VERMONT

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TO: Chris Bump, District 4 Project Manager

FROM: Keith Friedland, Hydraulics Technician

DATE: October 9, 2023

SUBJECT: Chelsea TH-4, Bobbinshop Road, over unnamed tributary to First Branch White River
Site location: 1.3 miles NW of VT-110
Coordinates: 44.006171, -72.468543

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	0.20 square miles
Land Cover	Mix of fields and forest with some residences

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

Annual Exceedance Probability (AEP)	Flow Rate in Cubic Feet per Second (cfs)	
50 % (Q2)	38	
10 % (Q10)	57	
4 % (Q25)	69	Design Flow – Local Road
2 % (Q50)	78	
1 % (Q100)	88	Check Flow

Channel Morphology

The channel for this intermittent stream is straight to sinuous with an estimated local channel slope of 8%. Field measurements of active channel width varied from 2 to 4 feet upstream and downstream of the structure.

Existing Conditions

The existing structure is a polyethylene culvert with a diameter of 2-feet, providing a waterway opening of 3.1 square feet. Water was observed "piping" along the sides of the culvert at the outlet, indicating there is likely a separation between one the culvert sections. Our calculations, field observations and measurements indicate the existing structure does not meet current standards of the VTrans Hydraulic Manual. The existing structure also constricts the channel width, resulting in an increased potential for debris blockage. This structure results in water overtopping the roadway before the 50% AEP (Q2).

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 consider roadway grade and other site constraints.

The low height from the streambed to the road might limit the replacement options. 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 minimum 4.5-foot diameter corrugated metal pipe, providing a waterway area of 15.9 square feet. This structure results in a headwater depth of 3.5 feet at 4% AEP and 4.1 feet at 1% AEP.
- A corrugated metal pipe arch with a minimum clear span of 60 inches and clear height of 46 inches, providing a waterway area of 15.6 square feet. This structure results in a headwater depth of 3.2 feet at 4% AEP and 3.8 feet at 1% AEP.
- Any similar structure that fits the site conditions could be considered

Note: The recommended structures were modeled with an inlet headwall.

The structures recommended above have been modeled with a culvert slope of 4%. The local stream slope should be verified prior to installation of the new culvert.

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.

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.

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. We can always check other options if the town settles on something not noted above.