

HYDROLOGY

The hydrology calculations for storm event discharge levels are based on the typical USGS Regression equations and drainage basin characteristics. Please see the attached spreadsheet on Appendix D for the original hydrology calculations. There is no gauge information available for McLean Stream. The slightly rounded values below were used in the hydraulic analyses.

SUMMARY OF HYDROLOGY DATA

Drainage Area = 13.0 square miles
Q25 = 315 c.f.s.
Design Discharge (Q50) = 360 c.f.s.
Check Discharge (Q100) = 410 c.f.s.
Ordinary High Water (Q1.1) = 80 c.f.s.

HYDRAULICS

HY-8 runs were used to: 1) evaluate the hydraulic characteristics of the existing bridge; 2) evaluate a slip-line alternate; and 3) size a precast box replacement alternate. At first version HY-8 7.20 was used, but an error was found in the tailwater values used in some HY-8 7.20 runs at low discharge rates. After the Maine Department of Transportation acquired version HY-8 7.30, all runs were updated for consistency.

Some applicable deficiencies in version HY-8 7.20 were corrected in version HY-8 7.30. For example, the newer version would allow inputting the structure more realistically, with its negative slope. For simplicity, the geometrics for the slip-lined alternate and the existing structure were kept as originally set up for HY-8 7.20.

The newer version seemed to function better than the older one when a range of discharge rates was used with a corresponding profile of distinct tailwater elevations. This worked very well for precast box alternates of various span lengths. However, this useful input option did not work for the twin culvert analyses, even in version HY-8.30. Consequently, a separate run had to be made for each discharge value for both the existing and the slip-lined twin culverts, as indicated by the enclosed hydraulic output results.

Mr. Michael Wight provided the one reliable tailwater elevation at the Department of Conservation link, <http://www.maine.gov/doc/commissioner/flood/bad.shtml>. This analysis uses the Q100 Headwater Elevation of the lake, as provided by the Army Corps of Engineers, as the Q100 tailwater for the bridge. Consider that: 1) there is no valid tailwater information for lesser discharges; and 2) the hydraulic characteristics, such as flow velocities and headwater elevations, are controlled by the tailwater. This means that only comparative, relatively inaccurate analyses can be made for discharge rates below Q100. The lower discharge rate tailwater elevations can only be assumed. Consequently, **other than the Q100 headwater, all headwater elevations in this report are inaccurate, and most certainly low.** Due to the seasonality of the lake, i.e. the regularity of high lake levels in spring, the actual Q1.1 headwater elevation, and the likely water level at the time of the cofferdam installation, is very likely to be closer to the Q100 headwater elevation than the reported Q1.1 headwater elevation.

Assumed TW Elevs.: Q1.1 – 583.5ft.; Q10 -584.91ft.; Q25-585.39ft.; Q50-585.98ft.; Q100-586.0ft.

The information that provides some usefulness to this comparative analysis includes:

- 1) The outlet of the structure is only 200 feet from Long Lake and it is apparent that the lake level is the tailwater elevation controlling the flow characteristics;
- 2) The Q100 storm elevation of the lake is provided and very useful for the upper limit of tailwater levels for a comparative analysis; and
- 3) The photographs of the bridge during the autumn months provide the only indication of hydraulic characteristics at lower depths and at low discharges.

A more realistic assumption would be that all discharge tailwater elevations are nearly equal to the Q100 tailwater elevation, and that the entire range of headwater values is nearly equal to the Q100 headwater. The values below illustrate a distinction between high and low water flows that is actually seasonal. It is critical that the Contractor and Resident realize that **the existing water elevations at the time of construction are likely to be close to the Q100 Headwater Elevation, and high above the reported Q1.1 Elevation.**

Summary

		Existing Structure	Recommended Structure	Sliplined w/
		Twin 12'6" x 8'1" Pipe Arches	19-foot Span Precast Box	9'9" x 6'7" Pipe Arches
Total Area of Waterway Opening	ft ²	162	133	102
Headwater elevation @ Q _{1.1}	ft	583.48	583.48	583.49
Headwater elevation @ Q ₁₀	ft	584.96	584.94	585.02
Headwater elevation @ Q ₂₅	ft	585.49	585.48	585.59
Headwater elevation @ Q ₅₀	ft	586.12	586.11	586.27
Headwater elevation @ Q ₁₀₀	ft	586.22	586.20	586.35
Hw/D Ratio @ Q ₅₀		1.052	1.051	1.053
Hw/D Ratio @ Q ₁₀₀		1.064	1.062	1.080
There are NO Documented Flood Records.				
Outlet Velocity @ Q _{1.1}	ft/s	0.601	0.717	0.695
Outlet Velocity @ Q ₁₀	ft/s	1.735	1.845	2.000
Outlet Velocity @ Q ₂₅	ft/s	2.154	2.137	2.406
Outlet Velocity @ Q ₅₀	ft/s	2.448	2.269	2.769

As indicated in the Preliminary Public Meeting notes, this site has a history of frequent flooding since a span type structure was replaced with the twin culverts. Unfortunately, there are no flood records to improve the hydraulic analysis. Due to the flooding, a rehabilitation by slip-lining is unacceptable. Replacement with a precast concrete box is sized to avoid raising headwater at all discharge rates.

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