Subject: FW: Environmental\Hydraulics Request: Whitingham VT-100 Hydraulics - OPS

From: Taft, Christopher (Christopher.Taft@vermont.gov)

To: whitingham1@yahoo.com; whitinghampublicworks@yahoo.com;

Cc: Joshua.Carvajal@vermont.gov;

Date: Thursday, June 23, 2016 7:01 AM

Attached is the hydraulic study for the two structures in Jacksonville in front of the fire station and town office. Please distribute to others if needed and let me know if you have any questions.

Chris

*Please note that the state email system has been upgraded and email addresses have changed. My new email address is Christopher.taft@vermont.gov Please update your contact information accordingly. Emails to my old email will be forwarded for only a short time.

Christopher Taft

Project Manager, District 1

P Please consider the environment before printing this e-mail.

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VT AGENCY OF TRANSPORTATION **PROGRAM DEVELOPMENT DIVISION**

HYDRAULICS UNIT

TO: Greg Krizan
Christopher Taft, District 1 Project Manager

FROM: Fianna Barrows, Structures and Hydraulics Design Engineer
Nick Wark, P.E., Hydraulics Engineer

DATE: 15 June 2016

SUBJECT: Whitingham VT 100 MM 7.79 over the East Branch North River
GPS coordinates: N 42.798453° W 72.822514°

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

Hydrology

This site has a flat drainage basin. It is a mixture of fields, residential, and wooded area. The total contributing drainage area is about 1.8 square miles. There is an overall length of 11,500 feet from the divide to the site, with a drop in elevation of 740 feet, giving an average overall channel slope of 6.4%. The stream slope at the site was estimated to be about 5%. Using several hydrologic methods, we selected the following design flow rates:

Percent Annual Exceedance Probability	Flow Rate in Cubic Feet per Second (cfs)
43 %	89
10 %	170
4 %	230
2 %	280 - Design Flow - Principal Arterial
1 %	340 - Check Flow

Channel Morphology

This is a perennial stream. There are two structures at this location. The upstream and downstream stream have been channelized by rock walls. Sediment transport was evident in the field. The flow is supercritical with a moderate grade. Field measurements of bankfull width varied from 10 feet to 13 feet. These bankfull widths are not natural; they are affected by the walls constructed on both sides of the channel. The Vermont Hydraulic Geometry Relationships anticipate a bankfull width of 17 feet for stream channels in equilibrium at this watershed size. Those curves may not be valid for this size drainage area.

Existing Conditions

Currently at this location there are two existing structures, 25 feet apart. The upstream structure is a concrete slab bridge with a maximum clear span of 5.7 feet and clear height of 6.2 feet, which provides a waterway area of 29 square feet. The concrete slab, abutments, and footings are all deteriorating. The abutment on the left facing downstream has a huge crack through it, possibly from settling. There is some scour under the footings. The downstream structure is a corrugated metal pipe arch with a clear span of 8.5 feet and clear height of 6 feet, providing a waterway area of 42 feet. The pipe's invert is rusting and deteriorating. Sediment has settled through the length of the 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 an increased potential for debris blockage. Water overtops the road just before 2% AEP.

Replacement 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.

The low height from the stream bed to the road limits the replacement options to a box structure, as the roadway would have to be raised substantially for a pipe. Raising the road that much would create a dam that could increase flooding of the upstream property, so that is not recommended.

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

1. A concrete box with an inside opening span of 14 feet and height of 8 feet. The box invert should be buried 3 feet. That will result in a waterway opening span of 14 feet with a height of 5 feet above streambed, providing 70 square feet of waterway area. Bed retention sills should be added in the bottom. Sills should be 12 inches high across the full width of the box. So the top of the sills will be buried 12 inches and not be visible. Sills should be spaced no more than 8 feet apart throughout the structure with one sill placed at the inlet and one at the outlet. The box should be filled up to the stream bed level with stone type E3. This structure will result in a headwater depth of 3.6 feet at 2% AEP and of 4.3 feet at 1% AEP.

2. Any similar structure with a minimum clear span of 14 feet and at least 70 square feet of waterway area, that fits the site conditions, could be considered. Please contact the hydraulics unit with alternatives that have significantly different inlet geometry so headwater depths can be calculated. Any structure with a closed bottom 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.

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

General Comments

If a new bridge is installed, the bottom of abutment footings should be at least six feet below the channel bottom, or to ledge, to prevent undermining. Abutments on piles should be designed to be free standing for a scour depth at least 6' below channel bottom.

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. A new structure should span the natural channel width.

Stone Fill, Type III 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.

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.

FDB

cc: Scott Jenson, A.N.R. River Management Engineer
Hydraulics Project File via NJW