

HYDROLOGY REPORT

Puddle Dock Bridge carries South Freedom Road over Fifteen Mile Stream in the town of Albion, Maine. A hydrology report for the Fifteen Mile Stream watershed was developed. Peak flow estimates were provided by the Environmental Office and calculated using the 1999 & 2015 United States Geological Survey Agency (USGS) full regression equation (see Appendix C). The summary of the site hydrology is in the table below.

SUMMARY			
Drainage Area	16.91	mi ²	
Q1.1	300	ft ³ /s	
Q10	1060	ft ³ /s	
Q25	1335	ft ³ /s	
Q50	1555	ft ³ /s	
Q100	1775	ft ³ /s	
Q500	2290	ft ³ /s	

Reported by: Brewer, Erin

Date: March 6, 2023

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

HYDRAULIC SUMMARY

The hydraulic analysis was completed using the U.S. Army Corps of Engineers' HEC-RAS program, version 5.0.7. HEC-RAS supports one-dimensional, steady flow, water surface profile calculations. The existing bridge, and the new bridge options were analyzed. Cross-sections were taken from survey data gathered for this project.

All the new bridge options have a larger freeboard than the existing structure. For a riverine bridge, a freeboard depth of 2 feet minimum for Q50 flow is recommended on smaller streams where there has been no history of ice jams. The existing bridge has a freeboard of 16.46 feet at Q50, the precast concrete girder on the 2 foot raised vertical profile has a freeboard of 18.81 feet at Q50, and the steel girder on the 2 foot raised profile has a freeboard of 19.15 feet at Q50. Since the freeboard is over 10 feet, then the girders can be assumed to be in a dry condition. If the steel girder is the one used, then weathering steel can be used since the girder will be dry.

An initial sizing has the steel girder height at 36 inches and the precast concrete girder height at 40 inches. Every headwater elevation and outlet velocity were the same when comparing the concrete girder to the steel girder model. The only output that changed in the Summary Table was the freeboard. The freeboard was larger for the steel girder option since the steel girder has a smaller height.

Below is a list of parameters used in each of the hydraulic models.

Existing Bridge

- Bridge Shape: Two-span steel girder bridge with unsymmetric span lengths
- Span: 60' 3 $\frac{3}{4}$ " – 20' 4 $\frac{1}{2}$ "
- Deck Width: 19 ft
- Skew: 0 degree

Steel Girder on Rock-Socketed H-Piles

- Single-span with no piers
- Span: 104 ft
- Girder Height: 36 in
- Deck Width: 32 ft
- Profile: Raised 2 ft vertically
- Skew: 0 degrees

Since all the replacement bridge options stay out of the channel above the Q500 elevation, the hydraulic outputs in HEC-RAS are the same. The only changes in the proposed options are the freeboard. There are a few HEC-RAS model outputs in the Summary Table below. See Appendix C for the Hydraulic Report for information on the hydraulic analysis, including assumptions, boundary conditions, and calibration.

SUMMARY

		Existing Structure	Recommended Structure
		Two Span Steel Beam	104' Single Span Steel
Total Area of Waterway Opening	ft ²	1020	1630
Headwater elevation @ Q _{1.1}	ft	220.04	219.48
Headwater elevation @ Q ₁₀	ft	222.98	221.61
Headwater elevation @ Q ₂₅	ft	223.87	222.22
Headwater elevation @ Q ₅₀	ft	224.54	222.68
Headwater elevation @ Q ₁₀₀	ft	225.19	223.13
Headwater elevation @ Q ₅₀₀	ft	226.60	224.12
Freeboard @ Q ₅₀	ft	16.46	19.15
Freeboard @ Q ₁₀₀	ft	15.81	18.70
Outlet Velocity @ Q _{1.1}	ft/s	7.82	5.20
Outlet Velocity @ Q ₁₀	ft/s	11.86	8.18
Outlet Velocity @ Q ₂₅	ft/s	12.79	8.78
Outlet Velocity @ Q ₅₀	ft/s	13.45	9.18
Outlet Velocity @ Q ₁₀₀	ft/s	14.05	9.50

Reported by: Brewer, Erin

Date: May 3, 2023

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