HYDROLOGY REPORT

The drainage area for the Pingree Bridge Culvert #2668 in Parkman was determined using Google planimeter maps. The flows were determined using the USGS Hodgkins regression equations for ungaged, unregulated streams in rural drainage basins in Maine with 6.12% wetlands area.

Summary

Drainage Area	6.72	mi^2
$Q_{1.1}$	150	ft^3 / s
Q_2	300	ft^3 / s
Q_{10}	650	ft^3 / s
Q_{25}	850	ft^3 / s
Q_{50}	1000	ft^3 / s
Q_{100}	1150	ft^3 / s
Q_{500}	1600	ft^3 / s

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The Pingree Bridge Culvert #2668 is located in the town of Parkman on Route 150 over the Pingree Center Stream and 0.01miles southerly of Wellington Road. The existing culvert is a 14' diameter corrugated metal pipe. The pipe is approximately 207' long and is immediately downstream of a dam. The dam is at the outlet of Pingree Pond and is in poor condition. Due to the condition of the dam and the possibility of future removal of the dam the hydraulic analysis was performed using flows that were based on no dam being present. The existing pipe is a hanging pipe and there is a scour hole at the outlet of the pipe approximately 4ft deep. The existing and proposed alternatives were each analyzed using HEC-RAS. The downstream connection type was modeled using cross sections taken over 100ft downstream. Based on survey information, site pictures and site visits a bankfull width of 12ft was used. With the removal of the culvert and the abutment walls and the possible removal of the dam this width could vary, although for the purposes of preliminary design 12ft was assumed reasonable. Heavy riprap aprons will be placed for 10ft along the upstream and downstream ends of the culvert and up to the Q50 elevation.

The first alternative was to do nothing. The existing culvert was analyzed with a length of 207' and a slope of 0.23%. The manning coefficient used was 0.024. The existing bridge is adequate from a hydraulic aspect, with a HW/D of 0.62 at the Q50 flow. There is a large scour hole at the outlet of the pipe and the existing pipe has a 2' hanging outlet.

The second alternative was sliplining the existing culvert with a 12' diameter CMP. The culvert had a slope of 0.23% matching the existing pipe and a manning coefficient of 0.025. This option would increase the outlet velocity. The HW/D ratio at the Q50 design flow was 0.79.

The third alternative was sliplining the existing culvert with a 11' diameter HDPE pipe. The culvert had a slope of 0.23% matching the existing pipe and a manning coefficient of 0.01. This option would increase the outlet velocity. The HW/D ratio at the Q50 design flow was 0.68.

The fourth alternative was a ConSpan O-series arch on concrete abutments founded 6ft below the streambed. The arch has a span of 18ft and a rise of 7ft-6.75in. The alternative has a natural stream bed. The HW/D ratio at the Q50 design flow was 0.48. This alternative resulted in the best hydraulic capacity and the lowest stream velocity at the Q2 design flow.

The fifth alternative was to replace the existing pipe with a precast concrete box with a span of 12' and a rise of 12'. The box was 245' long and filled with 2' of special fill along the bottom for the entire length. The box was set at a slope of 2%. The manning coefficient for the bottom of the box was 0.03 (natural bottom) and 0.011 for the top. This option would increase the outlet velocity. The HW/D ratio at the Q50 design flow was 0.60.

The sixth alternative was to replace the existing pipe with a precast concrete box with a span of 16' and a rise of 10'. The box was 245' long and filled with 2'-0" of special fill along the bottom for the entire length. The box was set at a slope of 2%. The manning coefficient for the bottom of the box was 0.03 (natural bottom) and 0.011 for the top. The HW/D ratio at the Q50 design flow was 0.60.

The alternative structures were sized prior to the HEC-RAS analysis using the design charts provided in the Federal Highway Administration's publication of Hydraulic Design of Highway Culverts - Hydraulic Design Series Number 5 (Publication No. FHWA-NHW-01-020). Please see Appendix D.

SUMMARY

	Existing Pipe	12' Diam CMP	11' HDPE Pipe	O-Series Arch	12x12 Precast Box	16x10 Precast Box
Total Area of Waterway Opening (sf)	154	113	95	134	120	132
Culvert Invert Upstream (ft)	509.77	510.77	510.77	509.7	507.7	507.7
Culvert Invert Downstream (ft)	509.3	510.3	510.3	505.6	503.6	503.6
Inlet WS @ $Q_{1.1}$ (ft)	513.14	514.36	513.55	510.99	511.39	511.1
Inlet WS @ Q_2 (ft)	514.47	515.8	514.74	511.75	512.39	511.92
Inlet WS @ Q_{25} (ft)	517.72	519.44	517.61	513.81	515.08	514.14
Inlet WS @ Q_{50} (ft)	518.43	520.29	518.21	514.28	515.7	514.65
Inlet WS @ Q_{100} (ft)	519.11	521.1	518.75	514.72	515.7	515.13
Outlet WS @ $Q_{1.1}$ (ft)	511.9	513.01	512.83	508.14	508.14	508.14
Outlet WS @ Q_2 (ft)	513	514.17	513.93	508.73	507.81	508.73
Outlet WS @ Q_{25} (ft)	515.65	516.96	516.8	508.77	509.88	509.11
Outlet WS @ Q_{50} (ft)	516.21	517.55	517.49	509.13	510.35	509.47
Outlet WS @ Q_{100} (ft)	516.74	518.1	518.24	509.46	510.35	509.83
Outlet Velocity @ $Q_{1.1}$ (ft/s)	7.63	7.84	9.09	3.28	4.91	3.68
Outlet Velocity @ Q_2 (ft/s)	9.21	9.51	10.97	5.32	11.31	5.99
Outlet Velocity @ Q_{25} (ft/s)	12.52	13.19	14.54	14.88	16.57	15.14
Outlet Velocity @ Q_{50} (ft/s)	13.2	14	15.18	15.73	17.54	16.13
Outlet Velocity @ Q_{100} (ft/s)	13.84	14.79	15.66	16.55	17.54	17.01
HW/D @ Q_{50}	0.62	0.79	0.68	0.48	0.60	0.60