April 30th, 2025

Attn: Mr. Brad Kalus, Vice President & Manager
Planmac Engineering Inc
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Toronto, ON, M8Z 2C9
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Re: Fluvial Geomorphic Assessment for Water Crossings to the Line 8 and Sideroad 10 Road Improvements in Bradford West Gwillimbury, ON

Dear Brad,

Aquafor Beech Limited was retained by Planmac Engineering to prepare a fluvial geomorphic assessment in support of a Class EA study for the Town of Bradford West Gwillimbury. The project area is located along Line 8 from Barrie Street to the east to Sideroad 10 to the west, and from Sideroad 10 just north of Line 8 until south to Reagens Industrial Parkway. Aquafor's Fluvial Geomorphologist has identified the existing conditions of all water crossings within the study limits (Figure 1). Four (4) crossings were identified as part of the initial 2017 EA study for this project. This update will review the conditions of these crossings as of the date of the field visit on March 5th, 2024.

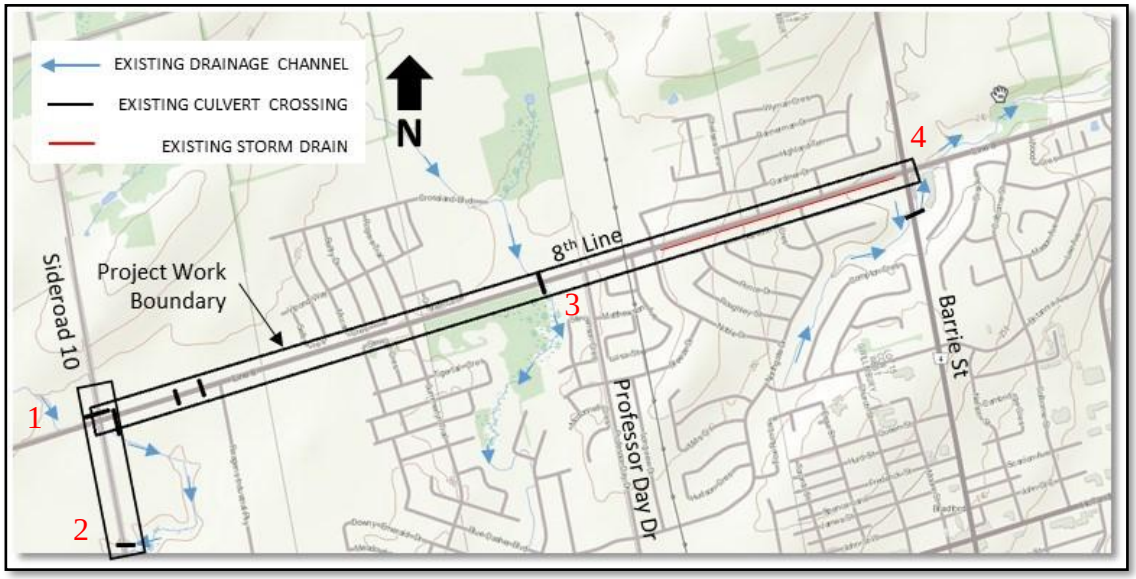

Figure 1: Drainage channels that cross Line 8 and Sideroad 10 with numbered crossings (red)

Fluvial Geomorphic Assessment

The crossings will be referenced from west to east and from upstream to downstream as indicated in Figure 1. Crossing 1 (Figure 1) is fed by a headwater drainage feature that crosses agricultural field and drains to a grass-lined roadside ditch (Figure 2). The ditch spans 3 meters at bankfull and narrows to less than 0.5 m at the base of the ditch. There is sparce phragmites in the ditch which will eventually proliferate and fill the ditch. At the northwest corner of Line 8 and 10

Sideroad there are 800 mm twin HDPE culverts that cross south to the southwest corner (Figure 3). Flow through this crossing is to the south.

Figure 2: Grass-lined ditch upstream of Crossing 1

Figure 3: Dual HDPE culverts on the northwest corner of Line 8 and 10 Sideroad.

Phragmites has also filled the southwest corner of line 8 and 10 Sideroad where the twin HDPE culverts outlet to an open ditch (Figure 4) before crossing east across 10 Sideroad by a 350 mm culvert that was not located in the field (Figure 5). The channel on the southwest corner extends for approximately 30 m and form a 5 m to 6 m wide landscaped grassy swale. The swale is approximately 0.7 m deep and shows no indication of erosion.

Figure 4: Dual Culvert outlet into phragmites lined swale.

Figure 5: 5-6 m grassy swale on the southwest corner of Line 8 and 10 Sideroad.

The northeast corner of Line 8 and 10 Sideroad has a 300 mm CSP culvert that outlets to the southeast corner. The road embankment shows sign of erosion from overland drainage and potentially elevated flow levels, indicating that the culvert is undersized (Figure 6). Flow through this crossing is to the south. The channel downstream of this culvert ranges from 2 to 5 m wide and has an average depth of 0.5m at bankfull. The channel is grass lined and at low flow becomes multi-threaded through a 100 m segment of channel, 50 m downstream of Line 8 (Figure 7).

Figure 6: Bank erosion on the northeast corner of Line 8 and 10 Sideroad.

Figure 7: 2-5 m wide channel downstream of Line 8.

The channel transitions to a confined system as grading has been completed to accommodate the channel. This drainage pathway constitutes a rip rap lined intermittent channel that acts as an oversized headwater drainage feature (Figure 8).

Figure 8: Widened channel corridor is confined by graded berms close to Crossing 2 (Figure 1) at 10 Sideroad.

Figure 9: HDF west of Crossing 2 (Figure 1) 10 Sideroad.

As the channel crosses 10 Sideroad towards the west at Crossing 2 (Figure 1) it lacks a defined channel morphology and becomes a headwater drainage feature that crosses agricultural fields once more. There is no evidence of erosion apparent through this section or near 10 Sideroad. Throughout the reach the channel was poorly channelized, showed no significant erosion and was assessed to have little potential to meander.

At Crossing 3 (Figure 1), the wetland/storm water facility shows multiple threads through the standing water. The flow passes over a weir structure built into a catch basin on the north side of Line 8 (Figure 10). Twin box culverts pass to the south under Line 8 and outlet to a wetland pond on the south side of the road. The wingwalls and road bed slope show no sign of outflanking or undermining, and there is little to no likelihood of this watercourse meandering.

Figure 10: Weir structure on the north side of Line 8.

Figure 11: Twin concrete box culverts outlet to a wetland on the south side of Line 8 at Crossing 3 (Figure 1).

Crossing 4 (Figure 1) is outside of the study area and the affected road improvement in this study. The drainage flows along a pipe towards the north and outlets to the creek through a Box culvert (Figure 12). As the channel flows northeast away from the study area, the 5 m wide channel meanders close to the gabion lined slope along Line 8. Future road improvements to the east of this study area will need to assess the erosion hazard limit of this channel.

Figure 12: Box Culvert at Crossing 4 (Figure 1) on the North side of Line 8.

Figure 13: Meandering channel along Line 8, east of the study area.

Conclusions and Design Recommendations

A fluvial geomorphic assessment has been completed for all watercourses in the study area of the Line 8 and 10 Sideroad road improvements study. No evidence was found to support the determination of a meander belt at any of the 4 crossings identified.

Crossings 1 and 2 were of the same watercourse that has been historically modified and provides connectivity of the headwater drainage through the agricultural field through this area. As such a meander belt does not apply to these crossings.

Crossing 3 is the conveyance of flow from an upstream pond to a downstream wetland and does not meander. As such the delineation of a meander belt is not applicable.

Crossing 4 is completely piped and does not require a meander belt hazard delineation through the study area subject to road improvements. Downstream of crossing 4 would require a meander belt assessment for any future road improvements, as it is with close proximity to Line 8, but remains outside of the scope of the proposed work.

Design considerations to the preliminary channel design (Figure 14) should include hydraulic modelling of the proposed flows. Channel treatments shown in Figure 14 show proposed stone to be added to the ditch and swale on the northwest and southwest corners of the roundabout. Order of magnitude estimates of channel velocity suggest that flows will be in the range of 1 to 2.5 m/s and the channel banks and substrate should be designed appropriately. Channel design should incorporate natural channel design principals and be restored with native plantings where possible. Additionally, the phragmites in these channels should be treated and removed prior to channel restoration.

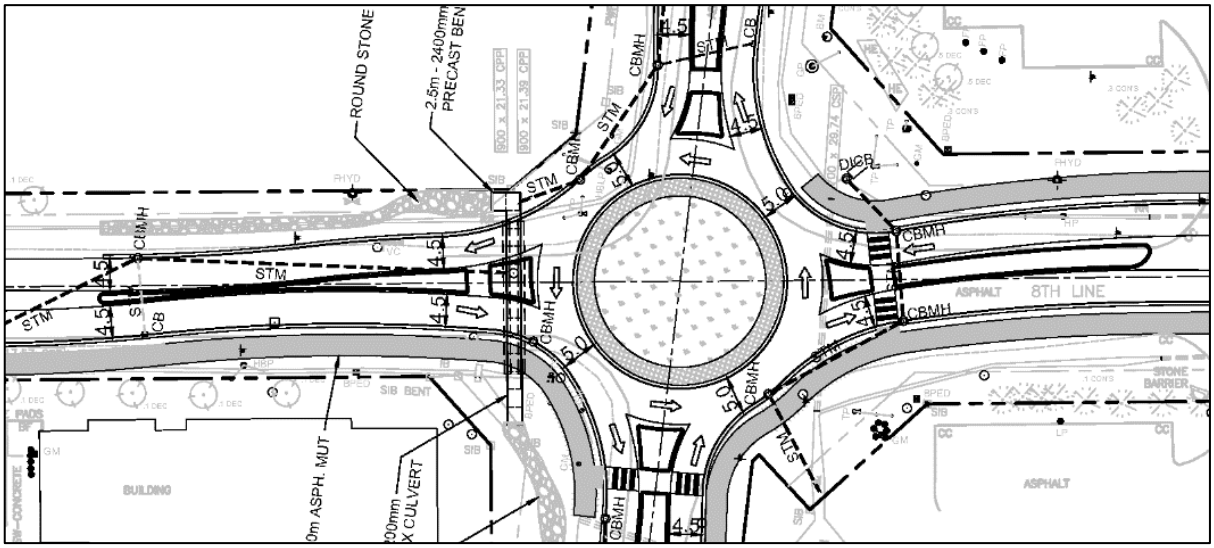

Figure 14: Preliminary design of the roundabout at Line 8 and 10 Sideroad.

April 30th, 2025

Should you require any additional information or clarification, please do not hesitate to contact myself at 416.550.5143.

Sincerely,
AQUAFOR BEECH LIMITED

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David Kynaston, Ph.D., P.Geo.
Geomorphology Practice Lead, Aquafor Beech Ltd.