VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION

HYDRAULICS UNIT

TO: Rachel Beauregard, District 5 Technician
Dick Hosking, District 5 Project Manager

FROM: Justin Hadley, Hydraulics Project Engineer

DATE: September 8, 2014

SUBJECT: Hinesburg, TH 1 Shelburne Falls Rd, 0.16 miles west of VT 116
GPS coordinates: N 44.340372° W 73.119308°

We have completed our hydraulic study for the above referenced site, and offer the following information for your use:

Hydrology

This site has a hilly drainage basin that is about half forested with the remainder clearings and a large High school. The total contributing drainage area is about 0.32 sq. mi. or about 204 acres. There is an overall length of 8,000 feet from the divide to the site, with a 510 foot drop in elevation, giving an average overall channel slope of more than 6 %. The stream slope at the site was estimated to be about 1%. Using several hydrologic methods, we selected the following design flow rates:

Recurrence Interval in Years	Flow Rate in Cubic Feet per Second (CFS)
Q2.33	20
Q10	50
Q25	70 - Town Highway Design Flow
Q50	80
Q100	100 - Check flow

Channel Morphology

The channel upstream is of low gradient with a sinuous plan form. The channel transitions at the site to low gradient stream that has been channeld straight to the downstream confluence. There is good coarse sediment transport at the site. Field measurements of bankfull width varied from 4 to 6 ft. throughout the site. The Vermont Hydraulic Geometry Relationships anticipate a bankfull width of 8 ft. for stream channels in equilibrium at this watershed size. The hydraulic relationship may not be valid a this site due to the small drainage area. No indications of active vertical or horizontal instability were observed. A scour hole exists at the existing structure outlet indicating that the structure causes a hydraulic constriction.

Existing Conditions

The existing structure is a 36" CPEP that provides a waterway opening of about 7 sq. ft. There re no headwalls at the inlet and outlet of the current pipe.

Our calculations, field observations and measurements indicate the existing structure does not meet the current standards of the VTrans Hydraulic Manual nor does the existing structure meet state

stream equilibrium standards for bankfull width (span length). The existing structure constricts the channel width, resulting in scour at the outlet. Headwater to depth ratios exceed allowable values established in the current VTrans Hydraulics Manual and water overtops the roadway below the design Q25 discharge.

Recommendations

In sizing a new structure we attempt to select structures that meet both the current VTrans hydraulic standards, state environmental standards with regard to span length and opening height, and allow for roadway grade and other site constraints.

Based on the above considerations and the information available, we recommend any of the following structures as a replacement at this site:

1. A concrete box with a 6' wide by 5' high inside opening, with 6" high bed retention sills (baffles) in the bottom. The box invert should be buried 24", so the top of the sills will be buried 6" and not be visible. That will result in a 6' wide by 3' high waterway opening above streambed, providing 18-sq. ft. of waterway area. Sills should be spaced no more than 8'-0" apart throughout the structure with one sill placed at the inlet and one at the outlet. Sills can be cast flat. This structure will result in a headwater depth at Q25 = 2.7' and at Q100 = 3.5', with no roadway overtopping up to Q100.

2. A 77" wide by 55" high corrugated metal pipe arch, with bed retention sills and buried 12". This structure will provide around 17 -sq. ft. of waterway area and will result in a headwater depth at Q25 = 2.9' and at Q100 = 3.8'.

3. A 72" diameter CMPP with the invert buried 24" could also be considered, and would perform similar to an open bottom arch. This structure will provide 20 sq ft of waterway area and result in a headwater depth at Q25 = 3.6' and at Q100 = 4.6', with no roadway overtopping up to Q100.

4. Any similar structure with a minimum clear span of 6' and at least 17 -sq. ft. of waterway area, that fits the site conditions, could be considered. Any structure should have bed retention sills and a buried invert as described above.

Prior to any further action toward implementation of any of the above recommendations, structure size and type must be confirmed, and may be modified, by the VT ANR River Management Engineer to ensure compliance with state environmental standards for stream crossing structures.

General comments

If a new box is installed, we recommend it have full headwalls at the inlet and outlet. The headwalls should extend at least four feet below the channel bottom, or to ledge, to act as cutoff walls and prevent undermining.

If the pipe arch or round pipe option is installed, concrete headwalls should be constructed at the inlet and outlet. The headwalls may be either half height or full height. The headwalls should extend at least four feet below the channel bottom or to ledge, to prevent undermining of the structure. We recommend a minimum cover of 3' over all pipe structures. Therefore the roadway grade would have to be raised about 0.5' to provide the required cover over the pipe. Pipe manufacturers can provide specific recommendations for minimum and maximum fill heights and required pipe thickness.

It is always desirable for a new structure of this size to have flared wingwalls at the inlet and outlet, to smoothly transition flow through the structure, and to protect the structure and roadway approaches from erosion. The wingwalls should match into the channel banks. Any new structure should be properly aligned with the channel, and constructed on a grade that matches the channel. A new structure should span the natural channel width.

Stone Fill, Type II should be used to protect any disturbed channel banks or roadway slopes at the structure's inlet and outlet, up to a height of at least one-foot above the top of the opening. The stone fill should not constrict the channel or structure opening.

Other regulatory authorities including the US Army Corps of Engineers may have additional concerns or requirements regarding replacement of this structure.

Please note that while a site visit was made, these recommendations were made without the benefit of a survey and are based on limited information. The final decision regarding replacement of this structure must comply with state regulatory standards, and should take into consideration matching natural channel conditions, roadway grade, environmental concerns, safety, and other requirements.

Please contact us if you have any questions or if we may be of further assistance.

JFH

cc: Chris Brunelle, A.N.R. River Management Engineer
Hydraulics Project File via NJW
Hydraulics Chrono File