MEMORANDUM

TO: Town of Hinesburg

FROM: Roy Schiff and Jessica Louisos of Milone & MacBroom, Inc.

DATE: July 10, 2013

RE: Summary of Findings
Patrick Brook / Route 116 Culvert Review – Hinesburg, VT
MMI# 4726-02

Existing Structure

- Existing concrete box culvert 7 feet wide, 4 feet tall, and 30 feet long
- Slope = 2.9%
- ID
  - Route 116 Culvert Project ID 6
  - VTrans MM 5.05
  - ANR SGA 300211002804071 (Stream Reach M15S2.01)

Proposal

- Extend existing culvert 5 feet upstream (east) as part of a road widening project for a portion of the Vermont Route 116 near the intersection of Commerce Street to accommodate a southbound left turn lane as part of the proposed Hannaford development in Hinesburg, Vermont.
- Extension will have width of 8 feet and height of 6 feet, according to the Route 116/Commerce Street Intersection Improvement Plan (Sheet C6) dated March 18, 2013.

Recommendations from Vermont 116 Culvert AOP Project in Hinesburg, Vermont (2012)

- When changes take place to the structure the size should be increased to improve conveyance, geomorphic compatibility, and aquatic organism passage.
- Width = 14 feet and height = 8 feet
- Embed structure 20% of the height
- Lower inlet by 1.5' to reduce slope. Lower outlet by 1.0' to increase backwater depth.
- Decrease slope by 0.9%. (Proposed slope = 2%)

Structure Condition

- MMI 2012 assessment: The bottom of the structure shows some signs of deterioration with scouring and some cracking at the joints between the walls and floor. The downstream end of the culvert has significant spalling and exposed rebar. The structure otherwise appears to be in acceptable condition based on the non-intrusive visual observations. The downstream end of the culvert is deteriorated, while the upstream end appears to have been repaired in the past several years. Otherwise ok condition.
- VTrans: No major structural issues. OK to extend from structural point of view. Some repair may be needed on wingwalls during extension.

- The proposed culvert extension will not change the structural condition of the existing culvert. We recommend that if the extension project takes place, minor concrete repairs on the wingwalls and box should be performed when the extension is installed. Repairs of the downstream face of the culvert should also be addressed to extend the engineering life of the extended structure.

Conveyance (flood water, sediment, debris, ice)

- Culvert is backwatered under normal flows.
- Undersized now for existing Patrick Brook 50-year design flow
    - If upstream diversion structure to canal continues to deteriorate and fails an estimated 689 cubic feet per second would flow through the structure and the water depth would be 9.2 (Hw/D).
    - If upstream diversion structure to canal remains in place, an estimated 155 cubic feet per second would flow through the structure and the water depth would be 1.1 (Hw/D).
- Culvert filled, or filled above top in the conservative design scenario, yet 3 feet of cover exists over the structure and active floodplain at culvert so some upstream flood storage exists to limit roadway overtopping.
- Limited existing capacity for sediment, debris, and ice in addition to design flow due to narrow width relative to channel bankfull width.
- The proposed culvert extension will not change existing flood capacity, or conditions in the mapped floodway, floodplain, or fluvial erosion hazard zone.
- Substantial changes to the movement of sediment, debris, and ice are also not anticipated, yet a longer structure, with a 1-foot width contraction at the extension, may be more prone to debris and ice jamming during floods. The culvert may be harder to clean out when it clogs since the change in dimensions would take place approximately 6 feet from the proposed inlet.
- Upstream peak flows should not be increased to the culvert given it is undersized. If possible, runoff volume increases should also be avoided.
- A ditch parallels Route 116 and directs drainage to the upstream side of the culvert. Reconfiguration of the ditch may be needed to accommodate the culvert extension.

Geomorphic Compatibility

- Partially compatible with the Patrick Brook channel
    - "Structure compatible with either current form or process, but not both. Compatibility likely short term. There is a moderate risk of structure failure and replacement may be needed. Re-design suggested to improve geomorphic compatibility" (Schiff et al., 2008a).
- Structure width is 70% of bankfull channel width.
    - Proposed state standard for culvert sizing is 120% bankfull channel width, or 100% bankfull channel width in low risk settings.
    - The current measured bankfull width of 10 feet may be unnaturally narrow in the event all flow travels down Patrick Brook because water has been diverted to the canal for many years. Hydraulic geometry curves (VTDEC, 2006) indicate the bankfull width should be 31.5 feet for the entire upstream watershed area of 7.2 square miles. Thus, the proposed structure width of 14 feet that is suitable for

conveyance and aquatic organism passage, may be undersized in terms of geomorphic compatibility.

- Sediment discontinuity exists at structure and may be leading to increase in downstream erosion potential.
- Historic channel straightening exists. Some channel migration is likely in the future, and sediment discontinuity may increase channel instability downstream.
- The proposed culvert extension will not change geomorphic compatibility.
- ANR to recommend larger culvert to improve geomorphic compatibility.

Aquatic Organism Passage

- Reduced aquatic organism passage
    - "Structures that likely limit AOP for some species or life stages due to limited depth or high velocities" (Schiff et al., 2008b).
- Minor impact to instream habitat under proposed culvert expansion likely.
- Good habitat potential upstream in wooded area. Downstream channel has narrow buffer and is exposed. Subject culvert important link to fish moving upstream from the LaPlatte River to reach better habitat between the culvert and canal, and possibly upstream should the diversion structure breach or the old channel to the north reconnect.
- The proposed culvert extension will decrease aquatic organism passage due to the length increase. This outcome is not desired, and in conflict with state design guidelines (Bates and Kirn, 2009). State stream alteration permit (VTANR, 2013) requires that structure repairs, when greater than 50% of the total structure cost, cannot further reduce aquatic organism passage. The proposed extension is not likely to be 50% of the total structure cost, yet the recommendation to not further reduce aquatic organism passage may be appropriate to follow.
- ANR to recommend larger culvert to improve aquatic organism passage.

Water Quality

- The proposed culvert extension will not change water quality. Water quality impacts will take place if there is a change to runoff characteristics at the subject parcel or in the upstream drainage area.

Sidewalk/Pedestrian Bridge Project

- The NRG Pedestrian Path and Bridge Plan dated 7/18/2008 shows a proposed crossing of Patrick Brook approximately 25 feet upstream of the existing Route 116 culvert. If the proposed culvert extension were to take place, the bridge would be approximately 19 feet upstream.
- Having two crossings close to each other is not preferred for both geomorphic compatibility and aquatic organism passage. This is especially true if the structures are sized less than the channel bankfull width.
- The area of the proposed path and bridge is often wet, in part due to the undersized subject culvert. A larger structure under Route 116 would likely improve the proposed pedestrian crossing and path.
- The proposed culvert extension will not require changes to the proposed pedestrian path and bridge layout, yet some adjustments to the project layout may be desired in the future depending on what takes place at the Route 116 culvert.

References

Bates, K. and R. Kirn, 2009. Guidelines for the Design of Stream/Road Crossings for Passage of Aquatic Organisms in Vermont. Prepared by Kozmo, Inc. with Vermont Department of Fish and Wildlife, Agency of Natural Resources, Waterbury, VT.

Schiff, R., J. S. Clark, and S. Jaquith, 2008a. The Vermont Culvert Geomorphic Compatibility Screening Tool. Prepared by Milone & MacBroom, Inc. with the VT DEC River Management Program, Waterbury, VT.

Schiff, R., J. S. Clark, and R. Kirn, 2008b. The Vermont Culvert Aquatic Organism Passage Screening Tool. Prepared by Milone & MacBroom, Inc. with the VT Department of Fish and Wildlife, Roxbury, VT.

VTDEC, 2006. Vermont Regional Hydraulic Geometry Curves. Appendix J of the Vermont Stream Geomorphic Assessment Protocol Handbooks: Remote Sensing and Field Surveys Techniques for Conducting Watershed and Reach Level Assessments. Vermont Agency of Natural Resources, Department of Environmental Conservation, Division of Water Quality, River Management Program, Waterbury, VT.