SITE 3

VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION

HYDRAULICS UNIT

TO: Dustin Rhodes, District 9 Technician

FROM: David Willey, Hydraulics Project Supervisor

DATE: July 16, 2012

SUBJECT: Lowell TH 3(Mines Road) Bridge 26 – Site 2300' north of TH 5 (Vag Road)
GPS coordinates: N 44.770167° W -72.5185°

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

Hydrology

This site has a hilly to mountainous drainage basin. It is a mixture of forested and open land cover. The total contributing drainage area is about 2.2 sq. mi. There is an overall length of 11,550 feet from the divide to the site, with a 1300-foot drop in elevation, giving an average overall channel slope of 11.3%. The stream slope at the site was estimated to be about 3%. 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	110
Q10	240
Q25	320 - Town Highway Design Flow
Q50	400
Q100	480 - Check flow

Existing Conditions

The existing structure is a 6.0' diameter corrugated metal pipe, providing 28.3 sq. ft. of waterway area. Water overtopped the roadway in this spring's flood. There is a lot of debris at the inlet of the pipe that should be removed. There is a 0.5' drop into a large scour pool at the outlet.

Our calculations show the existing structure is not adequate hydraulically. Headwater to depth ratios exceed the allowable values and water overtops the roadway below the design Q25.

Recommendations

In sizing a new structure we attempt to select structures that meet the hydraulic standards, fit the natural channel width, the roadway grade and other site conditions. We measured an upstream channel width of 8' – 12' and downstream channel width of approximately 15' – 20' during our site visit. The channel may be wider now after the flood. The Agency of Natural Resources 'VT Regional Hydraulic Geometry Curves' give a bank full width of 18' for this size drainage area. Those curves are only based on drainage area and do not consider other factors, such as storage, stream slope or other site specific conditions. They may not be valid for this size drainage area. The low height from the stream bed to the road limits the replacement options to a box structure, as there would not be adequate cover for a properly sized pipe. Based on our calculations and the information available, we recommend any of the following structures as a replacement at this site:

1. A concrete box with a 14' wide by 6' high inside opening, with 6" high bed retention sills (baffles) in the bottom. The box invert should be buried 12", so the top of the sills will be buried 6" and not be visible. That will result in a 14' wide by 5' high waterway opening above streambed, providing 70 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 should be cast in a V shape with a 10:1 lateral slope, to create a low flow channel in the center if the bed material in the structure is washed out. The spaces between sills should be filled with stone graded to match the natural stream bed material. This structure will result in a headwater depth at Q25 = 4.3' and at Q100 = 5.7', with no roadway overtopping up to Q100.

2. Any similar structure with a minimum clear span of 14' and at least 70-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.

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.

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.

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.

The Agency of Natural Resources (ANR), Corps of Engineers, or other permitting agency may have additional concerns regarding replacement of this structure, or any channel work. The River Management Engineer should be contacted with respect to those concerns, before a replacement structure is ordered. If ANR requires the invert of the structure to be buried to more than 1', the size of the structure will have to be larger to provide the required waterway area. ANR may want a wider structure, based on calculated bank full width.

Please keep in mind 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 the replacement of this structure should take into consideration matching the natural channel conditions, the roadway grade, environmental concerns, safety, and other requirements of the site.

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

DCW

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

6' EXISTING