Ocean House Road (Route 77) – Arterial 0.66 miles south of the Fowler Road @ Route 77 Intersection		
Stream Name:	Alewife Brook from Great Pond	Tributary To:	Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	This culvert was slip lined in 2008 by the MDOT and is in good physical condition. The original culvert was Corrugated Metal Pipes (cmp) and the slip lined culvert is HDPE with concrete supports.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input checked="" type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	70-inch	Approximate Length:	142 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No There has been no past flooding activity here primarily due to the substantial height of the embankment and corresponding roadway elevation above the culvert.		
Bed material within culvert:	None		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	34 Feet		
Additional Observations:			
Is the culvert hanging?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Additional Observations:	In 2008, the outlet of the pipe was inundated by installing a slot weir at the outlet invert and a stone berm in the channel downgradient approximately 30-feet beyond the culvert outlet. These barriers were designed, permitted, and installed by the		

		MDOT to create low velocity pool areas and allow for fish passage through the culvert.	
Culvert Structure:			
Culvert lining?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Condition inside culvert:		<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems	
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is water seeping along the outside of the culvert (piping)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:			
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input checked="" type="checkbox"/> Concrete Headwall/Abutment <input type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Culvert Outlet			

Outlet Type:		<input checked="" type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall	
Outlet damaged?		Headwall undermining?	Constrictions/obstructions at outlet?
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes – Slot weir at outlet invert and downstream stone weir <input type="checkbox"/> No
EC condition at outlet?		EC condition behind wingwall?	
<input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		<input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Habitat & Fish Passage			
Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is identified in the Maine Stream Habitat Viewer as #8766. The culvert is identified in the viewer as a potential barrier to aquatic organism passage based on a 2008 assessment. The viewer habitat values listed for this culvert include Alewife Pond habitat.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>This culvert appears to be undersized resulting in increased stream velocities that may inhibit movement by aquatic organisms. Additionally, low water depths within the culvert during low water periods may inhibit passage by larger fish. Future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p> <p>Alewife Brook supports a documented spawning population of alewives. Alewife are a federal and state species of concern. The culvert likely passes these fish upstream during spring flows, however during drier years there may be passage issues for alewives through both the culvert and the downstream fish passage structure that was designed to backwater the culvert. The majority of alewife habitat in the watershed is upstream of the culvert. Stream habitat connectivity is there for critical to maintaining alewife populations. Future culvert designs should prioritize fish and aquatic organism passage and utilize USFS Stream Simulation design standards as much as possible.</p> <p>https://www.fs.fed.us/eng/pubs/pdf/StreamSimulation/</p>		

	<p>A 2016 Stantec connectivity assessment of Alewife Brook noted that at this crossing, the culvert inlet creates an upstream backwater, apparently due to the shallow slope of the culvert and the cast-in-place concrete weir at the culvert outlet. Backwater conditions contribute to low velocities in the culvert during low flow conditions, and predicted higher velocities during high flows that could hinder or prevent fish passage, as well as vegetative growth in the upstream channel reach. Fish passage may be impacted by the smooth slip-lined plastic barrel culvert. Targeted monitoring during seasonal migration periods, including for American eel elvers, was recommended to evaluate whether a barrier to fish passage exists. A copy of the report is available from Casco Bay Estuary Partnership.</p>
<p>Additional Notes:</p>	<p>In 2008, the MDOT installed considerations in the culvert system to support fish passage through the culvert. In 2010, the U.S. Fish and Wildlife Service - Gulf of Maine Coastal Program, with funding from the Casco Bay Estuary Partnership, documented this location as a barrier to fish passage with a classification of "severe" based on findings from the 2008 culvert survey. This finding utilized the same data as the Maine Stream Habitat Viewer cited above, but a different methodology for analyzing and classifying barriers. The Maine Stream Habitat Viewer classification is more recent, and the classification of "potential barrier" is current.</p>

Stacy H

February 11, 2019

Signature

Date



Photo 1 (06-20-18): Facing west at Ocean House Road (Route 77) crossing of Alewife Brook. Culvert location coincides with the crack across the pavement surface. Culvert is located relatively deep in relation to the road surface elevation with a steep roadway embankment.



Photo 2 (06-20-18): Submerged inlet of the 70-inch high density polyethylene liner pipe within the original corrugated aluminum cross pipe. Pipe is supported on a concrete saddle.



Photos 3 (06-20-18): Looking upstream at the Alewife Brook flow to the Inlet of the culvert on west side of Ocean House Road (Route 77). Alewife Brook hydraulically connects Great Pond to Casco Bay.



Photo 4 (06-20-18): Submerged outlet of culvert with slotted weir invert to slow the flow velocity through the pipe to allow fish passage. Culvert outlet is supported by concrete saddle.



Photo 5 (06-20-18): Weir in outlet of culvert on the east side of Ocean House Road. Weir at outlet was installed to create a submerged outlet to allow Alewife fish passage.

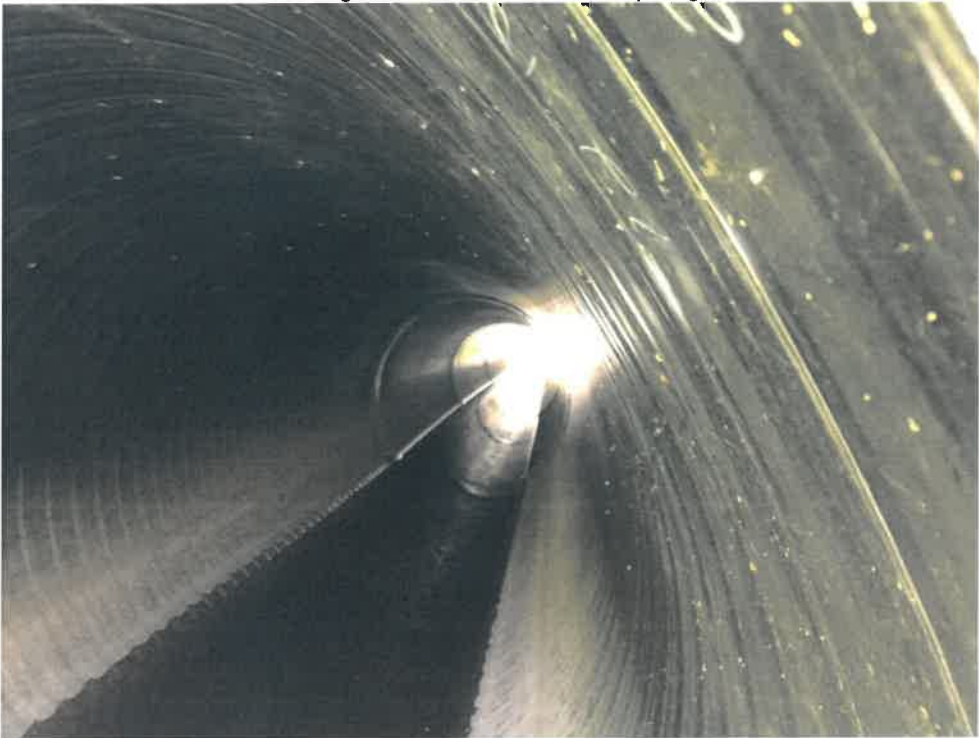


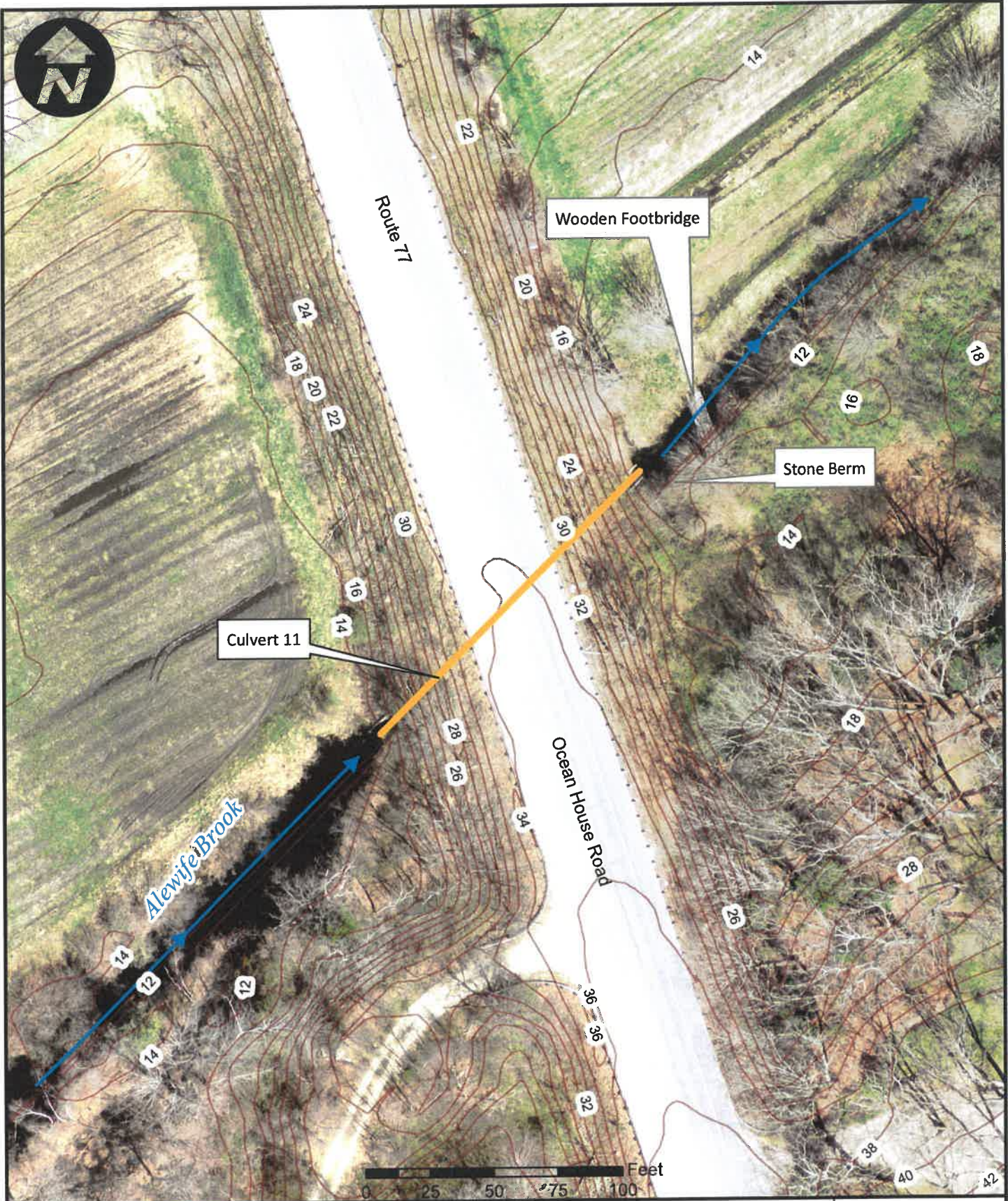
Photo 6 (06-20-18): View of the interior of the HDPE liner from the outlet toward the inlet of the pipe. Invert of the culvert is submerged.




Photo 7 (06-20-18): Downstream channel of the culvert outlet flow with stone weir wall with center opening to control elevation and flow from the culverts to dissipate energy of the outfall and reduce the velocity of the outflow to the receiving channel. The weir also creates a pool area within the channel.



Photo 8 (06-20-18): Downstream view of Alewife Brook from outlet area of the culvert. Stone berm is upstream of a wooden footbridge crossing over the stream in the background of the photo.



 <p>SEBAGO TECHNICS</p> <p>WWW.SEBAGOTECHNICS.COM 75 John Roberts Rd. - Suite 4A South Portland, ME 04106 Tel. 207-200-2100</p>	<p>Culvert Assessment - Culvert 11 70-inch HDPE Pipe</p>		<p>SCALE: 1" = 50'</p>
	<p>LOCATION:</p> <p>Route 77 @ Alewife Brook Cape Elizabeth, ME 04107</p>	<p>INFORMATION:</p> <p>Maine Office of GIS 2017 Orthoimagery Maine Office of GIS 2006 Lidar derived contours</p>	<p>DATE: 10/16/18</p>



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
www.sebagotechnics.com

Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 20, 2018	Culvert No:	12
Name & Location of Road Crossing:	Eastman Road – Feeder Street 0.22 miles southeast of the Eastman Road @ Sawyer Road Intersection		
Stream Name:	Trout Brook – Urban Impaired Stream	Tributary To:	Casco Bay & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E. sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	This culvert was installed in 1983 near the headwaters of Trout Brook. It is extremely flat with little cover and is partially inundated with water at all times which compromises its flow capacity.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input checked="" type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	10-inch	Approximate Length:	38 Feet
Does roadway have a history of flooding?	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No This culvert floods occasionally during extreme weather events		
Bed material within culvert:	None		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	72 Feet		
Additional Observations:			
Is the culvert hanging?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Culvert Structure:			
Culvert lining?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		

Condition inside culvert: <input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems			
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Visible
Is the culvert shape deflected?			<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Visible
Is water seeping along the outside of the culvert (piping)?			<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Visible
Should the culvert be video inspected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional Observations:	The culvert is inundated with water so it is not possible to check for a line of sight, shape deflection, or piping. The pipe cannot be video inspected in its current state of inundation with standing water.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall/Abutment <input type="checkbox"/> Concrete Wingwall <input checked="" type="checkbox"/> Headwall not visible		
Inlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input checked="" type="checkbox"/> Yes – Standing Water <input type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Culvert Outlet			
Outlet Type:	<input type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment		

		<input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall <input checked="" type="checkbox"/> Stone Headwall	
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at outlet? <input checked="" type="checkbox"/> Yes – Blockage in stream channel <input type="checkbox"/> No
EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Habitat & Fish Passage			
Is Habitat and/or Fish a consideration:		<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No	
		<p>This culvert is identified in the Maine Stream Habitat Viewer as #8224. The culvert is identified in the viewer as a potential barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Eastern Brook Trout Habitat.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>This culvert appears to be undersized resulting in increased stream velocities that may inhibit movement by aquatic organisms. Future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p> <p>Trout Brook supports wild Eastern Brook trout, despite increasing development within the watershed. Habitat connectivity is critical for maintaining trout populations. While the stream at this culvert is relatively small, it is important to recognize the value of this habitat for Eastern Brook Trout. Small and ephemeral streams are important for brook trout reproductivity. Future culvert design should allow for passage by weaker swimming fish and include a natural channel bottom within the culvert.</p>	

Additional Notes:

The site was not assessed in 2008, so it was not classified in the 2010 US Fish and Wildlife/Casco Bay Estuary Partnership report on fish barriers.

Sty Hg

February 11, 2019

Signature

Date



Photo 1 (10-22-18): Facing north at Eastman Road crossing of Trout Brook. Blue sign indicates that the culvert is within the Trout Brook Watershed which is an Urban Impaired Stream. Road freshly paved with new gravel shoulders.



Photo 2 (10-22-18): Submerged inlet of 10-inch polyvinylchloride (pvc) culvert is barely visible due to the standing water and the vegetation surrounding the pipe. No rip rap apron or headwall. Pipe is very shallow and flat which compromises its capacity.



Photos 3 (10-22-18): Facing west at inlet of submerged culvert on west side of Eastman Road and up gradient area flowing toward culvert.



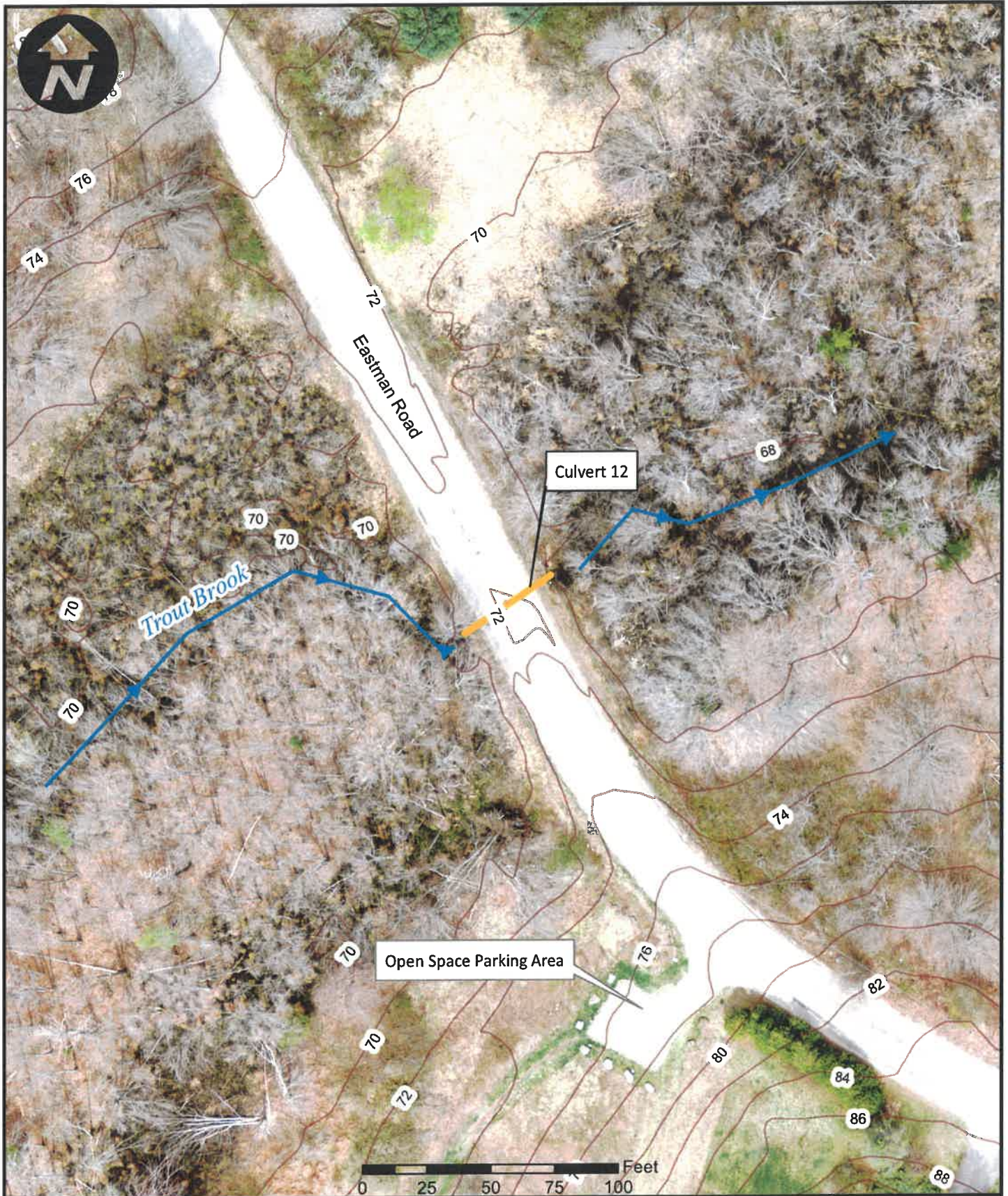
Photo 4 (10-22-18): Submerged outlet of culvert on the east side of Eastman Road. No rip rap apron has been provided. Area around the outlet has thick vegetation and standing water and is not draining well.



Photo 5 (06-20-18): Overhead view of submerged culvert outlet with a stone placed over the pipe to act as a headwall. Pipe is discolored due to years of exposure to sunlight.



Photo 6 (06-20-18): Facing northeast at the downstream channel of the culvert outlet. Thick vegetation and likely deposited sediment within the channel create standing water with a very slow flow rate.



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75 John Roberts Rd. - Suite 4A
South Portland, ME 04106
Tel. 207-200-2100

Culvert Assessment - Culvert 12
10-inch PVC Pipe

SCALE: 1" = 50'

DATE: 10/16/18

LOCATION:

Eastman Rd @ Trout Brook
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
www.sebagotechnics.com

Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 20, 2018	Culvert No:	13
Name and Location of Road Crossing:	Sawyer Road – Rural Connector 0.15 miles southeast of the Wells Road @ Sawyer Road Intersection		
Stream Name:	Spurwink River	Tributary To:	Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E. sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	This culvert was installed in 1997 by the Town. It is in fair condition and is the subject of a separate study being undertaken to review its possible replacement along with an additional nearby new overflow at the roadway low point. This study will analyze the hydrologic conditions of the replacement system on reducing flood risks to the road in light of sea level rise and effects to the surrounding habitat situation.		
Description of Existing Culvert			
Shape:	<input type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input checked="" type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	11.5 feet tall by 10.5 feet wide	Approximate Length:	77 Feet
Does roadway have a history of flooding?	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No The roadway floods at a lower elevation on Sawyer Road away from this culvert location during astronomical high tides and when extreme weather events coincide with high tide conditions.		
Bed material within culvert:	Yes, Silted		
Tidal Influence?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Approximate Elevation at Road Centerline:	8 Feet		
Additional Observations:	An MDOT inspection was conducted on this culvert on November 9, 2017 (attached) which noted holes in the top of the culvert, corrosion along bolt lines, and the need for additional rip rap		

Is the culvert hanging?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is there evidence of high water above the top of the culvert?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:			
Culvert Structure:			
Culvert lining?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Condition inside culvert: <input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems			
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is water seeping along the outside of the culvert (piping)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:		Additional rip rap needs to be added to the inlet embankment area. Outlet areas have been recently rip rapped.	
Culvert Inlet			
Inlet Type:		<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Embankment <input type="checkbox"/> Concrete Headwall/Abutment <input type="checkbox"/> Concrete Wingwall <input type="checkbox"/> Headwall not visible	
Inlet damaged? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good		EC condition behind wingwall? <input type="checkbox"/> good	

<input type="checkbox"/> fair <input type="checkbox"/> poor	<input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a
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Vegetation removal needed?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Culvert Outlet

Outlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall <input type="checkbox"/> Stone Headwall
---------------------	---

Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at outlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
--	--	--

EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a
--	--

Vegetation removal needed?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Habitat & Fish Passage

Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is identified in the Maine Stream Habitat Viewer as #11368. The viewer habitat values listed for this culvert include Anadromous Rainbow Smelt Habitat, Tidal Marsh, Habitat Connector, Tidal Waterfowl and Wading Bird Habitat, and the Scarborough Marsh Ecological Focus Area.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>The culvert is subject to increased inundation under a 1 ft or greater Sea Level Rise scenario delineated by Maine Geological Survey.</p> <p>https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml</p> <p>The culvert is within an area of potential marsh migration under a 1 ft or greater sea level rise scenario delineated by the Maine Natural Areas Program.</p> <p>https://www.maine.gov/dacf/mnap/assistance/marsh_migration.htm</p> <p>This site is subject to tidal flooding and is vulnerable to sea level rise. The culvert has been documented by the Wells National Estuarine Research Reserve as a tidal</p>
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	<p>restriction, which reduces tidal flooding upstream. The potential for upstream marsh migration under projected sea level rise scenarios could be impeded by the existing culvert. Due to the tidal influence at the site, it is recommended that future culvert design incorporate appropriate study of tidal flow under potential sea level rise conditions.</p> <p>Anadromous rainbow smelt have been previously documented in the Spurwink River, and spawning habitat is expected to be present near the head of tide, upstream of the culvert. Rainbow smelt are listed as a federal and state species of concern. The existing culvert is unlikely to present a significant barrier to smelt migration, however, future design should take fish passage for smelt into consideration.</p>
<p>Additional Notes:</p>	<p>This site is outside of the Casco Bay watershed, so this site was not included in the 2010 Casco Bay Estuary Partnership report. Comparable data are presented in the Maine Stream Habitat Viewer.</p> <p>Substantial study is anticipated in 2018-19 to determine the short and long terms effects to surrounding habitats that would occur if the culvert was to be replaced. These hydrologic and environmental studies are well beyond the scope of the current culvert assessment.</p>

Stacy H

February 11, 2019

Signature

Date



Photo 1 (10-22-18): Facing southwest at Sawyer Road culvert crossing. Road routinely floods beyond culvert crossing at low area of roadway elevation.



Photo 2 (06-20-18): Submerged inlet of 10.5-foot wide by 11.5-foot tall corrugated aluminum elliptical pipe with flared end and rip rap headwall on east side of Sawyer Road. Additional headwall rip rap should be added to the headwall.



Photo 3 (06-20-18): Overhead view of the culvert inlet with tidal channel flow of the Spurwink River upstream of the culvert.



Photo 4 (06-20-18): Upstream channel of the Spurwink River weaves through the Spurwink Marsh to the east of Sawyer Road.



Photo 5 (06-06-18): Submerged outlet of the aluminum elliptical pipe with flared end and rip rap headwall on the west side of Sawyer Road. Quantity of rip rap appears to be sufficient on the outlet area around the culvert.



Photo 6 (06-06-18): Overhead view of culvert outlet and the widened area of the Spurwink River beyond the culvert outlet. The Spurwink River channel flows to the north (right hand side of this photo).



Photo 7 (10-22-18): Facing north during high tide of the Spurwink River on the outlet to the west of Sawyer Road.



Photo 8 (10-22-18): Facing south during high tide of the Spurwink River on the outlet to the west of Sawyer Road. The Spurwink River channel downstream of culvert outlet flows through a wide pool area before flowing north parallel with Sawyer Road before turning to the west and winding toward the Atlantic Ocean.



Photo 9 (10-22-18): Facing north during high tide of the Spurwink Marsh pooling on both side of Sawyer Road. Sawyer Road floods often during intense weather and tide events in the foreground of the photo as the road elevation is lower than at the culvert crossing which the inlet to the Spurwink River culvert is visible on the right side (east) of Sawyer Road.



 WWW.SEBAGOTECHNICS.COM 75 John Roberts Rd. - Suite 4A South Portland, ME 04106 Tel. 207-200-2100	Culvert Assessment - Culvert 13 10.5-Foot Wide by 11.5-Foot Tall Elliptical Corrugated Aluminum Pipe		SCALE: 1" = 50'
	LOCATION: Sawyer Road @ Spurwink River Cape Elizabeth, ME 04107	INFORMATION: Maine Office of GIS 2017 Orthoimagery Maine Office of GIS 2006 Lidar derived contours	DATE: 10/16/18



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
16 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0016

Paul R. LePage
GOVERNOR

David Bernhardt
COMMISSIONER

April 24, 2018

Municipality of Cape Elizabeth
320 Ocean House Road, PO Box 6260
Cape Elizabeth, Maine 04107

RE: Town Line Bridge #6014

Dear Municipal Officials,

Enclosed is a copy of the 2017 Bridge Inspection Report for the bridge above that has identified deficiencies or preventative maintenance issues that should be addressed by the Town. Listed below is an itemized list of the deficiencies.

Town Line Bridge #6014

- Holes found during underwater inspection

The bridge and guardrail deficiencies should be addressed as soon as practical to ensure continued safe use of the bridge. Neglect of these deficiencies may result in a diminished function of the bridge through load posting or even closure.

Due to bridge legislation, there is no funding mechanism for the bridge, which is considered Minor Spans on a Town Way. The Department will inspect the bridges again in 2018. If you have any questions, do not hesitate to contact me at 624-3423.

Sincerely,

A handwritten signature in cursive script that reads 'Benjamin W. Foster'.

Benjamin W. Foster, P.E.
Assistant Bridge Maintenance Engineer

Enclosures

cc: Bridge Management
Road Commissioner
file



PRINTED ON RECYCLED PAPER

Highway Bridge Inspection Report

**TOWN LINE
SAWYER ST.
over
SPURWINH RIVER**



Asset Code: 6014

Inspection Date: 11/09/2017

Inspected By: Tim Merrithew

Inspection Type(s): Routine

National Bridge Inventory

Status: 1 - SD

Bridge Name: TOWN LINE

Sufficiency Rating: 69.8

Inspections

(90) INSPECTION DATE	& (91) DESIGNATED INSPECTION FREQUENCY	24	11/09/2017
(92) CRITICAL FEATURE INSPECTION	& (93) CFI DATE		
(92A) FRACTURE CRITICAL DETAIL		N	
(92B) UNDERWATER INSPECTION		Y	24
(92C) OTHER SPECIAL INSPECTION		N	05/31/2017

Identification

(1) STATE CODE	231 - Maine
(8) STRUCTURE NUMBER	6014
(5) INVENTORY ROUTE	
(5A) RECORD TYPE	1: Route carried "on" the structure
(5B) ROUTE SIGNING PREFIX	5 - CITY STREET
(5C) DESIGNATED LEVEL OF SERVICE	0 - None
(5) INVENTORY ROUTE	0
(5) INVENTORY ROUTE	0 - NOT APPLICABLE
(2) HIGHWAY AGENCY DISTRICT	01 - Southern
(3) COUNTY CODE	005 Cumberland
(4) PLACE CODE	10180
(6) FEATURES INTERSECTED	SPURWING RIVER
(7) FACILITY CARRIED	SAWYER ST.
(9) LOCATION	.5 MI N RTE 77
(11) MILEPOINT	0.010
(12) BASE HIGHWAY NETWORK	Inventory Route is not on the Base Network
(13) LRS INVENTORY ROUTE, SUBROUTE	
(13A) LRS INVENTORY ROUTE	0000500530
(13B) SUBROUTE NUMBER	00
(16) LATITUDE	43.58851
(17) LONGITUDE	-70.26293
(98A) BORDER BRIDGE CODE	
(98B) PERCENT RESPONSIBILITY	0
(99) BORDER BRIDGE STRUCT NO.	n/a

Structure Type and Material

(43) STRUCTURE TYPE, MAIN	
(43A) KIND OF MATERIAL/DESIGN	9 - Aluminum, Wrought Iron or Cast Iron
(43B) TYPE OF DESIGN/CONSTR	19 - Culvert (includes frame culverts)
(44) STRUCTURE TYPE, APPROACH SPANS	
(44A) KIND OF MATERIAL/DESIGN	0 - Other
(44B) TYPE OF DESIGN/CONSTRUCTION	00 - Other
(45) NUMBER OF SPANS IN MAIN UNIT	1
(46) NUMBER OF APPROACH SPANS	0
(107) DECK STRUCTURE TYPE	N - Not Applicable
(108) WEARING SURFACE/PROTECTIVE SYSTEMS	
(108A) WEARING SURFACE	N - NA
(108B) DECK MEMBRANE	N - NA
(108C) DECK PROTECTION	N - NA

Age of Service

(27) YEAR BUILT	1997
(106) YEAR RECONSTRUCTED	0
(42) TYPE OF SERVICE	
(42A) TYPE OF SERVICE ON BRIDGE	1 - Highway
(42B) TYPE OF SERVICE UNDER BRIDGE	5 - Waterway
(28) LANES	
(28A) LANES ON THE STRUCTURE	02
(28B) LANES UNDER THE STRUCTURE	00
(29) AVERAGE DAILY TRAFFIC	1080
(30) YEAR OF AVERAGE DAILY TRAFFIC	2016
(109) AVERAGE DAILY TRUCK TRAFFIC	5
(19) BYPASS DETOUR LENGTH	2

Geometric Data

(48) LENGTH OF MAXIMUM SPAN (ft.)	12.0
(49) STRUCTURE LENGTH (ft.)	11.0
(50) CURB/SIDEWALK WIDTHS	
(50A) LEFT CURB SIDEWALK (ft.)	0
(50B) RIGHT CURB SIDEWALK (ft.)	0
(51) BRDG RDWY WIDTH CURB-TO-CURB (ft.)	0
(52) DECK WIDTH, OUT-TO-OUT (ft.)	0
(32) APPROACH ROADWAY WIDTH (ft.)	26.0
(33) BRIDGE MEDIAN	0 - No median
(34) SKEW (deg.)	15
(35) STRUCTURE FLARED	0 - No flare
(10) INV RTE, MIN VERT CLEARANCE (ft.)	328.05
(47) TOTAL HORIZONTAL CLEARANCE (ft.)	31.0
(53) VERTICAL CLEARANCE OVER BRIDGE ROADWAY (ft.)	327.76
(54) MIN VERTICAL UNDERCLEARANCE	
(54A) REFERENCE FEATURE	N - Feature not a highway or railroad
(54B) MIN VERTICAL UNDERCLEARANCE (ft.)	0
(55) MIN LATERAL UNDER CLEARANCE RIGHT	
(55A) REFERENCE FEATURE	N - Feature not a highway or railroad
(55B) MIN LATERAL UNDER CLEARANCE RIGHT (ft.)	327.76
(56) MIN LATERAL UNDER CLEARANCE (ft.)	0

Classification

(112) NBIS BRIDGE LENGTH	No
(104) HIGHWAY SYSTEM OF THE INVENTORY ROUTE	0 - Structure/Route is NOT on NHS
(26) FUNCTIONAL CLASSIFICATION OF INVENTORY ROUTE	19 - Urban - Local
(100) STRAHNET HIGHWAY DESIGNATION	Not a STRAHNET route
(101) PARALLEL STRUCTURE DESIGNATION	N - No parallel structure
(102) DIRECTION OF TRAFFIC	2-way traffic
(103) TEMP STRUCTURE	
(105) FEDERAL LANDS HIGHWAYS	Not Applicable
(110) DESIGNATED NATIONAL NETWORK	Inventory route not on network
(20) TOLL	3 - On Free Road
(21) MAINTENANCE RESPONSIBILITY	03 - Town or Township Highway Agency
(22) OWNER	03 - Town or Township Highway Agency
(37) HISTORICAL SIGNIFICANCE	5 - Not eligible

Condition

(58) DECK	N - Not Applicable
(59) SUPERSTRUCTURE	N - Not Applicable
(60) SUBSTRUCTURE	N - Not Applicable
(81) CHANNEL & CHANNEL PROTECTION	7 - Bank protection needs minor repairs
(62) CULVERT	4 - Large spalls, heavy scaling, wide cracks

Load Rating and Posting

(31) DESIGN LOAD	9 - HS 25 or greater
(63) METHOD USED TO DETERMINE OPERATING RATING	1 - Load Factor (LF)
(64) OPERATING RATING	60.8
(65) METHOD USED TO DETERMINE INVENTORY RATING	1 - Load Factor (LF)
(66) INVENTORY RATING	40.8
(70) BRIDGE POSTING	5 - Equal to or above legal
(41) STRUCTURE OPEN/POSTED/CLOSED	A - Open

Appraisal

(67) STRUCTURAL EVALUATION	4
(68) DECK GEOMETRY	N
(69) UNDERCLEARANCES, VERTICAL & HORIZONTAL	N
(71) WATERWAY ADEQUACY	8 - Bridges Above Approaches
(72) APPROACH ROADWAY ALIGNMENT	8 - Equal to present desirable criteria
(36) TRAFFIC SAFETY FEATURE	
36A) BRIDGE RAILINGS:	0 - Does not meet acceptable standards/safety feature is required
36B) TRANSITIONS:	0 - Does not meet acceptable standards/safety feature is required
36C) APPROACH GUARDRAIL	0 - Does not meet acceptable standards/safety feature is required
36D) APPROACH GUARDRAIL ENDS	0 - Does not meet acceptable standards/safety feature is required
(113) SCOUR CRITICAL BRIDGES	8 - Stable for scour conditions

Proposed Improvements

(75) TYPE OF WORK

(75A) TYPE OF WORK PROPOSED
 (75B) WORK DONE BY
 (76) LENGTH OF STRUCTURE IMPROVEMENT (ft.)
 (94) BRIDGE IMPROVEMENT COST (\$K)
 (95) ROADWAY IMPROVEMENT COST (\$K)
 (96) TOTAL PROJECT COST
 (97) YEAR OF IMPROVEMENT COST ESTIMATE
 (114) FUTURE ADT 1620
 (115) YEAR OF FUTURE ADT 2036

Navigation Data	
(38) NAVIGATION CONTROL	0 - No navigation control on waterway (bridge)
(111) PIER OR ABUTMENT PROTECTION	
(39) NAV VERT CLEARANCE	0
(116) MIN NAVIGATION VERT CLEARANCE, VERT LIFT BRIDGE	0
(40) NAV HORIZONTAL CLEARANCE	0

Inspection Notes

Structure Number: 6014

Town: Cape Elizabeth

Structure Name: TOWN LINE

Structure Notes

11 foot aluminum bolted pipe culvert.

Wearing Surface

Deck

NBI Item 58: N

Superstructure

NBI Item 59: N

Substructure

NBI Item 60: N

Culvert

NBI Item 62: 4

Pipe itself in generally fair condition w/minor deflection of southerly side. corrosion along bolt line. Dive inspection found holes along top plate. Embankments have both eroded, beginning to effect shoulder pavement (photo). Pavement is cracked and opened up over center line of pipe. Fill has washed away from sides of pipe making it a high point allowing the pavement to break over the top. Additional rip rap is necessary to prevent further erosion. Pavement is worn and may need replacement over pipe. Too deep to wade see latest dive report.

Channel

NBI Item 61: 7

Other

Special Inspection

Monitoring

Pontis Notes

Inspector: Tim Merrithew
Inspection Date: 11/09/2017

Structure Number: 6014
Facility Carried: SAWYER ST.

Highway Bridge Inspection Report

Pictures



PHOTO 1
Description View of roadway facing North



PHOTO 2
Description Down stream view

Inspector: Tim Merrithew
Inspection Date: 11/09/2017

Structure Number: 6014
Facility Carried: SAWYER ST.

Highway Bridge Inspection Report

Pictures



PHOTO 3

Description General view of barrel showing some corrosion along bolt line



PHOTO 4

Description View showing crack in pavement above pipe

Inspector: Tim Merrithew
Inspection Date: 11/09/2017

Structure Number: 6014
Facility Carried: SAWYER ST

Highway Bridge Inspection Report

Pictures



PHOTO 5

Description Up stream view



PHOTO 6

Description View showing low approach rail



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
www.sebagotechnics.com

Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 20, 2018	Culvert No:	14
Name and Location of Road Crossing:	Sawyer Road – Rural Connector 0.08 miles northwest of the Wells Road @ Sawyer Road Intersection		
Stream Name:	Tributary to the Spurwink River	Tributary To:	Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E. sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	This culvert was installed in 1997 by the Town and is in good condition. Inlet has a concrete headwall and concrete supports a weir consisting of wooden boards.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input checked="" type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	36-inch	Approximate Length:	75 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No		
Bed material within culvert:	No		
Tidal Influence?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Approximate Elevation at Road Centerline:	14 Feet		
Additional Observations:			
Is the culvert hanging?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Additional Observations:	Both the inlet and the outlet of the pipe need to be cleared of vegetation and adding rip rap aprons would better control the proliferation of vegetation growth which impedes flow and makes maintenance of the culvert more challenging.		

Culvert Structure:			
Culvert lining?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Is the culvert shape deflected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Is water seeping along the outside of the culvert (piping)?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Should the culvert be video inspected?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional Observations:	Debris need to be removed from the immediate area around the inlet of the culvert. Very thick vegetation needs to be cleared at the inlet and outlet of the pipe.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input checked="" type="checkbox"/> Concrete Headwall/Abutment <input checked="" type="checkbox"/> Concrete Wingwall		
Inlet damaged? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Constrictions/obstructions at inlet? <input checked="" type="checkbox"/> Yes – Wooden board weir <input type="checkbox"/> No	
EC condition at inlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Culvert Outlet

Outlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall <input type="checkbox"/> Stone Headwall		
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> n/a	Constrictions/obstructions at outlet? <input checked="" type="checkbox"/> Yes – thick vegetation <input type="checkbox"/> No	
EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		EC condition behind wingwall? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Habitat & Fish Passage

Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is identified in the Maine Stream Habitat Viewer as #11284. The culvert is identified in the viewer as a barrier to aquatic organism passage. The viewer habitat values listed for this culvert include Tidal Marsh, Tidal Waterfowl and Wading Bird Habitat, and the Scarborough Marsh Ecological Focus Area.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>The culvert is subject to increased inundation under a 2 ft or greater Sea Level Rise scenario delineated by Maine Geological Survey.</p> <p>https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml</p> <p>The culvert is within an area of potential marsh migration under a 2 ft or greater sea level rise scenario delineated by the Maine Natural Areas Program.</p> <p>https://www.maine.gov/dacf/mnap/assistance/marsh_migration.htm</p> <p>This site is not currently subject to tidal flooding but it is vulnerable to sea level rise. The culvert appears to be undersized, and flow and aquatic organism passage may be further impeded by the associated upstream weir structure. Potential marsh migration under projected sea level rise scenarios could be impeded by the existing culvert as well as the associated upstream weir structure. Due to likelihood of future tidal influence at this culvert, it is recommended that future culvert design incorporate appropriate study of tidal flow under potential sea level rise conditions.</p>
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Additional Notes:

This site is not within the Casco Bay watershed, so it was not included in the 2010 US Fish and Wildlife Service/Casco Bay Estuary Partnership report on fish barriers.

Sty Hg

Signature

Date



Photo 1 (06-20-18): Facing south Sawyer Road crossing of the culvert. Crack on surface of the road may be due to the presence of culvert.



Photo 2 (06-20-18): Inlet of 36-inch High Density Polyethylene (HDPE) pipe headwall on northeast side of Sawyer Road. Concrete headwall conceals the HDPE pipe and pieces of concrete support wooden boards that creates an inlet weir to create an impoundment upstream of the pipe.



Photo 3 (06-20-18): Facing east at granite headwall of the culvert inlet with thick vegetation blocking the inlet area of the culvert. Providing a rip rap apron at the inlet would control vegetation from blocking the inlet.



Photo 4 (06-20-18): Upstream channel of the culvert is impounded which creates a large wetland area to the east of Sawyer Road.



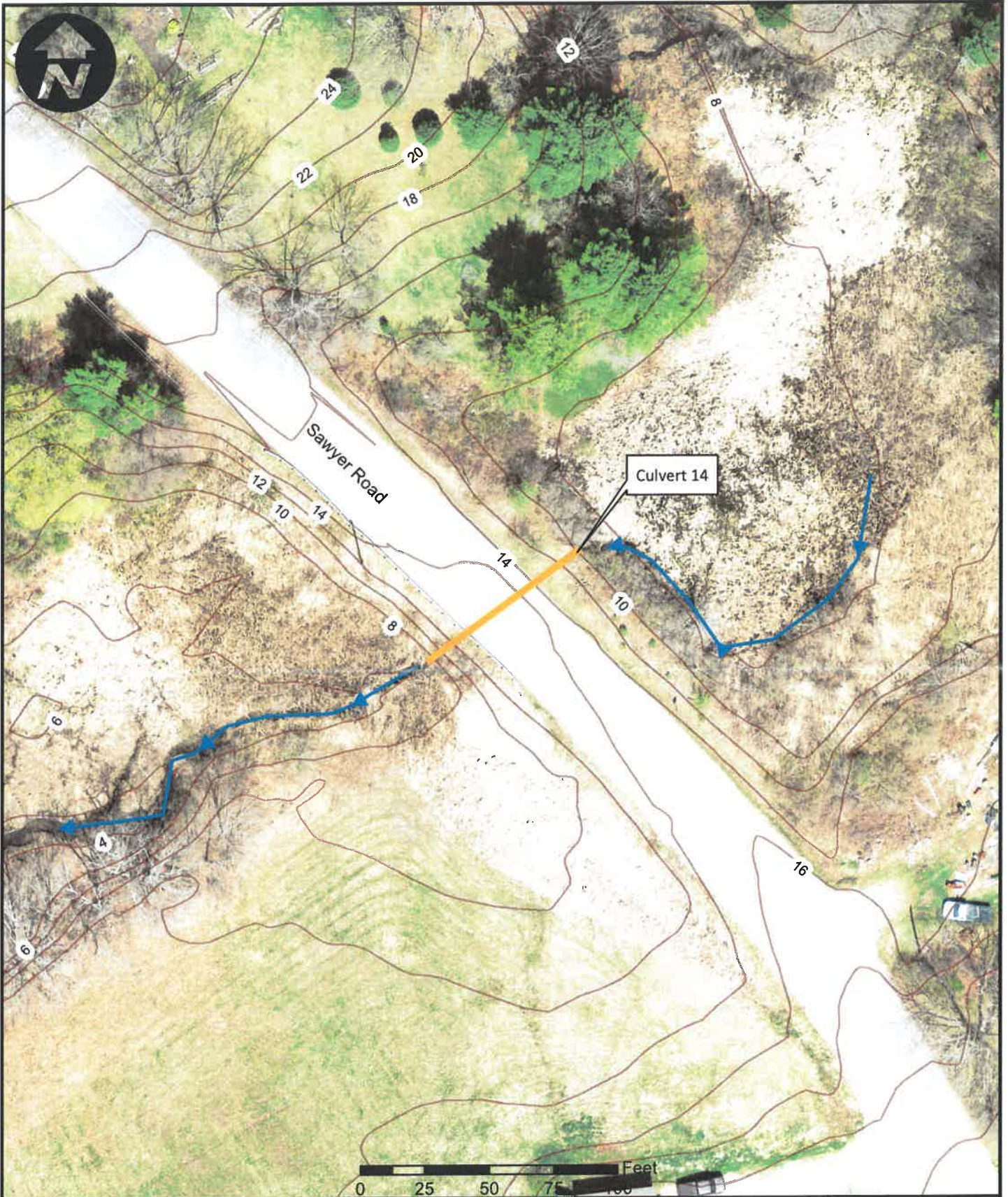
Photo 5 (06-06-18): Submerged outlet of the HDPE pipe on the west side of Sawyer Road. Thick vegetation around the end of the culvert could be better controlled with a rip rap apron.




Photo 6 (06-06-18): Overhead view of culvert outlet and the vegetation beyond the culvert outlet.



Photos 7 (06-20-18): Thich marsh vegetation dominates the downstream channel of the culvert that eventually drains to the Atlantic Ocean.



 WWW.SEBAGOTECHNICS.COM 75 John Roberts Rd. - Suite 4A South Portland, ME 04106 Tel. 207-200-2100	Culvert Assessment - Culvert 14 36-inch HDPE Pipe		SCALE: 1" = 50'
	LOCATION: Sawyer Rd North of 1270 Cape Elizabeth, ME 04107	INFORMATION: Maine Office of GIS 2017 Orthoimagery Maine Office of GIS 2006 Lidar derived contours	DATE: 10/16/18



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South Portland, ME 04106-6963
207.200.2100
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Culvert Inspection Form

City/Town: Cape Elizabeth
Project ID: 17125

Date:	June 20, 2018	Culvert No:	15
Name and Location of Road Crossing:	No road – Sanitary Sewer Easement Embankment 0.31 miles southeast of the Scott Dyer Road @ Spurwink Avenue Intersection		
Stream Name:	Willow Brook	Tributary To:	Spurwink River, Spurwink Marsh & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E. sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	These culverts were installed in 1984. The culverts are in poor condition overall, but the inverts of both pipes are corroding and deteriorating.		
Description of Existing Culvert			
Shape:	<input type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input checked="" type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input checked="" type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	Two: 36-inch wide by 48-inch tall	Approximate Length:	50 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No		
Bed material within culvert:	No		
Tidal Influence?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Approximate Elevation at Road Centerline:	10 Feet		
Additional Observations:	<p>These culverts are a prime candidate for replacement which will be a challenging project with the presence of a large diameter sanitary gravity interceptor sewer and a large diameter sanitary force main over the culvert. The force main carries the entire discharge flow from the Town's Treatment Plant.</p> <p>According to the Public Works Director there are also two, 4-inch underdrain pipes connected to the culverts which convey groundwater from the sanitary sewer pipes' bedding material.</p>		

Is the culvert hanging?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is there evidence of high water above the top of the culvert?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Additional Observations:	The pipes' exteriors are bituminous coated.		
Culvert Structure:			
Culvert lining?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Condition inside culvert:	<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems		
Box Culvert? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Cracks vertical/horizontal on sides/walls? <input type="checkbox"/> Yes <input type="checkbox"/> No	Undermining of footing of three-sided culvert? <input type="checkbox"/> Yes <input type="checkbox"/> No	Exposed footings? <input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Condition of oldest portion: <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension portion condition? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	Extension smaller than original pipe? <input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not visible	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not visible	
Is water seeping along the outside of the culvert (piping)?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:	Neither the inlet or the outlet has a rip rap headwall, apron, or plunge pool. Area is tidal and replacement culvert structure would need to be embedded.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall/Abutment <input type="checkbox"/> Concrete Wingwall <input type="checkbox"/> n/a		
Inlet damaged? <input type="checkbox"/> Yes <input type="checkbox"/> No	Headwall undermining? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Constrictions/obstructions at inlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

EC condition at inlet? <input type="checkbox"/> good <input type="checkbox"/> fair <input checked="" type="checkbox"/> poor - No rip rap present		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Culvert Outlet			
Outlet Type:		<input checked="" type="checkbox"/> Riprap Apron – Minor amount <input type="checkbox"/> Riprap Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall <input type="checkbox"/> Stone Headwall	
Outlet damaged? <input checked="" type="checkbox"/> Yes – corroded inverts <input type="checkbox"/> No		Headwall undermining? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> n/a	
Constrictions/obstructions at outlet? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			
EC condition at outlet? <input type="checkbox"/> good <input type="checkbox"/> fair <input checked="" type="checkbox"/> poor – some scouring		EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Habitat & Fish Passage			
Is Habitat and/or Fish a consideration:		<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is not identified in the Maine Stream Habitat Viewer because it is not located on a public road. However, the viewer habitat values listed for the culvert location include Tidal Marsh, and the Scarborough Marsh Ecological Focus Area.</p> <p>https://webapps2.cgis-solutions.com/MaineStreamViewer/</p> <p>The culvert is subject to increased inundation under a 1 ft or greater Sea Level Rise scenario delineated by Maine Geological Survey.</p> <p>https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml</p> <p>The culvert is within an area of potential marsh migration under a 1 ft or greater sea level rise scenario delineated by the Maine Natural Areas Program.</p> <p>https://www.maine.gov/dacf/mnap/assistance/marsh_migration.htm</p>	

	<p>The culvert outlet is perched and likely prevents upstream passage by aquatic organisms except during high tides. This site is subject to tidal flooding and is vulnerable to sea level rise. The culvert has been documented by the Wells National Estuarine Research Reserve as a tidal restriction, which reduces tidal flooding upstream. The potential for upstream marsh migration under projected sea level rise scenarios could be impeded by the existing culvert. Due to the tidal influence at the site, it is recommended that future culvert design incorporate appropriate study of tidal flow under potential sea level rise conditions.</p>
Additional Notes:	<p>This site is not within the Casco Bay watershed so it was not included in the 2010 US Fish and Wildlife/Casco Bay Estuary Partnership report on fish barriers.</p>

Step 14g

February 11, 2019

Signature

Date



Photo 1 (06-20-18): Facing east at the Sanitary Sewer Embankment crossing which also acts as a recreational trail connection to the Town Center. Culverts are located relatively deep in relation to the top elevation of the embankment. Stones visible in cleared area is the location of the emergency spillway.



Photo 2 (10-22-18): Inlets of the two, 48-inch wide by 36-inch tall corrugated aluminum pipes located northerly of the sanitary sewer crossing embankment. Inverts to both pipes are corroded and in decay.



Photos 3 (10-22-18): Looking down the barrel of the westerly inlet of the two Inlet culverts. Culverts' inlet invert has rusted away and the pipes are in poor condition.



Photos 4 (06-20-18): Looking down from onto one the two culverts' inlets. Culverts' inlet area is wide just upstream from the pipes with a narrower channel further upstream flowing toward the culverts.



Photo 5 (06-20-18): Upstream Willow Brook channel flows southerly through a wetland area to reach culvert.



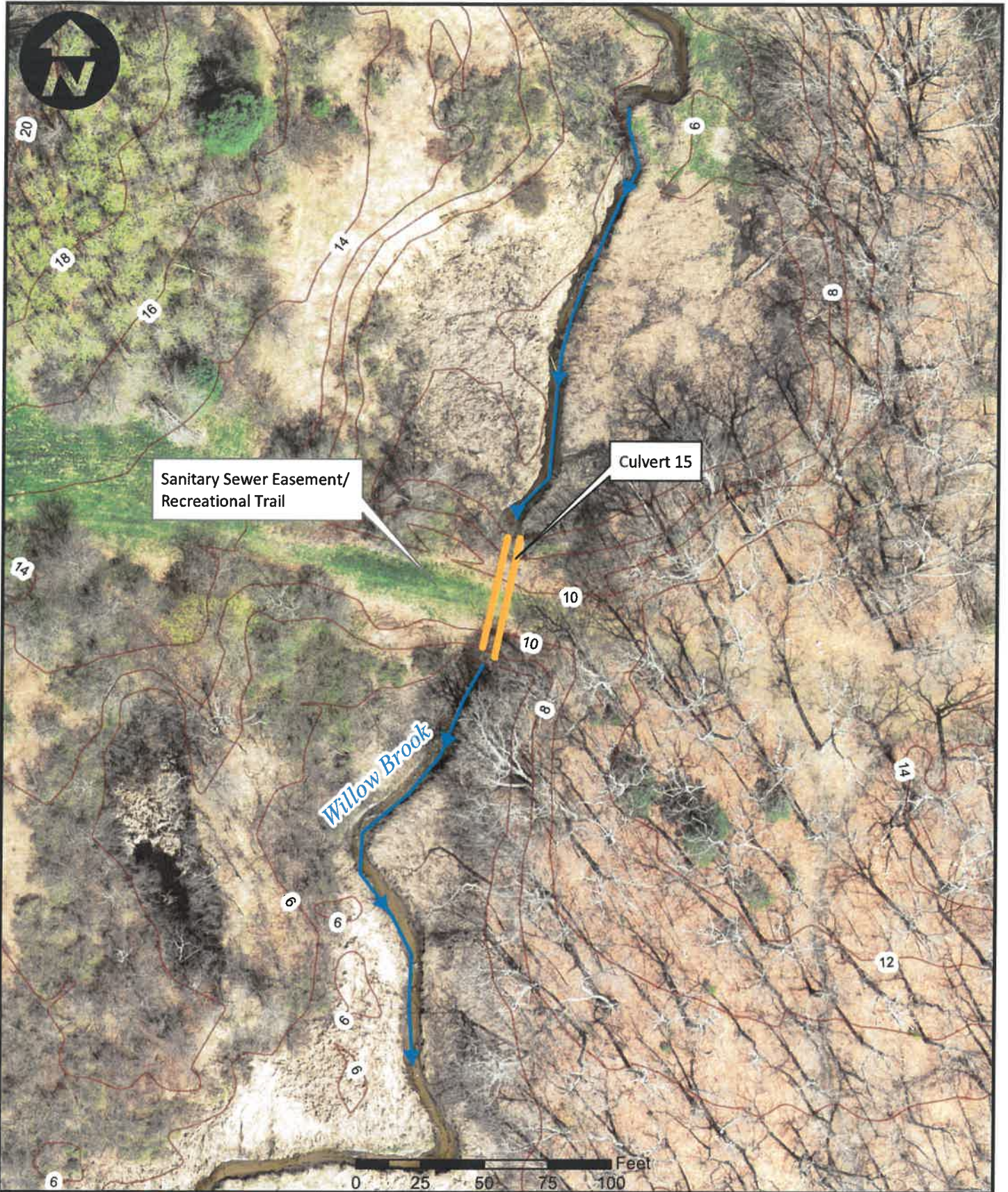
Photo 6 (10-22-18): One of the outlets of the culverts on the south side of the embankment is obscured by vegetation and partially buried in sediment. Outlet has some stone in the channel, but no formal plunge pool or visible headwall.



Photo 7 (10-22-18): Downstream channel of Willow Brook from the culvert outlet flow has marine sediment deposits from the tidal marsh.



Photo 8 (06-20-18): Downstream channel of willow Brook flows through the Spurwink Marsh in the background of photo and eventually discharges in the Spurwink River and then the Atlantic Ocean.



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75 John Roberts Rd., Suite 4A
South Portland, ME 04106
Tel. 207-200-2100

Culvert Assessment - Culvert 15
Two, 36" Tall by 48" Wide Elliptical Aluminum Corrugated Pipe

LOCATION:

Willow Brook South of Scott Dyer Rd
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours

SCALE: 1" = 50'

DATE: 10/16/18



75 John Roberts Road
 Suite 4A
 South Portland, ME 04106-6963
 207.200.2100
www.sebagotechnics.com

Culvert Inspection Form

City/Town: Cape Elizabeth
 Project ID: 17125

Date:	June 20, 2018	Culvert No:	16
Name and Location of Road Crossing:	Scott Dyer Road – Collector 0.22 miles northeast of the Scott Dyer Road @ Spurwink Avenue Intersection		
Stream Name:	Willow Brook	Tributary To:	Spurwink River, Spurwink Marsh & Atlantic Ocean
Town of Cape Elizabeth Representative: (name, phone, e-mail)	Robert Malley, Public Works Director Robert.malley@capeelizabeth.org (207) 799-4151		
Sebago Technics Representative: (name, phone, e-mail)	Stephen Harding, P.E. sharding@sebagotechnics.com (207) 200-2057		
Brief Narrative of Culvert Area & Any Past Concerns:	These culverts were installed in 2012 and are in good condition. The inlet the west culvert is lower in elevation so that pipe acts as the primary flow carrier with the other pipe being an overflow pipe to handle additional surface water during high intensity rainfall events.		
Description of Existing Culvert			
Shape:	<input checked="" type="checkbox"/> Round <input type="checkbox"/> Box <input type="checkbox"/> 3-Sided Box <input type="checkbox"/> Elliptical <input type="checkbox"/> Arch <input type="checkbox"/> Other		
Material:	<input checked="" type="checkbox"/> aluminum CP <input type="checkbox"/> concrete <input type="checkbox"/> HDPE <input type="checkbox"/> CMP <input type="checkbox"/> PVC <input type="checkbox"/> Other		
Size:	Two, 54-inch	Approximate Length:	60 Feet
Does roadway have a history of flooding?	<input type="checkbox"/> Yes (if yes, please describe circumstances) <input checked="" type="checkbox"/> No		
Bed material within culvert:	No		
Tidal Influence?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Approximate Elevation at Road Centerline:	17 Feet		
Additional Observations:	The southerly culvert is the prime flow carrying pipe and the northerly culvert is elevated and hanging for overflow conditions.		
Is the culvert hanging?	<input checked="" type="checkbox"/> Yes - east <input type="checkbox"/> No		
Is there evidence of high water above the top of the culvert?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		

Additional Observations:			
Culvert Structure:			
Culvert lining?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Condition inside culvert:		<input type="checkbox"/> cracking <input type="checkbox"/> spalling <input type="checkbox"/> abrasion <input type="checkbox"/> corrosion <input type="checkbox"/> joint gaps <input type="checkbox"/> open seems	
Box Culvert?		Cracks vertical/horizontal on sides/walls?	Undermining of footing of three-sided culvert?
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
Culvert extended?		Condition of oldest portion:	Extension portion condition?
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		<input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor	<input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor
			Exposed footings?
			<input type="checkbox"/> Yes <input type="checkbox"/> No
			Extension smaller than original pipe?
			<input type="checkbox"/> Yes <input type="checkbox"/> No
Is there a line of sight along the crown and spring line?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Is the culvert shape deflected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Is water seeping along the outside of the culvert (piping)?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Should the culvert be video inspected?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Additional Observations:	Minor amounts of vegetation around inlet and outlet area should be removed and silt has built up on the northerly elevated culvert outlet. Additional rip rap at the outlet apron would minimize future vegetation impacts and improve flow from culvert particularly for the eastern culvert.		
Culvert Inlet			
Inlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Apron/Embankment <input type="checkbox"/> Concrete Headwall/Abutment <input type="checkbox"/> Concrete Wingwall <input type="checkbox"/> n/a		
Inlet damaged?	Headwall undermining?	Constrictions/obstructions at inlet?	
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes - Minor vegetation <input type="checkbox"/> No	
EC condition at inlet?		EC condition behind wingwall?	
<input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor		<input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	

Culvert Outlet		
Outlet Type:	<input type="checkbox"/> Riprap Apron <input checked="" type="checkbox"/> Riprap Embankment <input type="checkbox"/> Concrete Headwall <input type="checkbox"/> Concrete Wingwall <input type="checkbox"/> Stone Headwall	
Outlet damaged? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Headwall undermining? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> n/a	Constrictions/obstructions at outlet? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
EC condition at outlet? <input checked="" type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor – some scouring	EC condition behind wingwall? <input type="checkbox"/> good <input type="checkbox"/> fair <input type="checkbox"/> poor <input checked="" type="checkbox"/> n/a	
Vegetation removal needed?		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Habitat & Fish Passage		
Is Habitat and/or Fish a consideration:	<input checked="" type="checkbox"/> Yes (if yes, please describe circumstances) <input type="checkbox"/> No <p>This culvert is identified in the Maine Stream Habitat Viewer as #11257. While no specific habitat values are identified for the location of the culvert in the state habitat data layers, in general any future culvert design should seek to adhere closely to stream crossing design standards recommended for all aquatic habitat. The Maine Stream Smart program outlines important considerations for habitat friendly culvert design.</p> <p>https://www.maineaudubon.org/projects/stream-smart/</p>	
Additional Notes:	This site lies outside the Casco Bay watershed, so it was not included in 2010 US Fish and Wildlife Service/Casco Bay Estuary Partnership report on fish barriers.	

Step 11g

February 11, 2019

Signature

Date



Photo 1 (10-22-18): Facing east at Scott Dyer Road at the Willow Brook culverts crossing.



Photo 2 (06-20-18): Inlet of two, 54-inch corrugated aluminum pipes located northerly of Willow Brook. Westerly (right) pipe is set lower to carry the primary flow. Inlet has a well armored rip rap apron and headwall.



Photos 3 (06-20-18): Looking northerly from Scott Dyer Road toward the two culverts Inlets.



Photo 4 (06-20-18): Upstream Willow Brook channel flows southerly through a wetland area to reach culvert inlets.



Photo 5 (06-20-18): Outlet of culverts on the south side of Scott Dyer Road. Westerly (left) pipe is set lower and carries the primary flow. Easterly culvert is partially blocked by vegetation.



Photo 6 (06-20-18): Culvert outlet discharge of Willow Brook on the south side of Scott Dyer Road. Some limited vegetation removal and rip rap at the end of the easterly pipe would ensure that its capacity is not compromised by additional vegetation growth.



Photo 7 (10-22-18): Downstream channel of Willow Brook flows to the Spurwink Marsh and then into the Spurwink River to eventually discharge in the Spurwink River and then the Atlantic Ocean.



SEBAGO
TECHNICS

WWW.SEBAGOTECHNICS.COM
75 John Roberts Rd. - Suite 404
South Portland, ME 04106
Tel: 207-200-2100

Culvert Assessment - Culvert 16
Two, 54-inch Corrugated Aluminum Pipes

LOCATION:

Scott Dyer Rd @ Willow Brook
Cape Elizabeth, ME 04107

INFORMATION:

Maine Office of GIS 2017 Orthoimagery
Maine Office of GIS 2006 Lidar derived contours

SCALE: 1" = 50'

DATE: 10/16/18

Appendix 3

Culvert Summary Table

The following table provides an "at-a-glance" highlights of data shown on the culvert assessment forms.

Culvert Summary Table

No	Location	Existing Type	Existing Size	*Calculated BFW (Measured)	*Q100 Peak Flood (cfs)	Watershed Size (Square Miles)	Date installed	Ownership	Vegetation	Habitat Impacts	Flood	Scour	Under-sized	Priority for Replacement	Proposed Replacement Structure	Cost estimate
Hydraulic Analysis group																
2	Shore Rd @ Dyer Pond Rd	AP	36 - inch	6.83' (7')	96.7 cfs	0.8 Sq Mi	2010	Town	N	N	M	M	Y	L	9'x5'x72' BC	\$280,000.00
3	Ocean House Rd @ Trout Brook	P	8'-2" W by 5'-9" T	6.83' (8')	101 cfs	0.8 Sq Mi	1983	State	N	d	L	L	N	M	10'x5'x96'BC	\$320,000.00
8	Spurwink Ave @ Trout Brook	AP	5'-0" W by 3'-8" T	7.26'	114 cfs	0.8 Sq Mi	2008	Town	Y	d, j, k	M	M	Y	M	12'x4'x56'BC	\$270,000.00
9	Mitchell Rd @ Pond Cove Brook	CMP	48 - inch	5.35' (9.3')	67.6 cfs	0.5 Sq Mi	1975	Town	Y	d	L	M	Y	H	12'x5'x64'BC	\$315,000.00
12	Eastman Rd @ Trout Brook	PVC	10 - inch	2.32'	18.7 cfs	0.1 Sq Mi	1983	Town	Y	d, g	M	L	Y	L	3'x48'RCP	\$90,000.00
15	Willow Brook @ Sewer Pipes Crossing	CMP	3'-0" W by 4'-0" T	8.06' (8.8')	135 cfs	1.1 Sq Mi	1984	Town	Y	a, b, f, k	L	H	Y	H	11'x5'x56'BC	\$275,000.00
Assessment only group																
1	Shore Rd @ Pond Cove	AP	3 - 36 - inch	8.79'	171 cfs	1.3 Sq Mi	1992/2015	Town	Y	a, f, g, j	M	L	Y	M		
4	Spurwink Ave @ #522	HDPE	36 - inch	3.32'	18.9 cfs	0.2 Sq Mi	2005	Town	Y	a, b, f, g, j, k	N	L	N	L		
5	Spurwink Ave @ Spurwink River	P	6'-0" W by 5'-0" T	10.4'	145 cfs	1.8 Sq Mi	1987	Town	N	a, b, f, g, j, k	M	H	Y	M		
6	Spurwink Ave @ Jordan Farm Pond outlet	AP	24 - inch	3.32'	36.6 cfs	0.2 Sq Mi	1992	Town	Y	N	Y	M	N	L		
7	Spurwink Ave @ SW of Purwoodock Dr	HDPE	30 - inch	3.32'	43.3 cfs	0.2 Sq Mi	2013	Town	N	d, j, k	L	M	N	L		
10	Old Ocean House Rd @ Alewife Brook	HDPE	2 - 48 - inch	9.79'	60.6 cfs	1.6 Sq Mi	2008	Town	Y	s, c	L	L	N	L		
11	Route 77 @ Alewife Brook	HDPE	70 - inch	9.47'	49.5 cfs	1.5 Sq Mi	2008	State	N	c, g, i, k	L	L	N	L		
13	Sawyer Rd @ Spurwink River	P	11'6" W by 10'-6" T	deferred to subsequent study			1997	Town	N	a, b, e, f, g, h, j, k	H	H	Y	H		
14	Sawyer Rd @ North off #1276	HDPE	36 - inch	3.32'	41.9 cfs	0.2 Sq Mi	1997	Town	Y	a, b, f, j, k	L	L	N	L		
16	Scott Dyer Road @ Willow Brook	CMP	2 - 54 - inch	7.67'	139 cfs	1.0 Sq Mi	2012	Town	Y	N	L	L	N	L		

*Source- Stream Stats, U.S.G.S.

Existing Type: AP- aluminum pipe, P- pipe arch, CMP- corrugated metal pipe, PVC - polyvinyl chloride, HDPE- High density polyethylene pipe

Existing Size: based on field measurement

BFW: Bank full width

Q100 Peak Flood (cfs): Estimated 100-year storm event peak flow rate in cubic feet per second (cfs)

Date installed: best information available

Ownership: state, town

Vegetation: N- not obstructing flows or access, Y- management needed

Habitat impacts: a- sea level rise impact; b- salt marsh intrusion; c- alewife spawning area blockage; d- eastern brook trout present; e- sea run smelt present; f- tidal marsh present; g- Beginning with Habitat connector in area of culvert; h- Threatened or endangered species present; i- non-native fish access risk if fish passage improvement; j- Tidal waterfowl or wading bird habitat present; k- Beginning with Habitat focus area; N- no data available

Flooding: H- floods more than 1/year, M- has flooded in past, L - no known flooding

Scour: H - impacting adjacent habitat, M - some scouring observed, L - No scouring

Under-sized: Y- yes, N- no

Priority for Replacement: high- should be replaced in 1-4 years, Medium - should be replaced in 5-10 years, Low - Replacement more than 10 years away

Appendix 4
Supplemental Hydraulic Analyses

Hydraulic analyses have been prepared for the following culverts:

1. Shore Rd @ Pond Cove
3. Ocean House Rd @ Trout Brook
5. Spurwink Ave @Spurwink River
8. Spurwink Ave @ Trout Brook
9. Mitchell Rd @ Pond Cove Brook
13. Sawyer Rd @ Spurwink River

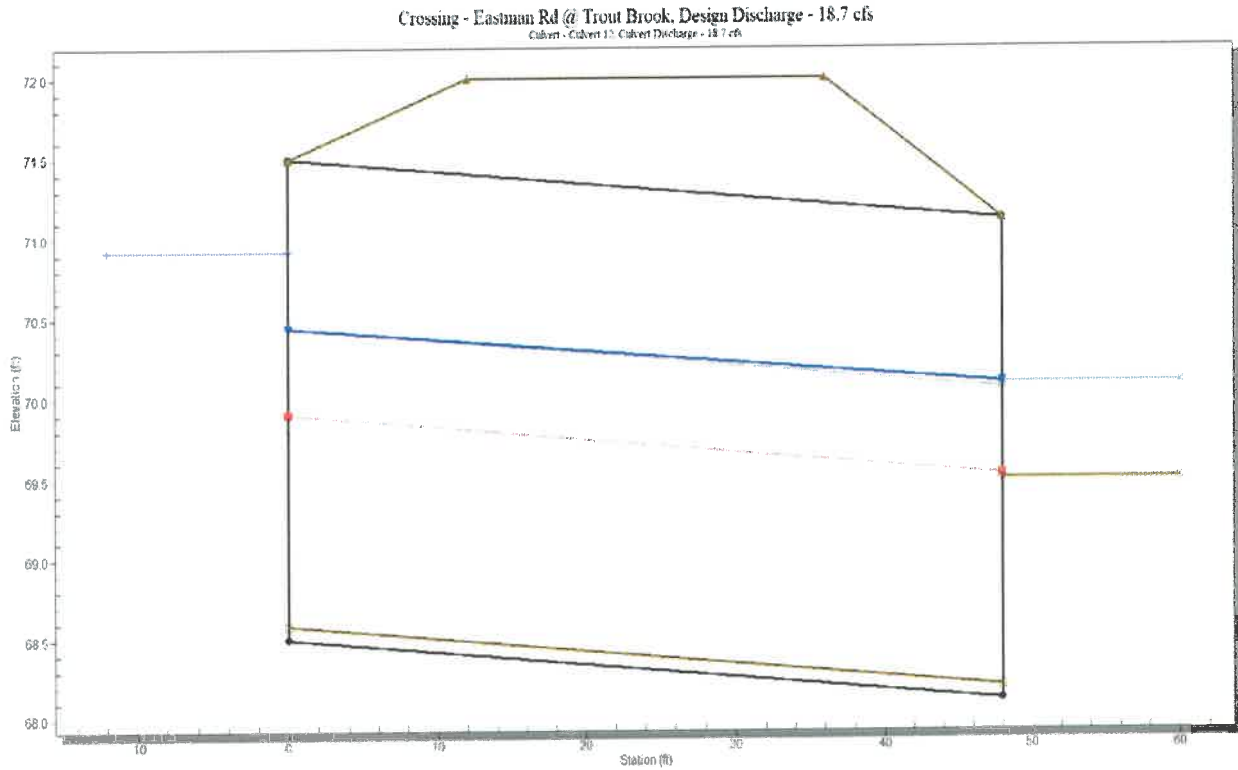


Figure 1. Q100 Headwater (Hw) elevation relative to culvert Depth (D).

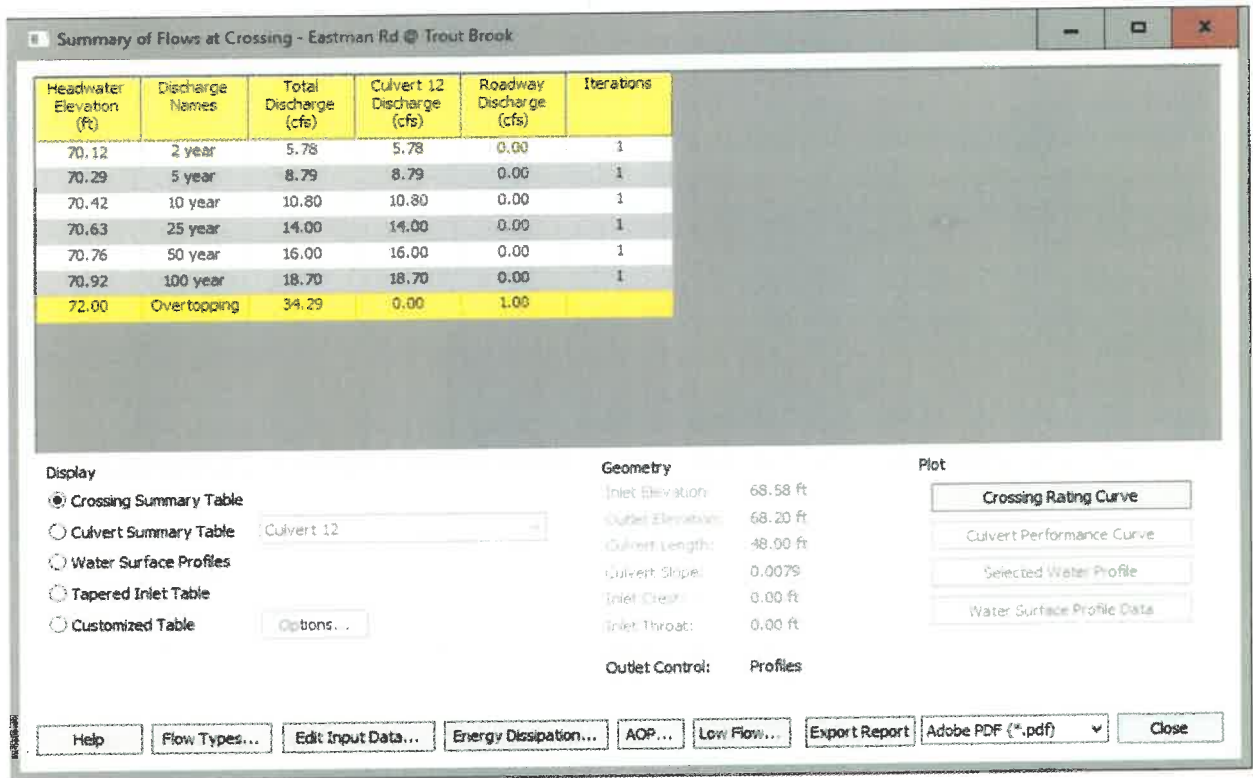


Figure 2. Summary of Flows at crossing.

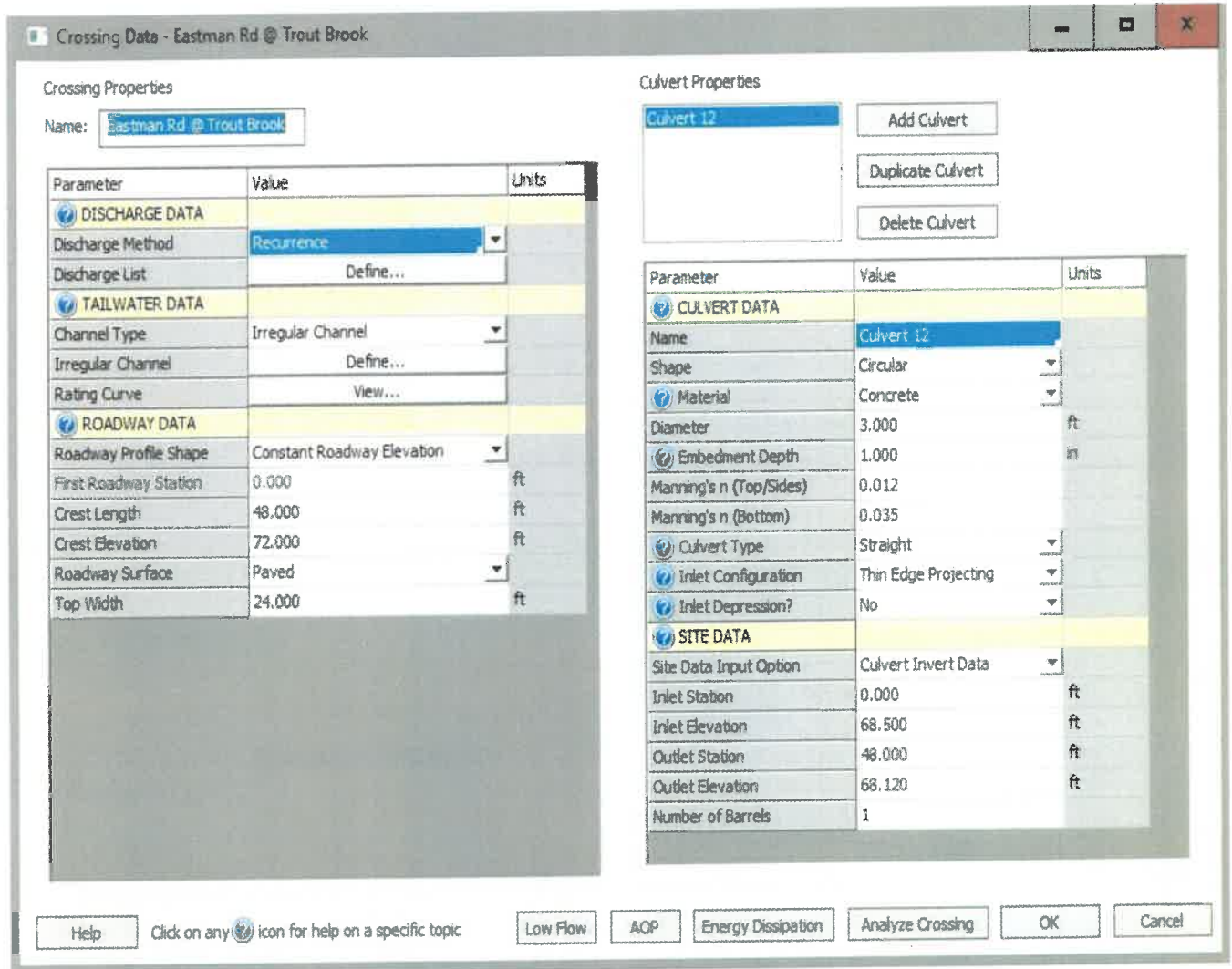


Figure 3. Crossing Properties. Assumed based on the data entered in Figures 4 & 5, meeting 1.2 bank full width and achieving Q100 Hw/D <= 1.

Number	Names	Flow (cfs)
1	1 year	
2	2 year	5.78
3	5 year	8.79
4	10 year	10.8
5	25 year	14.0
6	50 year	16.0
7	100 year	18.7
8	200 year	
9	500 year	

Figure 4. Discharge Data. Recurrence flow data based upon StreamStats.

Tailwater File

Browse for existing .TW file

Import...

Tailwater Channel

Slope of tailwater channel:

0.0050

ft/ft

Number of cross-sec points:

8

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	0.000	72.000	0.0700
2	100.000	70.000	0.0700
3	197.690	69.800	0.0700
4	197.700	69.500	0.0400
5	200.000	69.500	0.0400
6	200.010	69.800	0.0700
7	260.000	70.000	0.0700
8	300.000	72.000	

Figure 5. Tailwater Data. Assumed channel definition based on GIS information.

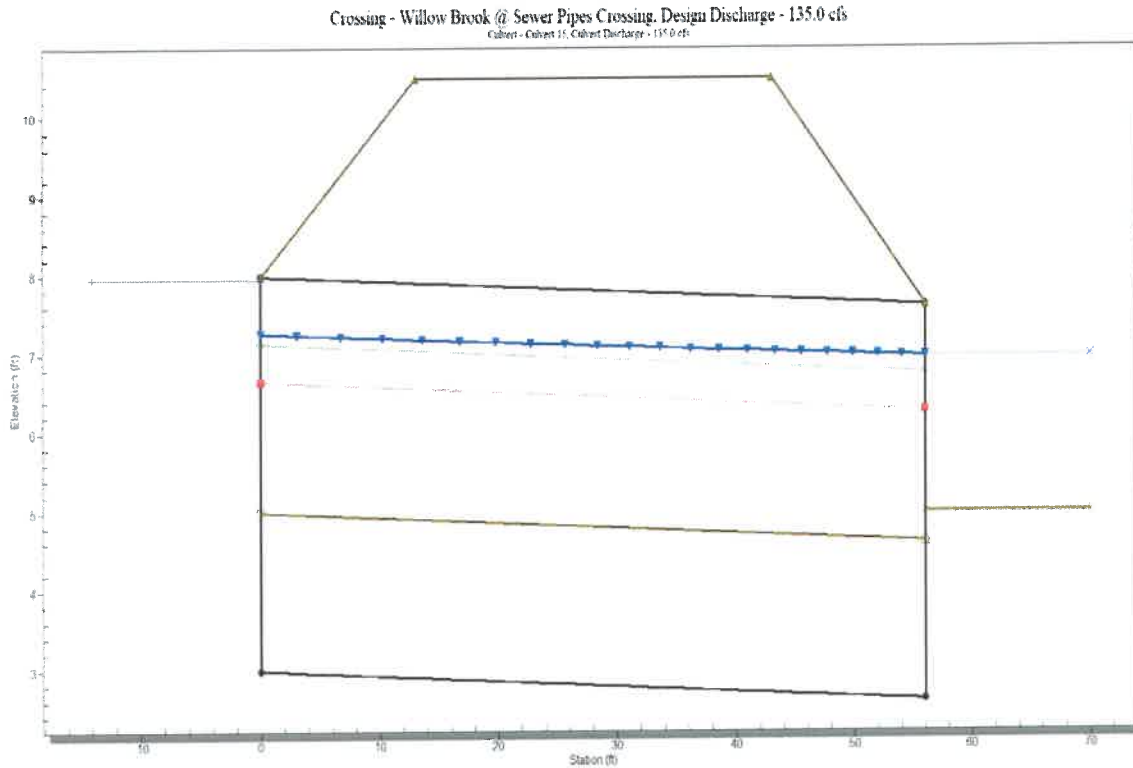


Figure 1. Q100 Headwater (Hw) elevation relative to culvert Depth (D).

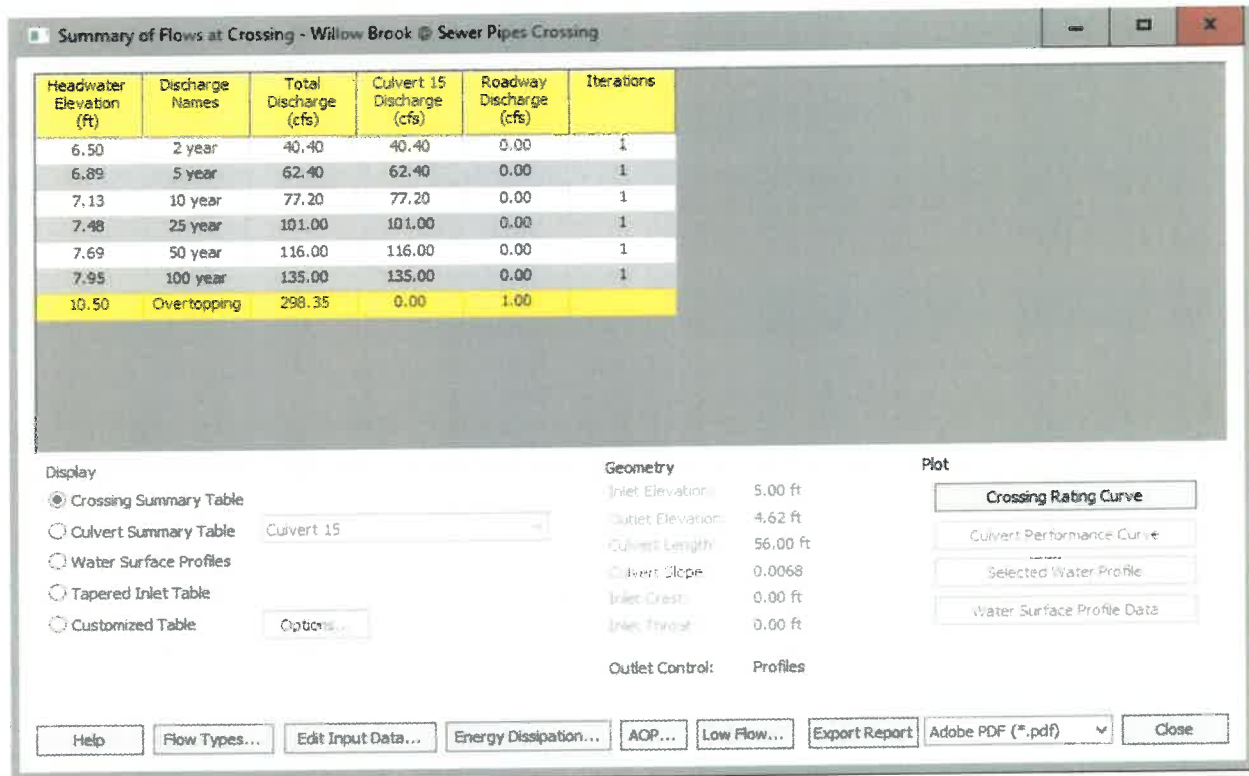


Figure 2. Summary of Flows at crossing.

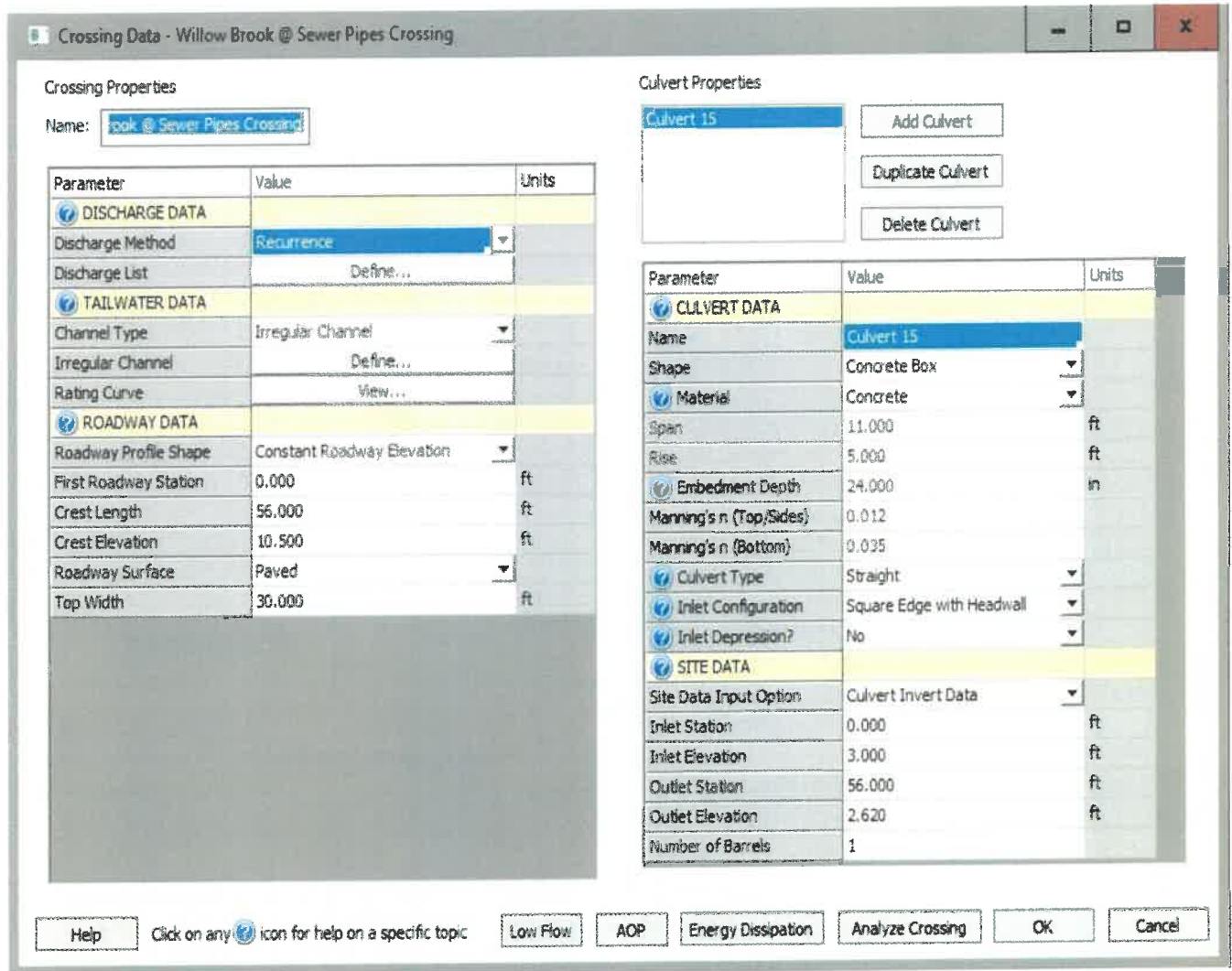


Figure 3. Crossing Properties. Assumed based on the data entered in Figures 4 & 5, meeting 1.2 bank full width and achieving $Q_{100} H_w/D \leq 1$.

Number	Names	Flow (cfs)
1	1 year	
2	2 year	40.4
3	5 year	62.4
4	10 year	77.2
5	25 year	101.0
6	50 year	116.0
7	100 year	135.0
8	200 year	
9	500 year	

Figure 4. Discharge Data. Recurrence flow data based upon StreamStats.

Tailwater File

Browse for existing .TW file

Import...

Tailwater Channel

Slope of tailwater channel:

0.0050

ft/ft

Number of cross-sec points:

10

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	0.000	10.000	0.0700
2	15.000	8.000	0.0700
3	90.000	6.000	0.0700
4	101.000	5.600	0.0700
5	101.010	5.000	0.0400
6	109.990	5.000	0.0400
7	110.000	5.600	0.0700
8	125.000	6.000	0.0700
9	132.000	8.000	0.0700
10	140.000	10.000	

Figure 5. Tailwater Data. Assumed channel definition based on GIS information.

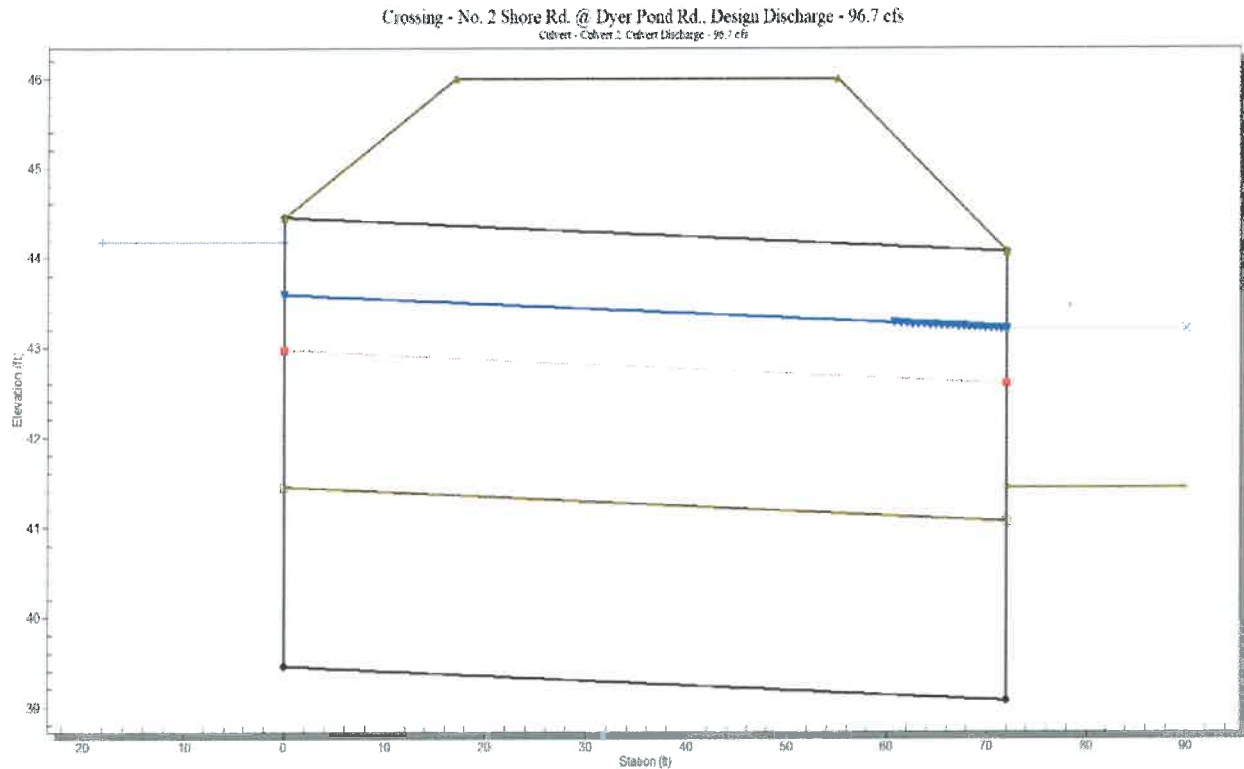


Figure 1. Q100 Headwater (Hw) elevation relative to culvert Depth (D).

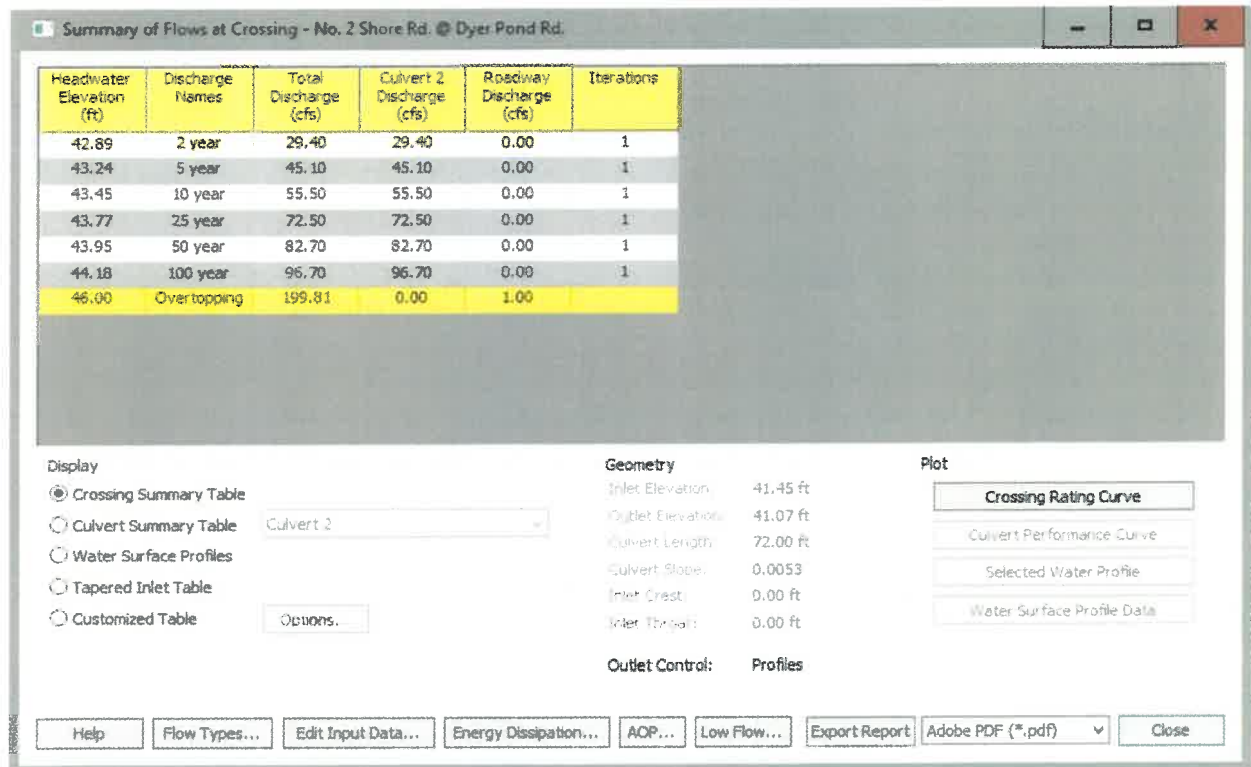


Figure 2. Summary of Flows at crossing.

Crossing Properties

Name:

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Recurrence	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Irregular Channel	
Irregular Channel	Define...	
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	72.000	ft
Crest Elevation	46.000	ft
Roadway Surface	Paved	
Top Width	38.000	ft

Culvert Properties

Parameter	Value	Units
CULVERT DATA		
Name	Culvert 2	
Shape	Concrete Box	
Material	Concrete	
Span	9.000	ft
Rise	5.000	ft
Embedment Depth	24.000	in
Manning's n (Top/Sides)	0.012	
Manning's n (Bottom)	0.035	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	39.450	ft
Outlet Station	72.000	ft
Outlet Elevation	39.070	ft
Number of Barrels	1	

Figure 3. Crossing Properties. Assumed based on the data entered in Figures 4 & 5, meeting 1.2 bank full width and achieving $Q_{100} H_w/D \leq 1$.

Number	Names	Flow (cfs)
1	1 year	
2	2 year	29.4
3	5 year	45.1
4	10 year	55.5
5	25 year	72.5
6	50 year	82.7
7	100 year	96.7
8	200 year	
9	500 year	

Figure 4. Discharge Data. Recurrence flow data based upon StreamStats.

Tailwater File

Browse for existing .TW file

Tailwater Channel

Slope of tailwater channel:

 ft/ft

Number of cross-sec points:

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	0.000	44.000	0.0700
2	60.000	42.000	0.0700
3	60.010	41.440	0.0700
4	66.990	41.440	0.0400
5	67.000	42.000	0.0400
6	80.000	42.000	0.0700
7	100.000	44.000	

Figure 5. Tailwater Data. Assumed channel definition based on GIS information.

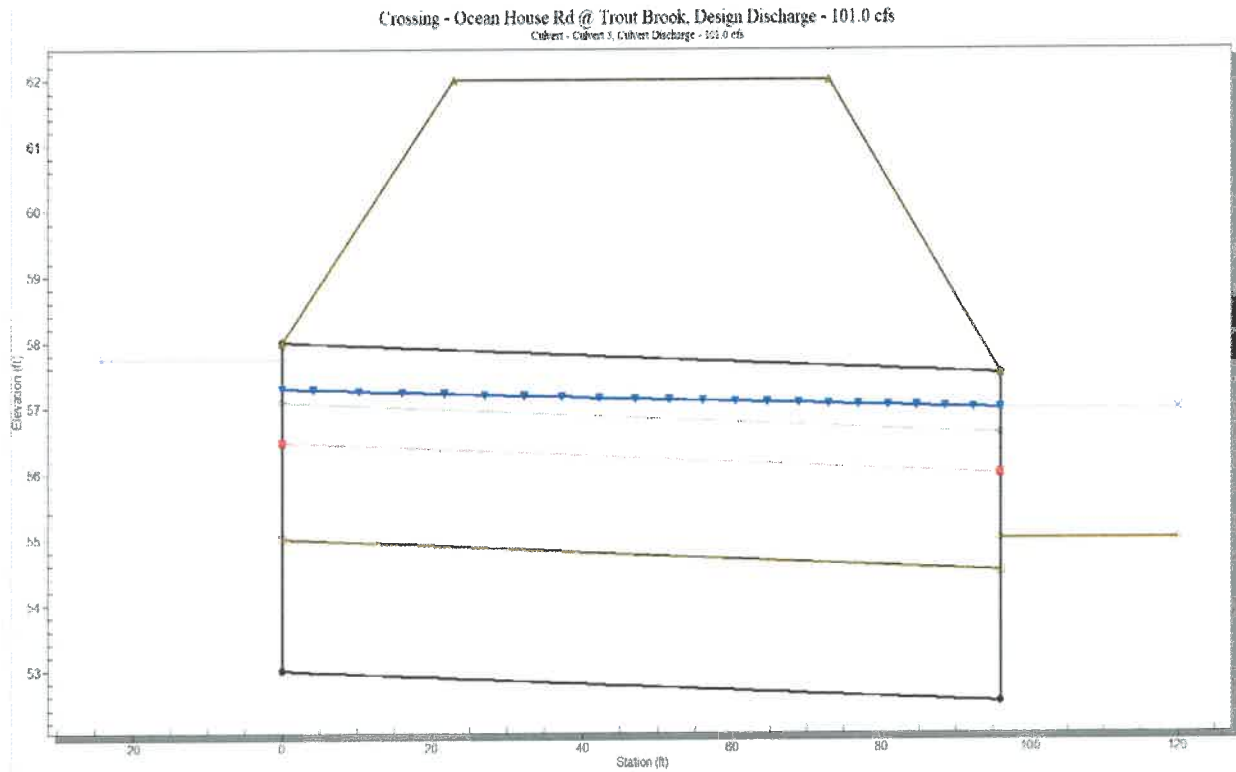


Figure 1. Q100 Headwater (Hw) elevation relative to culvert Depth (D).

Summary of Flows at Crossing - Ocean House Rd @ Trout Brook

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert 3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
56.44	2 year	30.40	30.40	0.00	1
56.80	5 year	46.80	46.80	0.00	1
57.01	10 year	57.70	57.70	0.00	1
57.33	25 year	75.40	75.40	0.00	1
57.51	50 year	86.20	86.20	0.00	1
57.75	100 year	101.00	101.00	0.00	1
62.00	Overtopping	285.34	0.00	1.00	

Display: Crossing Summary Table, Culvert Summary Table (Culvert 3), Water Surface Profiles, Tapered Inlet Table, Customized Table (Options...)

Geometry: Inlet Elevation: 55.00 ft, Outlet Elevation: 54.52 ft, Culvert Length: 96.00 ft, Culvert Slope: 0.0050, Inlet Crest: 0.00 ft, Inlet Throat: 0.00 ft, Outlet Control: Profiles

Plot:

Buttons: Help, Flow Types..., Edit Input Data..., Energy Dissipation..., ACP..., Low Flow..., Export Report, Adobe PDF (*.pdf), Close

Figure 2. Summary of Flows at crossing.

Crossing Data - Ocean House Rd @ Trout Brook

Crossing Properties

Name:

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Recurrence	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Irregular Channel	
Irregular Channel	Define...	
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.000	ft
Crest Length	96.000	ft
Crest Elevation	62.000	ft
Roadway Surface	Paved	
Top Width	50.000	ft

Culvert Properties

Culvert 3

Add Culvert

Duplicate Culvert

Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	Culvert 3	
Shape	Concrete Box	
Material	Concrete	
Span	10.000	ft
Rise	5.000	ft
Embedment Depth	24.000	in
Manning's n (Top/Sides)	0.012	
Manning's n (Bottom)	0.035	
Culvert Type	Straight	
Inlet Configuration	Square Edge with Headwall	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	53.000	ft
Outlet Station	96.000	ft
Outlet Elevation	52.520	ft
Number of Barrels	1	

Help Click on any icon for help on a specific topic Low Flow AOP Energy Dissipation Analyze Crossing OK Cancel

Figure 3. Crossing Properties. Assumed based on the data entered in Figures 4 & 5, meeting 1.2 bank full width and achieving $Q_{100} H_w/D \leq 1$.

Number	Names	Flow (cfs)
1	1 year	
2	2 year	30.4
3	5 year	46.8
4	10 year	57.7
5	25 year	75.4
6	50 year	86.2
7	100 year	101.0
8	200 year	
9	500 year	

Figure 4. Discharge Data. Recurrence flow data based upon StreamStats.

Tailwater File
 Browse for existing .TW file

Tailwater Channel
 Slope of tailwater channel: ft/ft
 Number of cross-sec points:

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	0.000	60.000	0.0700
2	6.000	58.000	0.0700
3	12.000	56.000	0.0700
4	20.000	55.550	0.0700
5	20.010	55.000	0.0400
6	26.990	55.000	0.0400
7	27.000	55.550	0.0700
8	40.000	56.000	0.0700
9	60.000	58.000	0.0700
10	70.000	60.000	

Figure 5. Tailwater Data. Assumed channel definition based on GIS information.

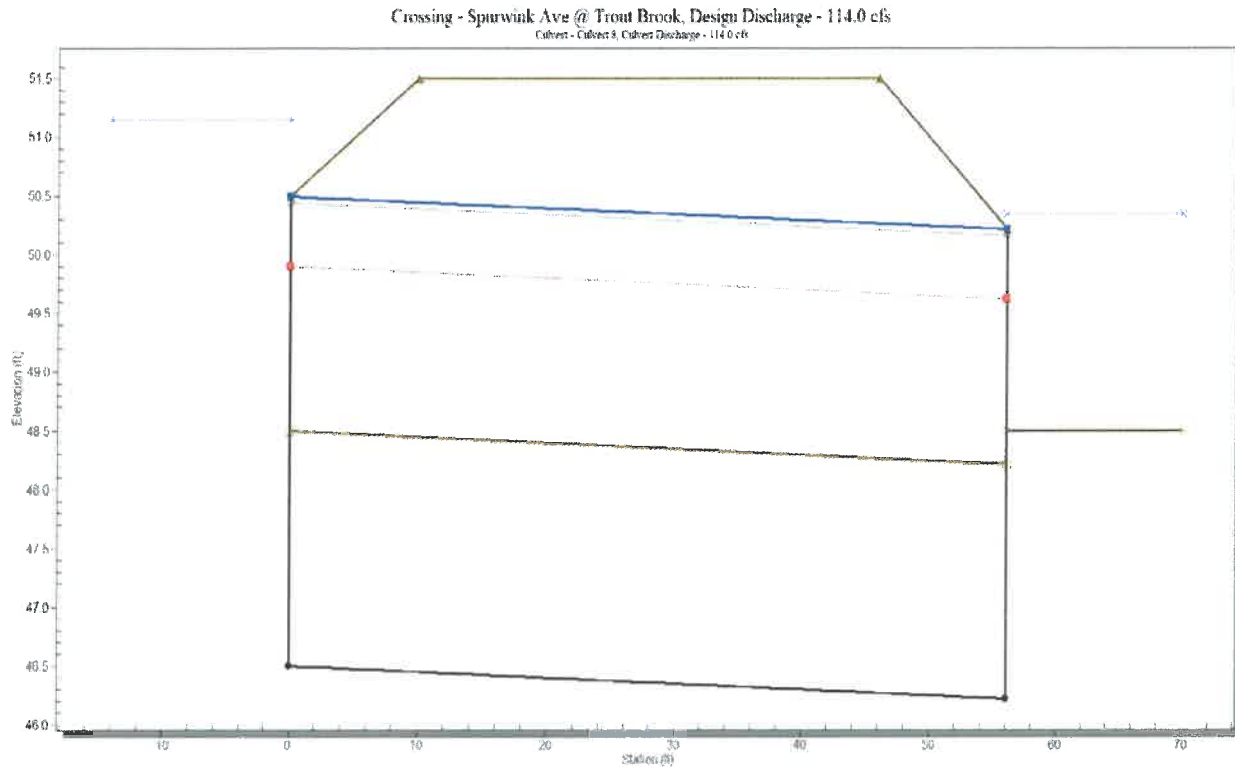


Figure 1. Q100 Headwater (Hw) elevation relative to culvert Depth (D).

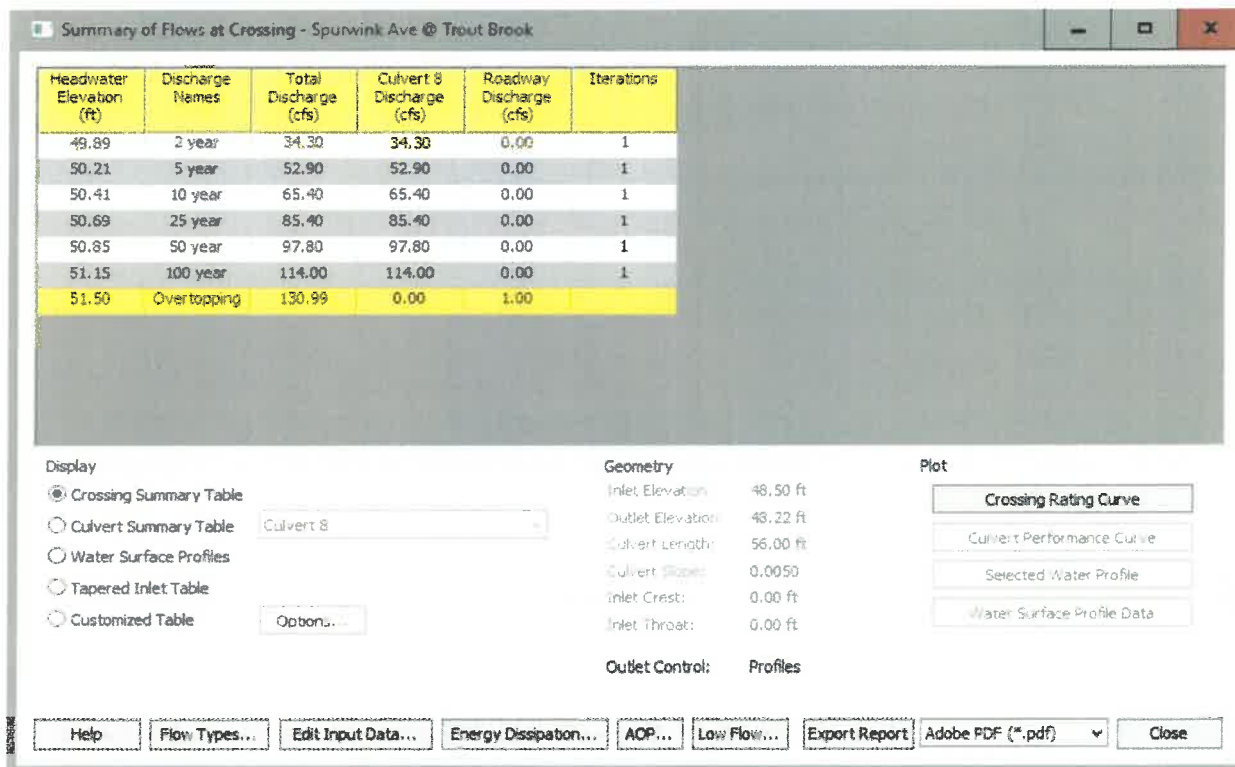


Figure 2. Summary of Flows at crossing.

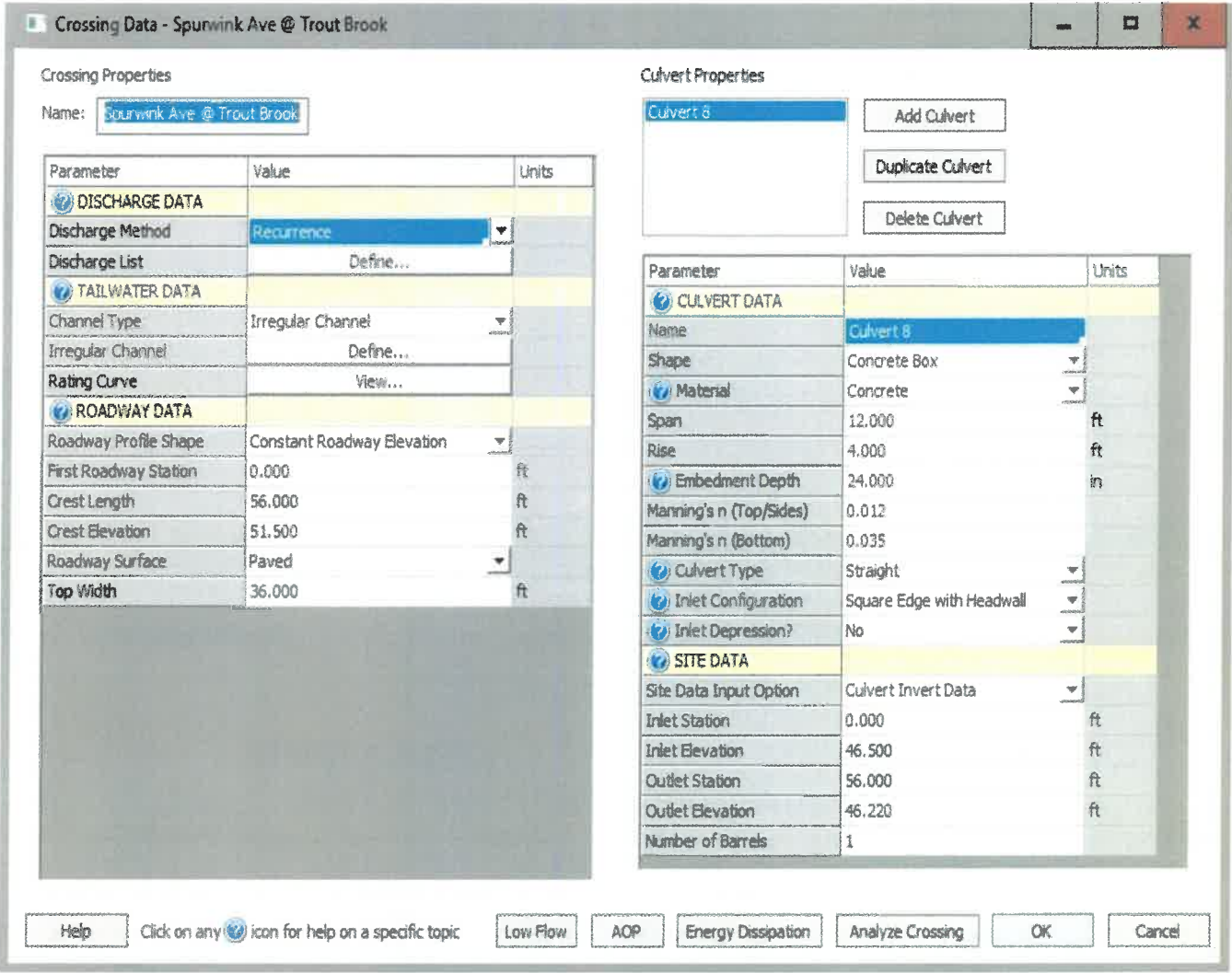


Figure 3. Crossing Properties. Assumed based on the data entered in Figures 4 & 5 and meeting 1.2 bank full width. Due to this crossing configuration, it was not reasonable to achieve the $Q_{100} H_w/D \leq 1$.

Number	Names	Flow (cfs)
1	1 year	
2	2 year	34.3
3	5 year	52.9
4	10 year	65.4
5	25 year	85.4
6	50 year	97.8
7	100 year	114.0
8	200 year	
9	500 year	

Figure 4. Discharge Data. Recurrence flow data based upon StreamStats.

Tailwater File

Browse for existing .TW file

Import...

Tailwater Channel

Slope of tailwater channel:

0.0050

ft/ft

Number of cross-sec points:

8

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	0.000	51.500	0.0700
2	25.000	50.000	0.0700
3	76.490	49.070	0.0700
4	76.500	48.500	0.0400
5	83.750	48.500	0.0400
6	83.760	49.070	0.0700
7	95.000	50.000	0.0700
8	160.000	51.500	

Figure 5. Tailwater Data. Assumed channel definition based on GIS information.

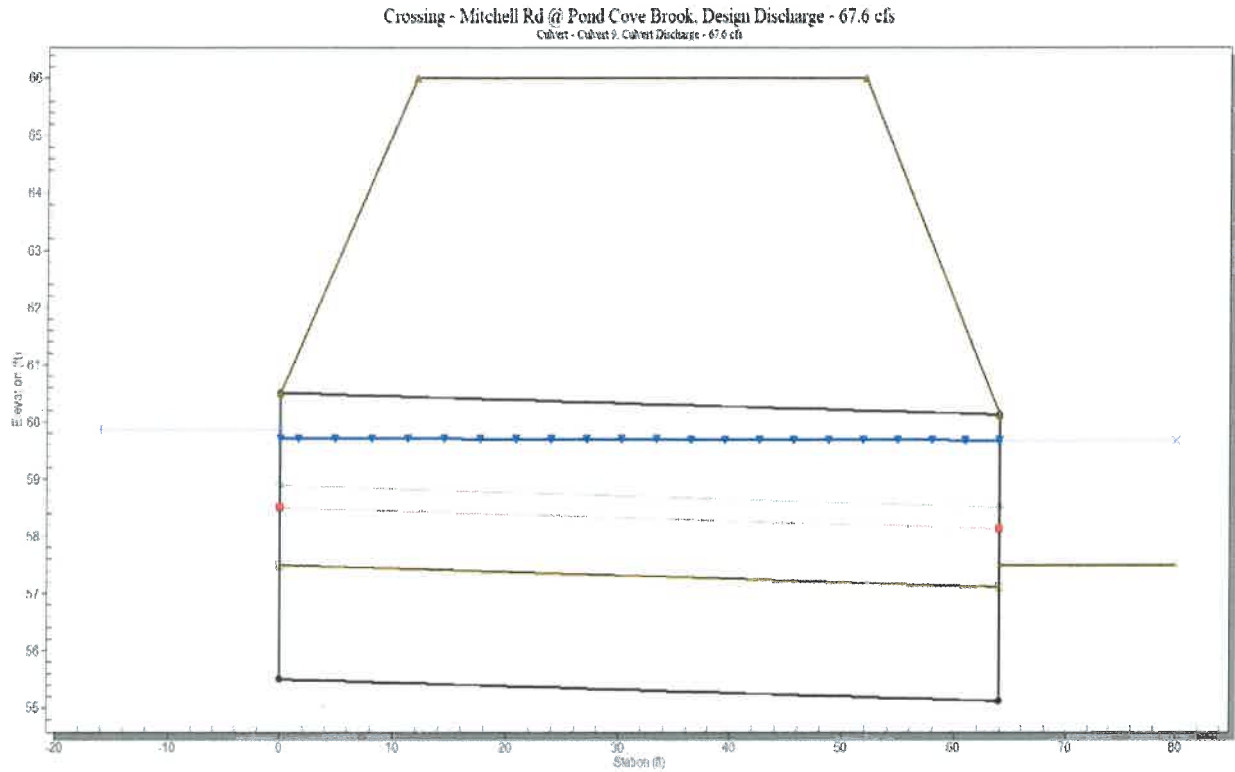


Figure 1. Q100 Headwater (Hw) elevation relative to culvert Depth (D).

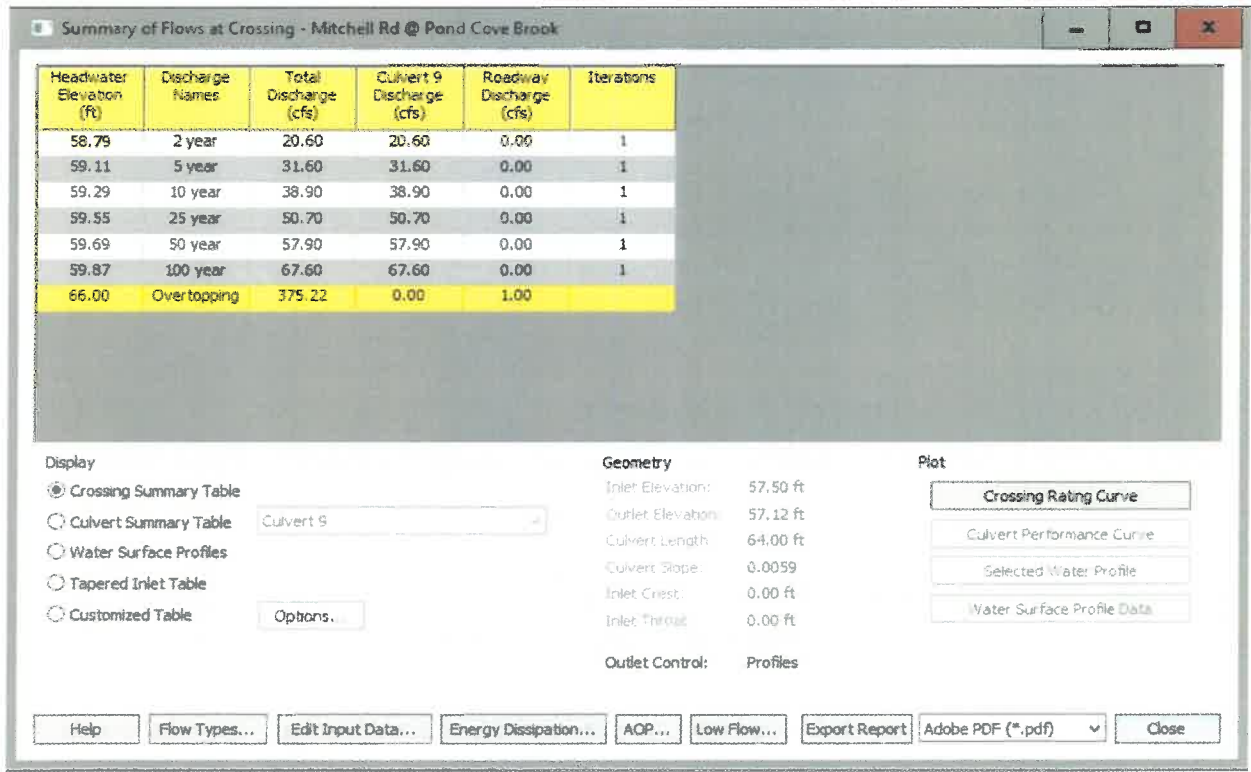


Figure 2. Summary of Flows at crossing.

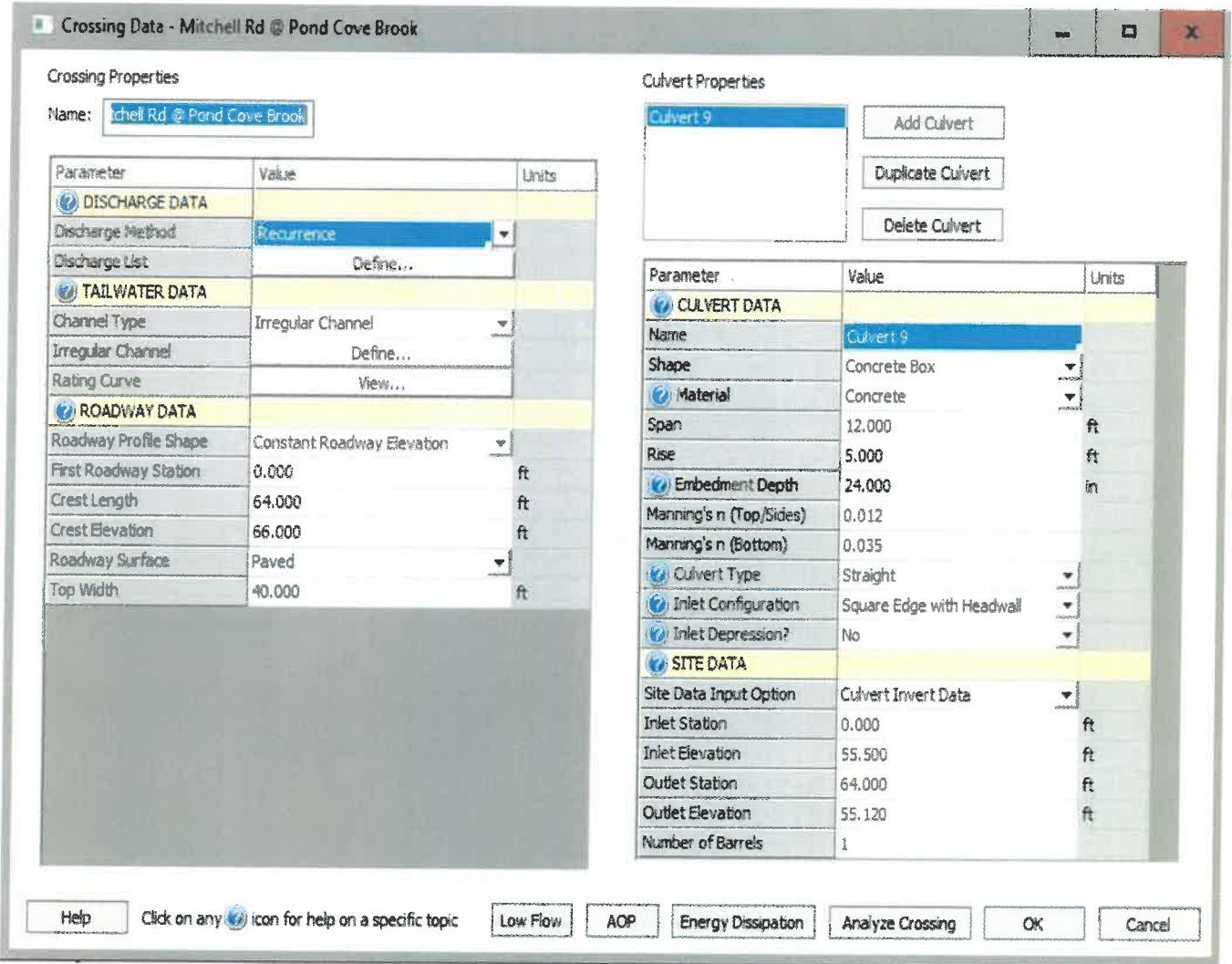


Figure 3. Crossing Properties. Assumed based on the data entered in Figures 4 & 5, meeting 1.2 bank full width and achieving $Q_{100} H_w/D \leq 1$.

Number	Names	Flow (cfs)
1	1 year	
2	2 year	20.6
3	5 year	31.6
4	10 year	38.9
5	25 year	50.7
6	50 year	57.9
7	100 year	67.6
8	200 year	
9	500 year	

Figure 4. Discharge Data. Recurrence flow data based upon StreamStats.

Tailwater File
Browse for existing .TW file

Tailwater Channel
Slope of tailwater channel: ft/ft
Number of cross-sec points:

Irregular Channel Cross-Section

No.	Station (ft)	Elevation (ft)	Manning n
1	0.000	64.000	0.0700
2	5.000	62.000	0.0700
3	10.000	60.000	0.0700
4	20.000	58.000	0.0700
5	20.010	57.500	0.0400
6	25.490	57.500	0.0400
7	25.500	58.000	0.0700
8	35.000	60.000	0.0700
9	50.000	62.000	0.0700
10	55.000	64.000	

Figure 5. Tailwater Data. Assumed channel definition based on GIS information.

Appendix 5
Engineer's Estimate of Conceptual Design

Sebago Technics
Engineer's Estimate of Conceptual Design
02/11/19

Item Description	Culvert #2	Culvert #3	Culvert #8	Culvert #9	Culvert #12	Culvert #15
	Amount	Amount	Amount	Amount	Amount	Amount
Earthwork	\$16,000.00	\$18,500.00	\$12,250.00	\$15,250.00	\$11,500.00	\$15,250.00
Paving	\$13,500.00	\$19,000.00	\$11,750.00	\$15,750.00	\$11,750.00	\$0.00
Sidewalk (Paving Only) or Curbing	\$1,500.00	\$4,000.00	\$0.00	\$0.00	\$0.00	\$0.00
Proposed Culvert #2- 9'x5' Precast Concrete Box Culvert (72' Length)	\$100,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Proposed Culvert #3- 10'x5' Precast Concrete Box Culvert (96' Length)	\$0.00	\$120,000.00	\$0.00	\$0.00	\$0.00	\$0.00
Proposed Culvert #8- 12'x4' Precast Concrete Box Culvert (56' Length)	\$0.00	\$0.00	\$115,000.00	\$0.00	\$0.00	\$0.00
Proposed Culvert #9- 12'x5' Precast Concrete Box Culvert (64' Length)	\$0.00	\$0.00	\$0.00	\$130,000.00	\$0.00	\$0.00
Proposed Culvert #12- 3' RCP (48' Length)	\$0.00	\$0.00	\$0.00	\$0.00	\$15,000.00	\$0.00
Proposed Culvert #15- 11'x5' Precast Concrete Box Culvert (56' Length)	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$115,000.00
Sewer Issue with Culvert #15* Unknown Value could increase pending investigation	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$30,000.00
Metal Guardrail	\$9,000.00	\$3,000.00	\$0.00	\$6,000.00	\$0.00	\$0.00
Riprap/Slope Stabilization	\$5,000.00	\$5,000.00	\$2,500.00	\$7,500.00	\$1,500.00	\$2,500.00
Plain Riprap Aprons	\$1,250.00	\$1,250.00	\$1,500.00	\$1,500.00	\$500.00	\$1,500.00
Site Restoration	\$1,500.00	\$1,500.00	\$1,500.00	\$2,000.00	\$500.00	\$500.00
Retaining Wall Repair	\$10,000.00	\$15,000.00	\$0.00	\$0.00	\$0.00	\$0.00
Pavement Markings	\$600.00	\$600.00	\$600.00	\$600.00	\$0.00	\$0.00
Traffic Control Devices and Flaggers	\$15,000.00	\$15,000.00	\$15,000.00	\$15,000.00	\$10,000.00	\$0.00
Temporary Soil Erosion & Water Pollution Control Including Cofferdams, Pumps, etc.	\$30,000.00	\$30,000.00	\$35,000.00	\$35,000.00	\$15,000.00	\$35,000.00
Mobilization and General Conditions (10%)	\$20,335.00	\$23,285.00	\$19,510.00	\$22,860.00	\$6,575.00	\$19,975.00
Contingency (25%)	\$55,921.25	\$64,033.75	\$53,652.50	\$62,865.00	\$18,081.25	\$54,931.25

Estimate Total	\$279,606.25	\$320,168.75	\$268,262.50	\$314,325.00	\$90,406.25	\$274,656.25
Engineer's Estimate of Conceptual Design (Rounded to appropriate order of magnitude)	\$280,000.00	\$320,000.00	\$270,000.00	\$315,000.00	\$90,000.00	\$275,000.00

Note: Pricing is based on 2019 costs and does not include permitting costs or surveying, engineering, and construction services.
Assumptions: The cost shown within assumes a 100' project length for each culvert. Stream restoration upstream and downstream outside of the immediate area surrounding the proposed culvert is not included within this cost.