

Bruce Freeman Rail Trail Culvert Inventory

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As you are aware, Tighe & Bond is assisting the Town of Sudbury with undertaking a Culvert Management Program that consists of Town staff completing an inventory of all crossings (culverts and bridges) throughout Sudbury previously identified by Tighe & Bond through a desktop exercise.

During fall and early winter 2017, Town staff members, John Murphy and Richard Weil, performed field investigations of the crossings on the Bruce Freeman Rail Trail in the section from the Town line with Concord to the intersection with Route 20. During this time, 16 culverts along the Rail Trail were inventoried. Crossings 4 and 72 were not inventoried by staff because they were determined to be bridges and the crossings south of Route 20 were not inventoried as they are not part of Phase 2 of the rail trail extension. The attached map shows the locations of all crossings on the rail trail and crossings where inventory information was collected.

Tighe & Bond has reviewed the information provided by Town staff. As requested by the Town of Sudbury, we are providing this memorandum summarizing the inventory of those culverts and our assessment based on the photographs and information included in the inventory.

Note that culverts labeled as BF____ were mapped by Town staff in the field as the crossing was not identified through our initial desktop inventory.

The following pages provide photographs and notes on each culvert. The next section discusses repair, replacement, and additional assessment needs.

Summary of Inventoried Culverts

Based on the photographs and inventory information provided by the Town, the following

- Culverts BF200, 29, 21, BF202, 101, 75, 32, and 107 are stacked stone and granite, which is common for old railroad crossings in New England. These culverts need an inspection of the interior to assess whether there are gaps in the stonework and evidence of backfill material entering the culvert through joints between stones, which would indicate a structural issue and may result in needed repair or replacement. Further inspection is needed by an engineer.
- The remaining eight culverts are a variety of diameters and materials, and range in condition. Culvert 3 is a 6-inch inside diameter concrete culvert, Culvert 14 is a box culvert but obstructed, Culvert 100 is cast iron circular pipe, Culvert 30 is a concrete box structure, Culvert BF203 is cast iron and based on photos may have a portion that is CMP, Culvert BF204 is a corrugated circular metal pipe, Culvert 158 is submerged, and Culvert BF205 is too buried /overgrown to identify however there is a note that

the rail trail plans show a 12" cast iron pipe. Condition and repair needs are further described in the following bullets.

- Culvert BF200 and 32 are mostly blocked with debris. These culverts are candidates for replacement but further evaluation is needed as described in this memorandum. Culvert 107 appears to have failed on the downstream end and is a candidate for replacement.
- Two culverts need repairs:
 - The headwalls of Culvert 100, at both the inlet and outlet, are failing. Depending on actual site conditions, headwalls could be removed and area could be stabilized with riprap or headwalls could be replaced. Culvert does not likely need to be replaced.
 - BF203 needs headwalls to be repointed with mortar. Pipe appears to be in good condition.
- Culvert 3 appears undersized but in good condition. Evaluation of need to repair given hydraulics and potential impacts to abutting wetlands systems must be completed to determine if replacement is warranted.
- If Culvert BF204, under Morse Road, truly is a small diameter culvert, debris removal and further evaluation is needed to determine if replacement is warranted.
- The stability of the Culvert 30 outlet embankment needs to be confirmed as the slope of riprap appears steep and spot repairs appear to have been made to improve stability. If the embankment is unstable, repairs or replacement is needed.
- Culverts 3 (upstream), BF200 (downstream), 14 (upstream and downstream), 21 (upstream and downstream), BF202 (upstream and downstream), BF204 (upstream), 32 (downstream) 107 (downstream), BF205 (upstream and downstream), 158 (upstream and downstream) all need some level of debris, trash, and/or sediment removal.
- Culverts 14 and 158 were mostly submerged at the date of visit and therefore an inventory could not be completed. Following sediment and debris removal, further evaluation of condition is necessary to determine replacement or repair needs.

Culvert 3

There is excessive debris buildup upstream due to Beaver Dam, which is restricting flow. Debris should be removed. Pipe appears to be approximately 6" interior diameter with a 1.5 inch wall thickness, which may be undersized depending on hydraulic needs of the site. Upsizing the culvert at this location could have impacts to the abutting wetlands systems. A site visit and further evaluation are needed to determine if replacement is appropriate.



Photo 1: Looking upstream from Culvert 3



Photo 2: Pipe may be outlet of Culvert 3

BF200

Culvert appears to be mostly blocked with debris and have minimal hydraulic capacity. This culvert appears to be a candidate for replacement, however, additional information is needed (e.g. Is there a history of flooding here? Does this culvert ever see flow?) At a minimum, culvert needs to be cleaned to remove sediment and obstructions at the inlet.



Photo 3: Inlet of BF200



Photo 4: Outlet of BF200

Culvert 14

There are heavy obstructions (trash, wood) upstream of the culvert. It is difficult to identify the inlet and outlet from the photographs. Town staff could not complete inventory because culvert is submerged. Culvert needs to be cleaned to remove sediment and obstructions for further assessment to be completed.



Photo 5: Culvert 14 looking upstream



Photo 6: Downstream views at Culvert 14 (left stream channel, culvert outlet)

Culvert 100

Headwalls appear unstable and susceptible to collapse, which could block streamflow. Pipe appears to be in good condition. If issues are limited to the headwall, one low cost option would be to remove the concrete on upstream side and stabilize the area with riprap. Depending on actual site conditions, headwalls may need to be replaced.



Photo 7: Inlet of Culvert 100



Photo 8: Outlet of Culvert 100

Culvert 29

The upstream headwall appears stable. The interior from the outlet needs to be assessed to verify that there is not material coming through joints between stones that make up the culvert walls/roof, which would indicate a potential structural issue.



Photo 9: Inlet of Culvert 29



Photo 10: Outlet of Culvert 29

Culvert 30

From the photographs there appears to be minor spalling and cracking in the concrete. Inventory information provided by Town staff notes medium severity scour under the footers at the inlet. The stability of the embankment on the downstream end needs to be confirmed as the slope of riprap appears steep and spot repairs appear to have been made to improve stability. If the embankment is unstable, repairs or replacement is needed. The photographs do not allow us to confirm stability of the embankment on the upstream end.



Photo 11: Inlet of Culvert 30



Photo 12: Outlet of Culvert 30

Culvert 21

Culvert needs to be cleared of obstructions for further assessment to be completed, especially on upstream end. Verify that there is not loss of backfill material through joints between stones. If loss of backfill material above the culvert is noted, the culvert should be repaired or replaced depending on severity of issues. The culvert width appears to become smaller at the outlet end, reducing flow capacity and increasing the likelihood of getting clogged with debris.



Photo 13: Inlet of Culvert 21



Photo 14: Outlet of Culvert 21

BF202

Culvert needs to be cleaned to remove obstructions for further assessment to be completed. Culvert needs verification that stones on upstream and downstream headwall continue to be stable and to verify that there is not loss of backfill material through joints between stones. If headwalls or culvert interior need stabilization, consider repair versus replacement options.



Photo 15: Inlet of Culvert BF202



Photo 16: Outlet of Culvert BF202

Culvert 101

Culvert needs verification that stones on upstream and downstream headwall continue to be stable and to verify that there is not loss of backfill material through joints between stones. If headwalls or culvert interior need stabilization, consider repair versus replacement options.



Photo 17: Inlet of Culvert 101



Photo 18: Outlet of Culvert 101

BF203

Headwalls need to be repointed with mortar. Pipe appears to be in good condition. Photograph shows steel rods that extend through pipe at inlet – confirm purpose.



Photo 19: Inlet of Culvert BF203



Photo 20: Outlet of Culvert BF203

BF204

Debris blocks upstream end and reduces hydraulic capacity. It is difficult to determine the culvert condition from the photograph. The inventory data note the inlet and outlet are 1' diameter corrugated metal pipe. Area upstream and downstream of culvert needs to be cleaned to remove obstructions and confirm culvert.



Photo 21: Inlet of Culvert BF204



Photo 22: Outlet of Culvert BF204

Culvert 75

Culvert needs verification that stones on inlet and outlet headwall continue to be stable and to verify that there is not loss of backfill material through joints between stones. If headwalls or culvert interior need stabilization, consider repair versus replacement options.



Photo 23: Inlet of Culvert 75



Photo 24: Outlet of Culvert 75

Culvert 32

Based on the photographs and inventory information provided by the Town, this outlet of this culvert appears to be blocked. Sediment and material needs to be removed to determine the outlet condition. We cannot determine if the culvert has collapsed. If the culvert has collapsed, it should be replaced. A site visit by is needed to confirm specific next steps.



Photo 25: Inlet of Culvert 32



Photo 26: Outlet of Culvert 32

Culvert 107

The outlet of this culvert may be collapsed as indicated by the granite block shown at an angle protruding from the water. There is significant debris preventing flow on the downstream side. Culvert needs to be cleaned to remove sediment and obstructions and further assessed.



Photo 27: Inlet of Culvert 107



Photo 28: Outlet of Culvert 107

BF205

No photographs were taken of BF205 as the upstream and downstream side was too buried /overgrown to identify. Notes from the field inventory indicate the outlet has a stone/granite headwall. Condition could not be assessed. There is a note that the rail trail plans show a 12" cast iron pipe.

Culvert 158

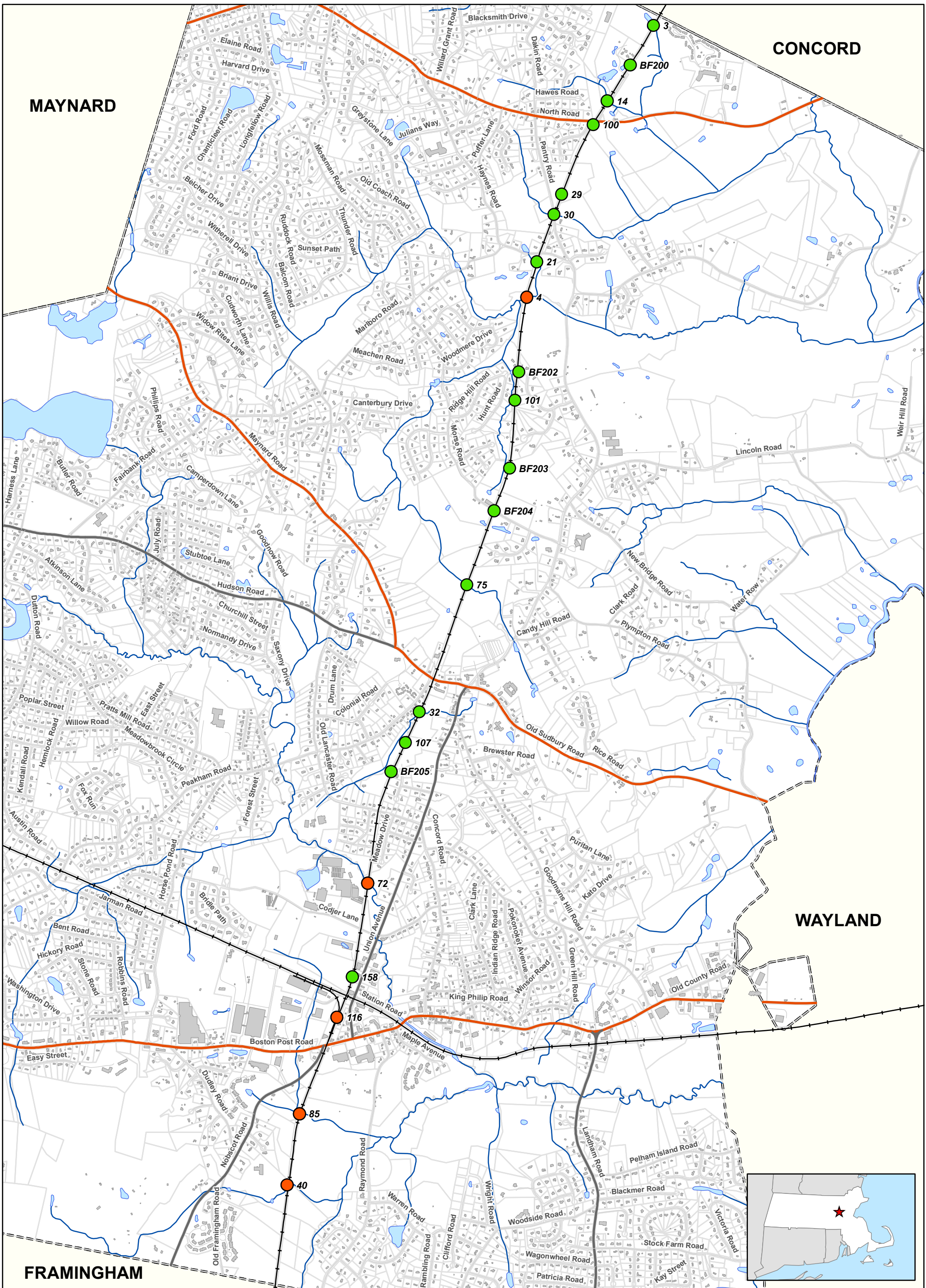
The photographs show a mostly submerged culvert and there is vegetative growth that is blocking the view of the inlet and outlet, therefore the condition cannot be assessed. Additional information is needed (is there a history of flooding at this location?) Debris appear to be reducing hydraulic capacity. Culvert needs to be cleaned to remove sediment and obstructions.



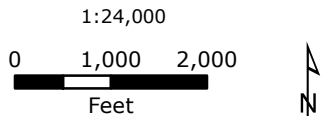
Photo 29: Inlet of Culvert 158



Photo 30: Outlet of Culvert 158



- LEGEND**
- Inspected Crossing
 - Crossing Not Inspected
 - Buildings
 - Parcels
 - Other Numbered Highway
 - Major Road - Collector
 - Minor Street or Road
 - Town Boundary



**Bruce Freeman
Rail Trail Crossings**

Sudbury, Massachusetts

February 2018