

HYDROLOGY/HYDRAULICS SUMMARY

The project is located at the US 1 bridge over Grand Lake Stream in Princeton (outlet of Lewey Lake). Calculation of design hydrology is a challenge at this location because of the large watershed area and complicated drainage patterns. The existing structure drains approximately 488 square miles of rural area with a very high percentage (approximately 22%) of that area in wetlands. The 100 year storm flow is 9455 cubic feet per second. Water levels in this location are controlled by the Grand Falls Dam, which is 5 miles downstream. Immediately upstream and downstream of the bridge are Lewey Lake and Grand Falls Flowage, respectively.

Both of these water bodies have a large potential for storage, and it is unlikely that the calculated peak flows actually pass through the bridge opening, for the given return periods. While the HEC-RAS hydraulic model does not take the drainage area detention into consideration, it does show that the proposed bridge opening is more than adequate to pass these flows.

The top of flashboard elevation at Grand Falls Dam is 203.5', which has been used as the typical water surface elevation at the bridge, and verified by the site survey as well as the St. Croix River Board hydrograph shown with the hydrology data. Local response at the Preliminary Public Meeting indicated no known roadway overtopping or significant rise in water levels. A significant reduction in the water surface elevation to facilitate construction will not be feasible.

The proposed structure opening is marginally larger than the existing opening and no effective change in water elevations will occur. The proposed structure has been raised by about 2 feet for boat traffic clearance. There will be approximately 2.8 feet of clearance (freeboard) between the 100 year water surface elevation and the bottom of the superstructure.

The proposed bridge will have spread footings founded on bedrock. Consequently, scour is not an issue. Plain riprap will be used where required on the approach roadway sideslopes and around wingwalls.

SUMMARY OF HYDOLOGY

Drainage Area = 488 square miles
 Low Flow (August) Q = 1.84 cfs
 Ordinary High Water (Q_{1.1}) = 2667 cfs
 10 Year Flood (Q₁₀) = 6575 cfs
 25 Year Flood (Q₂₅) = 7721 cfs
 Design Discharge (Q₅₀) = 8561 cfs
 Check Discharge (Q₁₀₀) = 9455 cfs
 Q₅₀₀ = 11482 cfs

SUMMARY OF HYDRAULICS

Existing Bridge Summary Table			
Return Period	Discharge	Headwater Elevation (ft)	Outlet Velocity (cfs)
1.1	2667	203.18	1.32
25	7721	204.45	2.97
50	8561	204.99	3.02
100	9455	205.54	3.06
500	11482	206.74	3.14

Proposed Bridge Summary Table			
Return Period	Discharge	Headwater Elevation (ft)	Outlet Velocity (cfs)
1.1	2667	203.22	1.3
25	7721	204.45	2.97
50	8561	204.96	3.03
100	9455	205.5	3.08
500	11482	206.72	3.15