

HYDRAULICS UNIT

TO: Tom Anderson, District Technician, District 6
FROM: Leslie Russell, P.E., Hydraulics Project Engineer *LR*
DATE: 27 October 2009
SUBJECT: Warren Covered Bridge Road TH 3 CB 6 over the Mad River



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 mostly forested with some clearings and ponds. The total contributing drainage area is about 27.5 sq. mi. There is an overall length of 37,290' from the divide to the site, with a 2,550' drop in elevation, giving an average slope of 6.8%. Slope at the site is estimated to be less than 1%. Using several hydrologic methods, we determined the following design flow rates:

<u>Recurrence Interval in Years</u>	<u>Flow Rate in Cubic Feet per Second (CFS)</u>
Q2.33	2000
Q10	3300
Q25	4300 - Town Highway Design Flow
Q50	5300
Q100	6450 - Check flow

Existing Structure

The inspection report indicates that the existing covered bridge has a span of approximately 47' and a rise of 10.2', providing a waterway opening of about 480 sq. ft. The bridge is slightly skewed to the river. Our calculations show this structure to be hydraulically inadequate because there is not 1.0' of freeboard at the Q25 flow. The abutments constrict the channel quite a bit. It has been reported that during high flood events, debris gets caught in the opening and flooding occurs over the road on the western side of the channel. There is a scour hole on the upstream side of the western abutment and a deep scour hole along the eastern abutment and downstream of that abutment. However, the Flood Insurance Study shows that all flows up to the Q100 do not overtop the bridge, but it may overtop the lower roadway approaches. There is a dam approximately 300' downstream of the bridge which ponds water through the bridge.

The Town would like to replace the west abutment and wingwall. It is advisable to have the abutment placed back toward the bank. However, the structure would have to be evaluated to make sure it can span a greater span than what is currently in place. The structure should not be lower in elevation than it currently is and the clear span should be at least as long as the existing.

Recommendations

In order to recommend a replacement size at this site, we would need survey up and downstream of the bridge. The floodway is 70' to 100' in this reach.

General Comments

If a new abutment is installed, the bottom of abutment footings should be at least six feet below the channel bottom, or to ledge, to prevent undermining.

It is always desirable for any new structure 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.

Building a longer upstream wingwall with less skew to the river would provide a smoother transition from the upstream channel bank to the abutment and would direct water into the bridge better. This would improve the hydraulics and might reduce scour and debris problems at the bridge. Large stone fill or upstream rock veins could also be used for that purpose.

Permitting concerns might be a problem and may require a more detailed study if any big changes are made.

Stone Fill, Type IV 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 Stream Alteration Engineer should be contacted with respect to those concerns before the Town orders a new structure.

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.

A structure of this size warrants a more detailed hydraulic study if survey should become available.

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

LGR

cc: Patrick Ross, A.N.R. Stream Alterations Engineer
Mike Hedges, VTRANS, Structures Engineer
Hydraulics Project File via NJW
Hydraulics Chrono File

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