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FACULTY OF ENGINEERING

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Modifications to Hammonds Plains Road to Alleviate Drainage-Induced Flooding

PROJECT SCOPE

WSP Global Inc. was approached by the Halifax Regional Municipality to alleviate reoccurring flooding problems in the Hammonds Plains Road area within Bedford, Nova Scotia. Access through Hammonds Plains Road is necessary since it is a high traffic road and an emergency egress for the Bedford area. During large storm events, localized flooding occurs at the intersection of Hammonds Plains Road and Bluewater Road.

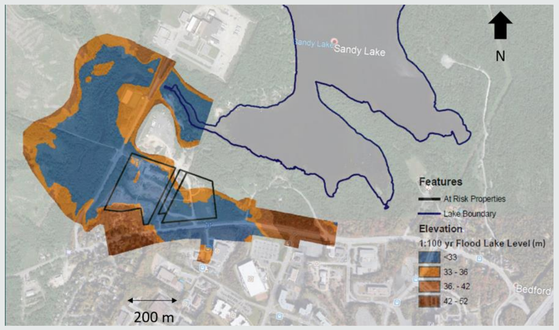
Above: Existing channel and project site. Hammonds Plains, Nova Scotia.

DESIGN PROCESS

Analysis of Existing Channel
- Site Inspection
- Data Collection
- Sandy Lake Water Levels
- HEC-RAS Modelling of Existing Channel
- Channel Geometry from LiDAR CAD Surface

Design of Proposed Channel
- Fish Passage Consideration
- Low Flow Conditions
- Open Channel Shape
- Sediment Transport
- Infrastructure Design
- Roadway Design
- HEC-RAS Re-modelling

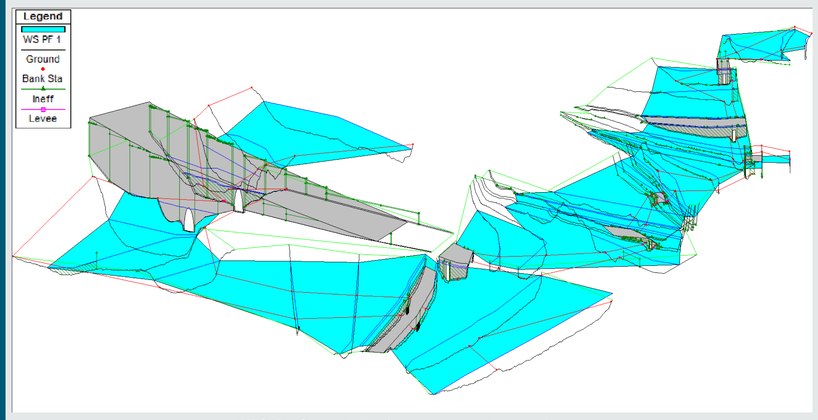
DOWNSTREAM LAKE BOUNDARY



Above: Sandy Lake level as a results of a 100 year storm event.

FINAL DESIGN

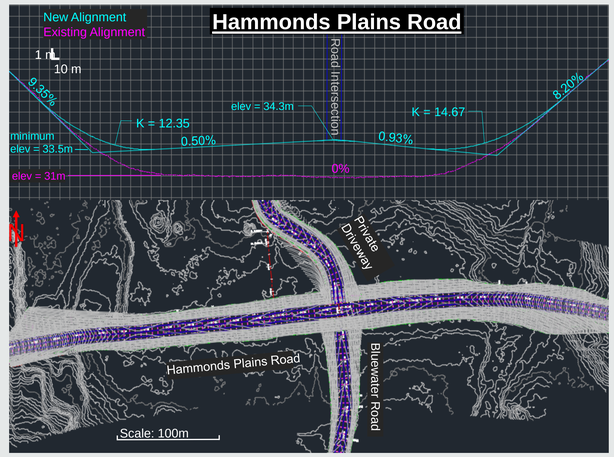
The following design was created to alleviate flooding issues for a 1 in 100 year storm event. The main goal for the design was to mitigate the flooding happening on Hammonds Plains Road. The design also considered mitigating the surrounding properties and roadway.



Above: HEC RAS model of proposed channel.

ROADWAY

The minimum roadway elevation will be 33.5 m to combat downstream lake level conditions for a 100 year return period. Street lights are present, therefore no headlight control is needed. Sag curves were designed for comfort with a K_{min} of 12. The road peaks at the Bluewater Road intersection to create minimum longitudinal slope of 0.5% to promote drainage away from intersection, and the road is crowned at 2%.



CHANNEL INFRASTRUCTURE

Culverts were designed in accordance with the Watercourse Alteration Act Sizers Manual and the Halifax Water Design Specifications.
Culvert types chosen include circular, arch and box culverts.

Culvert Sizes 1:100 Flooding Event					
Culvert	Span / Diameter (m)	Rise (m)	Length (m)	Style	Description
1	Unchanged	-	-	-	Small Local Drainage
2	Removed	-	-	-	Crossing Bluewater Road
3	2.44	2.13	18	Box	Crossing Private Entrance HPR
4	Removed	-	-	-	Crossing Access to Manhole
5A	2.44	2.13	20	Box	Watershed A Drainage
5B	1.83	2.13	18	Box	Watershed C Drainage
6	2.13	1.52	8	Box	Private Crossing South
7	2.13	1.52	15	Box	Private Crossing North
8	4.87	4.0	33	Box	Crossing FDL South
9	1.5 (6)	-	20	Circular	Crossing Access Road
10	10	5.5	25	Arch	Crossing FDL North

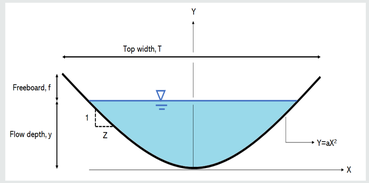
Above: Arch culvert.

Above: Box culvert.

Above: circular culvert.

CHANNEL GEOMETRY

A parabolic channel shape was chosen as the optimal geometry shape for the proposed channel. The parabolic channel allows for a greater flow depth at low flow rates. Parabolic channels are hydraulically stable and approximate the geometry of natural open channels. The parabola's shape is governed by its side slopes, denoted as 1/Z in the figure.



Above: Geometric properties of the parabolic channel.

FISH PASSAGE

The proposed channel was designed in accordance with the Fisheries Protection Program for the Maritimes Region. Using a prorated calculation method, the standard fish passage June Q60 design flow was calculated as 0.065 m3/s. Sediment transport was evaluated using the Shields criterion.

Energy dissipations pools as well as open bottom and embedded structures were incorporated into the culvert design to facilitate fish passage.

CONCLUSION AND RECOMMENDATIONS

- Realign watercourse to promote flow away from Hammond's Plains Road using parabolic shape to maintain fish passage
- Install new box and arch culverts to prevent constriction of flow through the channel
- Raise all roads to a minimum of 33.5m with a 0.5% longitudinal slope and 2% crown
- Proper lake water surface profile studies for storm events
- Two dimensional, unsteady hydraulic analysis
- Sediment transport within hydraulic analysis
- Flow contributions (apart from over-land flow) and water table studies for the surrounding area

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