

HYDROLOGY AND HYDRAULICS REPORT

Overview & Purpose

The Great Works River Bridge project is located in South Berwick, York County, Maine. The existing bridge is a 95 foot single span riveted steel girder bridge that carries State Route 236 over the Great Works River. The existing bridge is structurally deficient and functionally obsolete, therefore warrants either major rehabilitation or replacement. The primary purpose of this hydrology and hydraulics report is to accurately predict, using available hydraulic and ground surface site data, water surface elevations, flow rates and water velocities during potential flooding events. Using these predicted velocities, flows and their corresponding elevations as design criteria; we can ensure that the reconstructed or replacement bridge has proper scour protection and is designed to an elevation high enough to enable it to withstand such flooding events.

Flood Insurance Study

As an added source of data for this project, the Federal Emergency Management Agency (FEMA) has provided a flood insurance study for the Town of South Berwick. This FEMA study provides flood profiles, i.e. water surface elevations for various flooding events (see [appendix ...](#)). This study is dated December 5, 1984; therefore vertical datum shift conversions from the NGVD 29 to the NAVD 88 datum are necessary for data comparison purposes. Datum conversion was performed using the NGS VERTON program ([see appendix ...](#)).

Peak Flow Calculations

The Great Works River drainage basin characteristics produced by the Hydrology Section of the MDOT Environment Office are tabulated below. In accordance with MDOT policy, the USGS regression equations (Hodgkins, 1999) were used to compute the peak discharges.

Drainage Area	87.795 mi ²
Wetlands	14.71%
Design Discharge (Q₅₀)	3815.4 ft ³ /s
Check Discharge (Q₁₀₀)	4322.1 ft ³ /s
Scour Check Discharge (Q₅₀₀)	5530.8 ft ³ /s
Ordinary High Water (Q_{1.1})	847.9 ft ³ /s

HEC-RAS Model

Using the peak flow data (listed above), ground surface data (MDOT field survey) and bridge geometry a representative model was generated utilizing HEC-RAS v 4.0. HEC-RAS is a computer program developed by the Army Corps of Engineers that models the hydraulics of water flow through natural rivers and other channels. With the aid of the HEC-RAS program, values for flood flow rates, velocities and elevations were generated. As a check for accuracy and method of calibration, the computer model results were compared to the flow elevations produced for the FEMA flood profile ([see](#)).

Summary of Hydraulic Data

	Existing Bridge	Proposed Bridge
Headwater El. @ Q₅₀	85.50 ft	85.50 ft
Headwater El. @ Q₁₀₀	86.47 ft	86.47 ft
Discharge Velocity @ Q₅₀	4.30 ft/s	4.30 ft/s
Discharge Velocity @ Q₁₀₀	4.54 ft/s	4.54 ft/s
Ordinary High Water Q_{1.1}	77.97 ft	77.97 ft
Discharge Velocity @ Q_{1.1}	2.05 ft/s	2.05 ft/s
Freeboard @ Q₅₀	0.28 ft	2.00 ft

NOTE: The MDOT Bridge Design Guide specifies a minimum freeboard depth of 2 feet (distance between the Q₅₀ water surface elevation and bottom of bridge) for smaller streams where there is no history of ice jams.

Conclusion

As shown in the table above, the existing bridge has a Q₅₀ freeboard depth of only .28 ft which does not meet current MaineDOT design standards. The recommended option, which is to replace the existing bridge, has the potential to provide freeboard depth of a minimum of 2 ft, in turn meeting or exceeding the current design standard. There is no history of major scour issues at the site therefore the existing riprap design has proven to be adequate. The Q₅₀ stream velocity is a considerably slow, 4.30 ft/s, therefore use of the existing riprap as is with some modification will be an option. Another option would be to remove the existing riprap entirely and replace with a new plain or heavy riprap and geo-textile design.