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TO: James Cota, District 8 Project Manager
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CC: Chris Brunelle, ANR River Management Engineer

FROM: Keith Friedland, Hydraulics Technician

DATE: August 10, 2020

SUBJECT: Fairfield TH-41, Juaire Road over Fairfield River tributary to Black Creek
Site location: 0.26 miles east of TH-1, South Road
Coordinates: [44.781212, -72.950556](#)

Thank you for your request for a hydraulic study in Fairfield on TH-41 (Juaire Road). VTrans provides preliminary recommendations for towns at no charge in response to flooding events and for hazard mitigation. This program has been level funded for many years while demand has gone up. To best serve the towns of Vermont we have limited this service to smaller structures (culverts) that can be accurately modeled without survey.

A drainage area and structure of this size warrants a more detailed hydraulic study that will need to be designed to meet both hydraulics and regulatory standards (i.e., bankfull width). To do this with confidence a detailed hydraulics model using site survey will be needed. Example software programs that can be used are HEC-RAS and SRH-SMS 2D. We recommend hiring a consultant to do this work along with the site and structural design.

The following physical characteristics are descriptive of this drainage basin:

Drainage Area	9.69 square miles
Water Bodies and Wetlands (NLCD 2006)	1.6 %

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 %	370
10 %	680
4 %	890
2 %	1,100
1 %	1,300

Design Flow – Local Road

Check Flow

The channel for this perennial stream is sinuous with an estimated local channel slope of 1%. Field measurements of bankfull width varied from 24 to 33 feet upstream and downstream of the structure.

The existing structure is a corrugated metal pipe with a diameter of 15 feet, providing a waterway opening of 177 square feet. **The HY8 hydraulics modeling program utilized for the existing structure has limited capabilities for studying a drainage area and structure of this size.** 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** 10.9 feet at 4% AEP and 13.4 feet at 1% AEP.

Based on a desktop review we estimate a bridge on the scale of **approximately** 28 to 30 feet wide (span) by 12 to 14 feet high will be required. The new structure should be properly aligned with the channel, spanning the natural channel width, and constructed on a grade that matches the channel. The design consultant in coordination with ANR and other regulators should determine the final size. Other regulatory authorities such the US Army Corps of Engineers may have additional concerns or requirements regarding this structure.

Please see the following sites for more information:

VT ANR Stream Alteration Permit

<https://dec.vermont.gov/watershed/rivers/river-management>

VTrans Hydraulics Manual

<https://vtrans.vermont.gov/sites/aot/files/highway/documents/structures/VTrans%20Hydraulics%20Manual.pdf>

HEC-RAS

<https://www.hec.usace.army.mil/software/hec-ras/download.aspx>

SMS/SRH-2D

<https://www.aquaveo.com/downloads?tab=2#TabbedPanels>