VERMONT

Vermont Department of Environmental Conservation *Agency of Natural Resources*
Watershed Management Division
Springfield Regional Office
100 Mineral Street, Suite 303
Springfield, VT 05156
www.watershedmanagement.vt.gov

[phone] 802-885-8855
[fax] 802-885-8890
[cell] 802-345-3510

AUTHORIZATION TO CONDUCT STREAM ALTERATION ACTIVITIES

Pursuant to Section C.2.2.5 of the VT Stream Alteration General Permit (replacement to improve existing culverts)

Project Number: **SA-05-044-2015 Norwich Route 132 Culvert**
Applicant Name: Selectboard, Town of Norwich, Vermont
Mailing Address: Town of Norwich, PO Box 376, Norwich, Vermont 05055
Project Location: Rte 132 Replacement Culvert over un-named tributary

Contact: Neil Fulton or Andy Hodgdon
Phone: (802) 649-1419 or (802) 649-2209
Email: manager@norwich.vt.us or ahodgdon@norwich.vt.us

The Secretary of the Vermont Agency of Natural Resources (VT ANR) has determined that:

1. This project authorizes the replacement of a structurally deficient 4' wide X 6' tall bridge with a 10' wide X 5' tall concrete box culvert on an un-named tributary to the Ompompanossuc River to preclude emergency repairs.
2. The proposed activity is eligible for coverage under the VT ANR Stream Alteration General Permit.
3. The proposed activity will meet the terms and conditions of the General Permit provided:
   a) The project will be completed and approved as shown on the attached plans undated, prepared by the town of Norwich as reviewed and approved by the VT ANR herein. Shop drawings shall be approved prior to construction.
   b) The project will not adversely affect the public safety by increasing flood hazards. See VTrans Hydraulic Report.
   c) The project will not significantly damage fish life or wildlife. Provide 12" sills buried 24" below stream bed.
   d) The project will not significantly damage the rights of riparian owners. See attached VTrans Hydraulic Report.
   e) The project will not obstruct the movement of aquatic life indigenous to the waterbody beyond the actual duration of construction. Use Type E1 Stone Fill in retention sills as per attached SRMPP Appendix M Stone Fill.
   f) The project is conducted in a manner which minimizes or avoids any discharge of sediment or other pollutants to surface waters in violation of the VT Water Quality Standards.
   g) The ANR River Management Engineer is notified by phone or email when construction begins and when the project is complete.
   h) In-stream working dates for all GP activities are from June 1st through October 1st; any in-stream work outside these dates will require an Individual Stream Alteration Permit authorization by the River Management Engineer.
   i) This authorization has been posted for three days public comment. This authorization constitutes final approval.

If there are any changes in the project plan or deviation in construction from the plan, the Permittee must notify the River Management Engineer immediately.

If the project is constructed as you have described, as shown on the above referenced approved plans and according to the above conditions, there is no reason to expect any violation of Vermont Water Quality Standards.

Signed this 23rd day of December, 2015
Alyssa B. Schuren, Commissioner
Department of Environmental Conservation

This permit expires October 1, 2016.

by _____
Todd Menees, P.E., P.H., River Management Engineer

Streambed Stone Fill Design Guidance

Type	Velocity Range (fps)*	Embeddedness (in)
E1	$V \leq 9$	18
E2	$9 < V \leq 11$	24
E3	$11 < V \leq 13$	36
E4	$13 < V \leq 15$	48

*Maximum velocity should be based on a minimum 50-year design flow rate and calculated at the structure outlet.

Item xxx.xxx CY Streambed Stone Fill Specification

Type E1. The longest dimension of the stone shall be at least 18 inches, and at least 50 percent of the volume of the stone in place shall have a least dimension of 12 inches, and at least 25 percent of the particles shall have a maximum dimension of 2 inches and be well graded material.

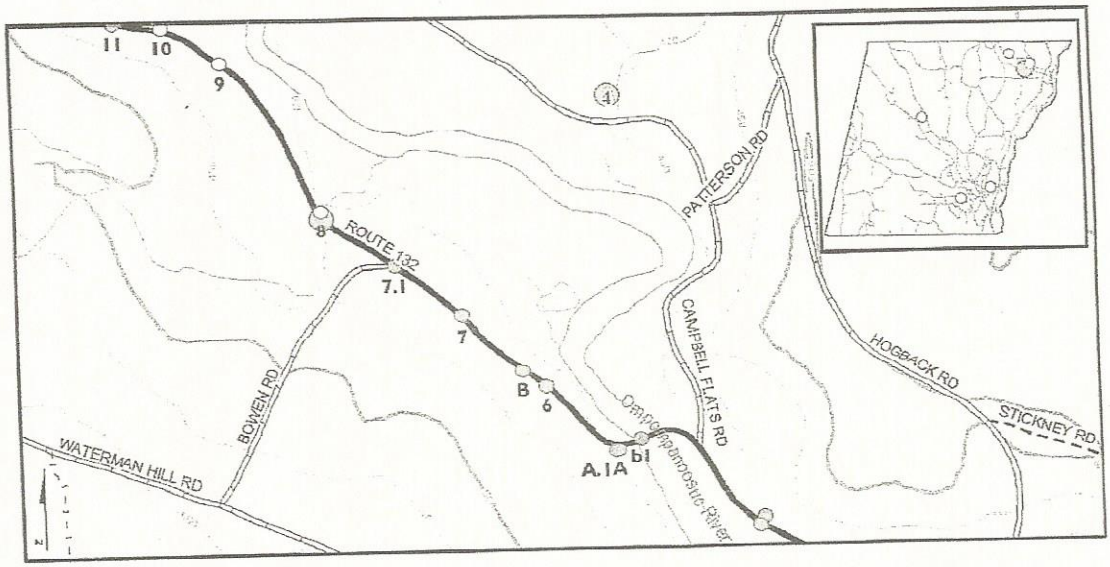
Type E2. The longest dimension of the stone shall be at least 24 inches, and at least 50 percent of the volume of the stone in place shall have a least dimension of 18 inches, and at least 25 percent of the particles shall have a maximum dimension of 2 inches and be well graded material.

Type E3. The longest dimension of the stone shall be at least 36 inches, and at least 50 percent of the volume of the stone in place shall have a least dimension of 24 inches, and at least 25 percent of the particles shall have a maximum dimension of 2 inches and be well graded material.

Type E4. The longest dimension of the stone shall be at least 48 inches, and at least 50 percent of the volume of the stone in place shall have a least dimension of 36 inches, and at least 25 percent of the particles shall have a maximum dimension of 2 inches and be well graded material.

Notes

- The streambed stone fill shall be hard, blasted, angular rock other than serpentine rock containing the fibrous variety chrysotile (asbestos). Similar sized river sediment is an acceptable alternative as is a mixture of angular material and river sediment.
- Stone placed inside of a closed structure shall be placed such that the structure is not damaged.
- Care shall be taken to limit segregation of the materials.
- Add sand borrow item as needed to seal the bed and prevent subsurface flow.
- There shall be no subsurface flow upon final inspection.



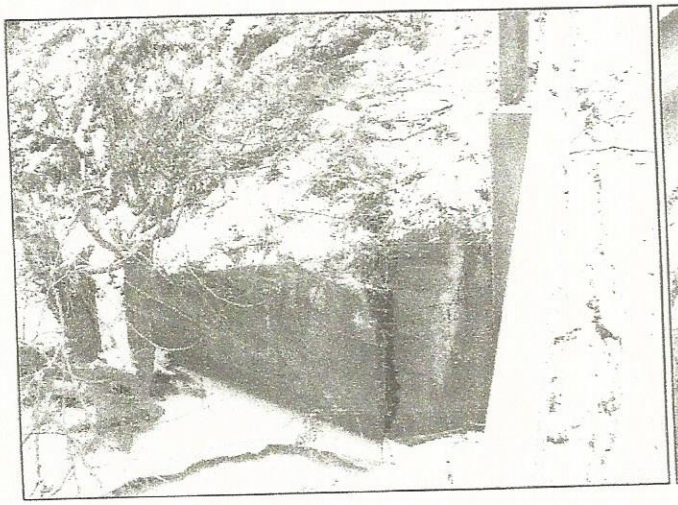


Figure 1: Cracked wingwalls

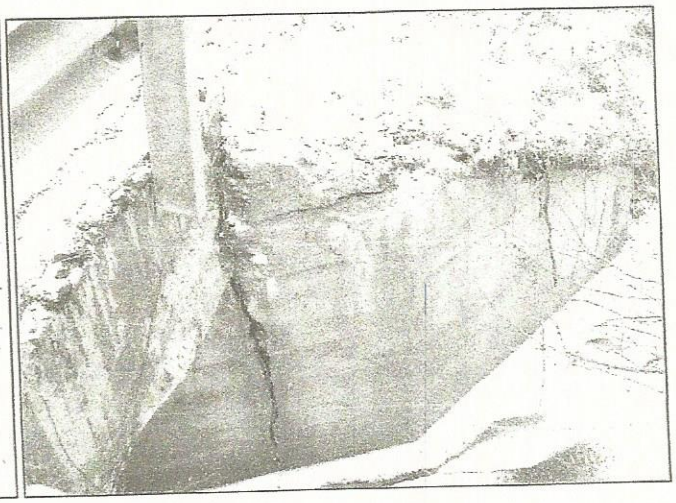


Figure 2: Cracked wingwalls

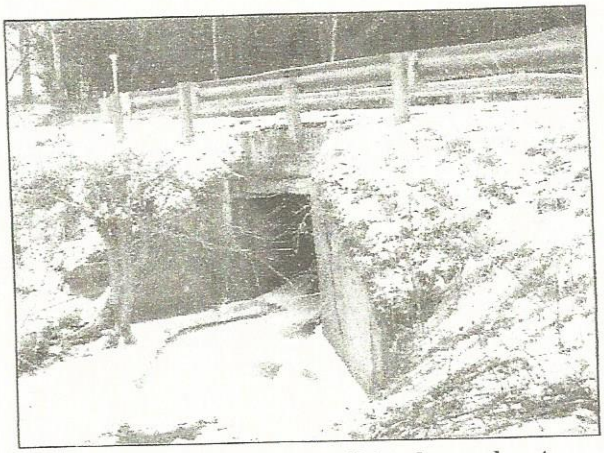


Figure 3: Poor condition box culvert

Site Description

At the first stream crossing below the intersection of Bowen Hill, a concrete box culvert that was built in 1927 and is in very poor condition.

Recommended Treatment

Scope of work:

- Demolish and remove existing concrete box culvert.
- Replace existing concrete culvert with a metal pipe arch with a 117" minimum clear span and 79"minimum clear height.
- Install 12" high bed retention sills in the bottom of the structure, buried 24", so the top of the sills and invert are buried below the streambed.
- Sills will be spaced no more than 8'- 0" apart throughout the structure with one sill placed at the inlet and one at the outlet.
- Sills will 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.
- This will result in a structure with an approximate waterway opening of 37.7 square ft. This structure will result in approximate headwater depths at Q50=4.1' and at Q100-4.8'.
- Concrete headwalls will be constructed at the inlet and outlet. The headwalls will extend at least four feet below the channel bottom or to the ledge, to prevent undermining of the structure.
- The new structure will have flared wing walls at the inlet and outlet, to smooth transition flow through the structure, and to protect the structure and roadway approaches from erosion.
- Stone fill-Type II will 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.
- Repair of road pavement after the installation of the metal pipe arch.
- Installation of 150 linear feet of used SBGR State of Vermont-type w-rail with radius panels and buffers.

Permit Requirements - A VT DEC Stream Alteration Permit will be required for this project. Contact Pat Ross at (802) 279-1143.

Construction Notes:

- Construction Specifications-See specifications in Vermont Better Backroads Manual, 2009.
- Buried Cable/Utilities-Buried cable/utilities may be on site. Call Dig Safe 1-888-DIG-SAFE to locate buried utilities prior to construction
- Crown roads ½ to ¾ inch per linear foot after project installation and maintain thereafter.
- Stabilize all disturbed soils with seed and mulch.
- Appropriate erosion control measures shall be utilized throughout the duration of the project in accordance with the ANR stream engineer.
- All cost of installing, maintaining, and removing the signs and barricades, and traffic control are to be borne by the successful bidder.
- All traffic signs shall conform to the Manual of Uniform Traffic Control Devices (MUTCD), 2009 Edition.
- All orange signs shall be fabricated using reflectorized fluorescent orange-colored sheeting.
- It is estimated that this project will take approximately two weeks to complete, during which time an acceptable detour will need to be established for Route 132 traffic.

Cost Estimates for Treatment

The total cost of removal and disposal of the existing cement box culvert, purchasing and installing the new metal pipe and culvert with concrete work as described above, clearing and grubbing, channel relocating, stone-filled slope stabilizing, repairing pavement, traffic control, erosion control, guardrail installation, turf establishment, and mobilization will be $115,000.

Cost Benefit Analysis:
This culvert is in such poor shape that it will eventually cave in; causing an emergency repair that would put the burden of the entire replacement cost to the town.

This project is located in a highly visible area on Route 132, which is one of the main arteries going to the towns of Thetford, Strafford, and Sharon. It would demonstrate the benefits of being proactive in the maintenance of stream crossings and proper drainage on this important connecting route.

VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION

HYDRAULICS UNIT

TO: Trevor Starr, District Project Manager, District 4

FROM: Leslie Russell, P.E., Hydraulics Project Engineer

DATE: 16 March 2012

SUBJECT: Norwich VT 132 – 300' west of TH 14 – over unnamed brook

---

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 drainage basin. It is mostly forested. The total contributing drainage area is about 0.8 sq. mi. There is an overall length of 9855 feet from the divide to the site, with a 630 foot drop in elevation, giving an average overall channel slope of 6.4 %. The stream slope at the site was estimated to be about 1%. Using several hydrologic methods, we came up with the following design flow rates:

Recurrence Interval in Years	Flow Rate in Cubic Feet per Second (CFS)
Q2.33	45
Q10	110
Q25	145
Q50	180 - State Highway Design Flow
Q100	220 - Check flow

Existing Conditions

The existing structure is a small slab bridge. It has a clear span length of 4', with a clear height of about 6', providing a waterway opening of 24 sq. ft. The bridge has concrete abutments. The southeast wingwall on the outlet is separating from the eastern abutment.

The bridge is on a skew to the roadway and constricts the channel. The top of the footings can be seen indicating that there is scour through the bridge. There is potential for debris and ice to block this narrow structure.

The downstream channel is incised and during high water, it may be possible for this structure to see backwater from the Ompompanoosuc River because the confluence is a couple hundred feet downstream of the structure.

This structure results in a headwater depth of 6.8' at Q50 and 8.0' at Q100.

Recommendations

In sizing a new structure we attempted to select structures that meet the hydraulic standards, fit the natural channel width, the roadway grade and other site conditions. Though there was ice and snow on the day of the site visit, we measured the channel width to be approximately 10'. ANR regression

equation calculates bankfull width as 12'. However, the equation does not take into account any other factor besides drainage area. We recommend any of the following structures as a replacement at this site:

1. A concrete box with a 10' wide by 5' 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 10' wide by 4' high waterway opening above streambed, providing 40-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 Q50 = 3.7' and at Q100 = 4.2', with no roadway overtopping at Q100.

2. A metal pipe arch with a 117" minimum clear span and 79" minimum clear height. There should be 12" high bed retention sills in the bottom of the structure that are buried 24", so the top of the sills and invert are buried below the streambed. Sills should be built as for the box above. This will result in a structure with an approximate waterway opening of 37.7 sq. ft. This structure will result in approximate headwater depths at Q50 = 4.1' and at Q100 = 4.8'.

3. Any similar structure with a minimum clear span of 10' and at least 40 sq. ft. of waterway area, that fits the site conditions, could be considered.

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 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. Obtaining the minimum cover of 3' should be no problem at this site. Pipe manufactures 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.

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

deeper than specified above, the size of the structure will have to be larger to provide the required waterway area.

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.

LGR

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

Non_PMS_Projects\Hydraulics\ProjectFiles_NonCADD\Norwich\VT 132\Norwich VT 132 prel hyd memo.docx