

HYDROLOGY REPORT

The following Hydrology Report was prepared for, and provided within, a bridge replacement feasibility study performed in 2011 for Grist Mill Bridge for MaineDOT.

SUMMARY			
Drainage Area	153	mi ²	
Q1.1	1,335	ft ³ /s	
Q10	4,022	ft ³ /s	
Q25	4,898	ft ³ /s	
Q50	5,559	ft ³ /s	
Q100	6,259	ft ³ /s	
Q500	7,914	ft ³ /s	

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

HYDRAULIC REPORT

The following hydraulics narrative was prepared for, and provided within, a bridge replacement Feasibility Study (PIN 17092.02) performed in 2011 for Grist Mill Bridge for MaineDOT. Note the proposed bridge referenced in the following narrative is a conceptual structure developed for the Feasibility Study and is not the recommended Alternative associated with this PDR. The span lengths of the proposed bridge within the Feasibility Study and this PDR are only 5-ft different and have similar riprap slope geometry. The difference between these span lengths and overall geometrics of the two structures is considered insignificant in affecting the overall results and therefore additional hydraulic analyses were not performed under this WIN.

Hydraulics

Existing Structure

The hydraulic model for the existing structure was performed with the software, HEC-RAS. The cross sections of the stream were created by importing the MicroStation survey file (provided by MaineDOT) into HEC-RAS to produce an accurate model of the stream and its features. The hydraulic opening was determined based on existing drawings and field measurements. Using the available information a model was created of the existing condition without backwater.

A second scenario was considered, which took into consideration the effect of backwater from the Penobscot River. The Q100 headwater elevation from the model without backwater was then compared to the data provided by a FEMA flood map for this area. This comparison indicated that there was a backwater condition during a flood, although showed that it did not control the results of the hydraulic model. Because the backwater did not control, it was unnecessary to create a HEC-RAS model which accounted for backwater.

Since this site has a history of ice jams, the existing bridge was checked against the parameters set in the Bridge Design Guide for a major riverine bridge. This check resulted in a determination that it is hydraulically inadequate.

Proposed Structure

The hydraulics of the proposed structure was also modeled with HEC-RAS. The same model of the stream was used as in the existing structure scenario, with

the only change being to the geometry of the structure. This resulted in a homogeneous comparison of the existing and proposed structure.

The proposed structure has attributes that improve the hydraulics from the existing structure. The span of the proposed bridge has been increased from 51 feet to 100 feet with 1.75:1 slopes within the structure, from the face of the abutments to the streambed. The elevation of the bottom of the proposed structure is approximately 5 feet higher than existing, which also contributes to improving the hydraulic opening of the bridge.

Since backwater showed to have a small contribution to the hydraulics of the existing structure, it was determined to be unnecessary to include it in the hydraulic model of the proposed structure.

The proposed structure was deemed hydraulically adequate, per the Bridge Design Guide parameters.

Hydraulic Model Results

The following is a summary of the headwater elevations and outlet velocities of the two models for Q1.1, Q50, and Q100. Note for reference that the streambed elevation in the models at the inlet is approximately 5.0 feet.

		Existing Concrete T-Beam Bridge	Proposed Bridge
Hydraulic Opening	ft ²	480	1290
Headwater EL. @ Q _{1.1}	ft	9.4	9.4
Headwater EL. @ Q ₅₀	ft	14.8	14.7
Headwater EL. @ Q ₁₀₀	ft	15.5	15.4
Outlet Velocity @ Q _{1.1}	ft/s	9.7	10.4
Outlet Velocity @ Q ₅₀	ft/s	14.7	16.2
Outlet Velocity @ Q ₁₀₀	ft/s	15.3	16.8
Clearance @ Q ₅₀	ft	2.5	7.5

Scour

The streambed beneath the entire structure consists of bedrock. The existing abutments are founded on bedrock and show no effects of scour. The abutment type is undecided at the time of this report due to the unknown depth of bedrock outside the existing streambed. Upon final design a scour analysis will be completed if deemed necessary given the abutment type and bedrock elevations.