VERMONT

State of Vermont
Structures and Hydraulics Section
One National Life Drive
Montpelier, Vermont 05633-5001
vtrans.vermont.gov

Agency of Transportation

[phone] 802-371-7326
[fax] 802-828-3566
[ttd] 800-253-0191

TO: James Cota, District 8 Project Manager
John Wilkin, District 8 Technician

CC: Chris Brunelle, ANR River Management Engineer

FROM: Keith Friedland, Hydraulics Technician

DATE: June 24, 2020

SUBJECT: Georgia TH-25, Silver Lake Road, over unnamed tributary to Beaver Meadow Brook
Site location: 0.6 miles north of TH-31 (Skunk Hollow Road)
Coordinates: 44.696199, -73.059527

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

Hydrology

The following physical characteristics are descriptive of this drainage basin:

Drainage Area	0.49 square miles
Land Cover	Forest and Silver Lake
Avg. Drainage Basin Slope	8.7 %
Water Bodies and Wetlands (NLCD 2006)	10.9 %

Using the USGS hydrologic method, the following design flow rates were selected:

Annual Exceedance Probability (AEP)	Flow Rate in Cubic Feet per Second (cfs)	
43 %	14	
10 %	27	
4 %	36	Design Flow – Local Road
2 %	44	
1 %	52	Check Flow

Channel Morphology

The channel for this perennial stream is sinuous with an estimated local channel slope of 4%. Field measurements of bankfull width varied from 6 to 10 feet at a bankfull depth of 1 to 3 feet upstream and downstream of the structure.

Existing Conditions

The existing structure is a corrugated metal pipe with a diameter of 3 feet, providing a waterway opening of 7 square feet. Our calculations, field observations and measurements indicate the existing structure does meet current standards of the VTrans Hydraulic Manual. However, it does not meet the state stream equilibrium

standards for bankfull width (span length). The existing structure constricts the channel width, resulting in an increased potential for debris blockage. This complication is known to cause ponding at the inlet, increase stream velocity and scour at the outlet, and may also lead to erosion and failure of channel banks. This structure results in a headwater depth of approximately 3.5 feet at 4% AEP and 4.9 feet at 1% 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 streambed to the road might limit the replacement options to a box structure, as the roadway may have to be raised for a pipe arch option. Pipe manufacturers can provide specific recommendations regarding minimum and maximum fill heights and required pipe thickness. Based on the above considerations and the information available, we recommend any of the following structures as a replacement at this site:

- A concrete box with an inside opening span of 7 feet and minimum height of 5 feet. The box invert should be buried 2 feet. This will result in a clear height of 3 feet above streambed, providing 21 square feet of waterway area. Bed retention sills should be added in the bottom of the structure. Sills should be 12 inches high at the edges of the box and 6 inches high in the center, creating a V-shape across the full width of the box. Sills should be spaced no more than 8 feet apart throughout the structure with one sill placed at both the inlet and the outlet. The structure should be filled level to the streambed with E-Stone, Type II, allowing flow to be kept above the surface, providing the conditions necessary for aquatic organism passage. This structure results in a headwater depth of 1.6 feet at 4% AEP and 2 feet at 1% AEP.

- A pipe arch with a clear span of 87 inches and height of 63.2 inches. The invert should be buried 2 feet. This will result in a clear height of 3.3 feet above streambed, providing 18 square feet of waterway area. Bed retention sills need to be added and filled as described for the box above. This structure results in a headwater depth of 1.6 feet at 4% AEP and 2.2 feet at 1% AEP.

Note: *Any similar structure that fits the site conditions could be considered. Any structure with a closed bottom should have bed retention sills and a buried invert as described above.*

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.

Prior to any action toward the implementation of any recommendations received from VTrans, stream type and structure size 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. Regulatory authorities including the US Army Corps of Engineers may have additional concerns or requirements regarding this structure.

General Comments

It is always desirable for a new structure to have flared wingwalls, matched into the channel banks at the inlet and outlet, to smoothly transition flow and protect the structure and roadway approaches from erosion. It is also recommended that full height concrete headwalls be constructed at the inlet and outlet. Any closed bottom structure should also be equipped with cutoff walls, extending to a depth equal to the culvert rise, up to 4 feet, or to ledge, to serve as undermining prevention. Any new structure should be properly aligned with the channel, span the natural channel width, and be constructed on a grade that matches the channel.

The structures recommended above have been sized with respect to hydraulic and environmental standards and do not consider debris blockage complications. To minimize maintenance and ensure constructability, it is recommended that the structure height be adequate for installation of E-Stone and passage of debris.

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.