MEMORANDUM

TO: Adam Lougee, Addison County Regional Planning Commission
Bryan Davis, Chittenden County Regional Planning Commission

FROM: Roy Schiff, Milone & MacBroom, Inc.

DATE: June 22, 2012

RE: Vermont 116 Culvert AOP Project in Starksboro and Hinesburg, VT
MMI# 3928-03 and 3993-05

Introduction

Vermont Route 116 in Starksboro and Hinesburg is slated for re-paving by the Vermont Agency of Transportation (VTrans) in 2013. Smaller culverts (diameter ~ 48 inches or smaller) that are in structurally poor condition or that cause flooding over the roadway are planned to be replaced in 2012 to allow for settling before resurfacing a year later. This pilot project, led by the Addison and Chittenden County Regional Planning Commissions, injects aquatic organism passage (AOP) assessment and design into the planned culvert replacements on Vermont 116. The primary objective of this project is to identify structures where subtle and inexpensive design changes such as small increases to pipe size or re-setting of the culvert can improve fish passage so that these changes can be readily incorporated into planned culvert replacements. The ultimate goal of this work is to incorporate fish passage improvements into regular paving operations around the state.

Methods and Results

This project consisted of three steps: (1) Assessment and initial prioritization; (2) Hydraulic and AOP calculations, and final prioritization; and (3) Design recommendations.

Assessment and Initial Prioritization

Culvert assessment had been previously performed at some of the structures following the Vermont Bridge and Culvert Assessment (VTANR, 2009). Existing data were reviewed and an assessment plan was made. All existing structures were visited – fifteen in Starksboro and twenty-two in Hinesburg. Photo-documentation was performed (Appendix A). If no data existed culverts were fully assessed. Culverts were re-assessed if field conditions and past assessment data did not agree. Data such as current structural condition and structure slope were recorded for prioritization and calculations. Assessment data were used to generate screening scores for AOP (Schiff et al., 2008b) and geomorphic compatibility (GC) (Schiff et al., 2008a) from the internet-based Vermont Data Management System. Data were used to initially prioritize structures for improvements in AOP, GC, and structural condition.

Tabulated assessment results and maps (Table 1 and Figure 1) were distributed to the project team for review prior to the first of three meetings. Members of the project team had assessed some of the subject culverts or had an interest in their condition and fish passability. The project team included the following members.

- Addison County Regional Planning Commission
- Chittenden County Regional Planning Commission
- Town of Starksboro
- Town of Hinesburg
- Lewis Creek Association
- LaPlatte River Watershed Partnership
- Vermont Agency of Transportation
- Vermont Department of Fish and Wildlife
- Vermont Department of Environmental Conservation
- U.S. Fish and Wildlife Service
- Milone & MacBroom, Inc.

Feedback from the project team was incorporated into the assessment results to refine the initial prioritization. At this stage in the project bridges were removed from further consideration as they were beyond the scope of the project. Sixteen of the smaller structures were found to have no fish habitat and thus AOP was not a consideration at these locations. Many of these culverts were located along roadside ditches or depressions in fields rather than perennial streams. The drainage area to these small structures was typically less than or equal to 0.1 square miles.

Hydraulic and AOP Calculations

Watershed area was delineated in GIS or using the internet-based U.S. Geological Survey StreamtStats tool where peak flow estimation can be performed (Olson, 2002). The 50-year design flow was estimated by numerous regression equations based on guidance in the Vermont Hydraulics Manual (VTrans, 2001). Pipe-sizing hydraulic calculations (FHWA, 1985; VTrans, 2001) were performed for all structures to facilitate current or future replacement. Pipes were sized to maintain an acceptable level of submergence (i.e., Hw / D = 1.2) during the design flow.

AOP hydraulic design calculations were performed using FishXing (Furniss et al., 2009) and Vermont AOP guidelines (Bates and Kirn, 2009) to investigate fish passing at the existing structure and the larger structure typically required to adequately contain the design storm. Changes to the pipe slope, inlet and outlet were explored to achieve fish passage. AOP calculations were only performed at those structures where suitable fish habitat existed.

AOP was also explored at larger structures sized to completely span the channel bankfull width to be geomorphically compatible with the stream channel. These larger structures were only recommended at AOP priority locations where improvements beyond the scope of this project may be desired in the future. Hydraulic and AOP calculations were tabulated (Table 2) to illustrate the four possible alternatives – leave the pipe as existing, enlarge the pipe to safely convey the design flow, further enlarge the pipe if necessary to improve AOP, and enlarge the pipe even more if necessary to contain the bankfull channel width. A second project team meeting was held to review the calculation results and initial design recommendations.

Design Recommendations

The final product of the project consists of a table summarizing the design recommendations (Table 3). Structures are grouped by action items for the current VTrans paving project, future AOP improvement recommendations that are beyond the scope of this project, smaller structures where AOP is not an important consideration, and bridges that are outside of the project scope. Eight culverts are slated for replacement with design adjustments to improve AOP before paving (Figure 2). Ten culverts were identified as important AOP improvement projects for the future as they are beyond the scope of small culvert replacements during paving.

Results were presented to the project team for feedback and several groups elected to visit structures to explore design recommendations. U.S. Fish and Wildlife Service visited site 16 in Hinesburg to observe potential brook trout habitat and determined that the site was not an AOP priority due to a nearby natural upstream barrier. Vermont Department of Environmental Conservation visited most sites to explore geomorphic compatibility and generally agreed with the recommendations. One pipe size recommendation was increased to accommodate known debris clogging at a site.

Summary

The total project cost was $25,000 for thirty-seven structures in Starksboro and Hinesburg. The average cost per structure is $675 for assessment, pipe-sizing, and AOP recommendations. The end result of this effort will be implementation of eight AOP improvement culverts during paving of Vermont 116, future design recommendations for ten additional AOP improvement projects as the opportunity arises, and hydraulic pipe sizing at sixteen structures where AOP is not a priority in case the smaller pipes need to be replaced in the future.

The methods and results of this project were presented to the Chittenden County Regional Planning Commission Transportation Advisory Committee, the VTrans Transportation Planning Initiative, and at the National Ecohydraulics Conference in Amherst, Massachusetts. Comments were made during each presentation expressing the desire to use this project as a template for other state and local roads in Vermont and the region to make AOP a regular part of paving projects. The presentations have been distributed to numerous Transportation Agencies in the northeast United States to facilitate this goal.

Bibliography

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