ENBRIDGE

Joel Denomy
Technical Manager,
Regulatory Applications
Regulatory Affairs

tel 416-495-5676
EGIRegulatoryProceedings@enbridge.com

Enbridge Gas Inc.
500 Consumers Road
North York, Ontario M2J 1P8
Canada

November 28, 2019

RECEIVED
DEC 05 2019
ONTARIO ENERGY BOARD

VIA EMAIL, RESS and COURIER

Christine Long
Registrar & Board Secretary
Ontario Energy Board
2300 Yonge Street, Suite 2700
Toronto, Ontario, M4P 1E4

Dear Ms. Long:

Re: EB-2018-0108 Enbridge Gas Inc. (Enbridge Gas) Don River Replacement Project (Project) Response to Ontario Energy Board (Board) Questions on Request to Vary No. 1

On October 15, 2019 Enbridge Gas submitted a Request to Vary Form for the Project. The request to vary involved a change to the schedule for the completion of the tie-ins and therefore the in-service date of the Project.

Subsequently on October 24, 2019 Enbridge Gas received a letter from the Board requesting additional information such that a decision can be made on Enbridge Gas' Request to Vary. On November 1, 2019 Enbridge Gas filed the additional information requested by the Board. On November 20, 2019 Enbridge Gas received a letter from the Board indicating that the Board required Enbridge Gas to submit complete answers to the questions set out in the Board's letter of October 24, 2019.

Enbridge Gas' updated responses to the Board's questions are set out below. For completeness the responses provided by Enbridge Gas in its November 1, 2019 letter are included. Each of these responses is followed by additional narrative which addresses the Board's request in its November 20, 2019 letter.

1. *An explanation of the operational risks, network constraints, and costs associated with performing the by-pass option*

   Enbridge Gas evaluated the operational risks and network constraints associated with constructing a bypass during the winter months in order to attempt to complete the pipeline tie-ins in 2019. The primary risks include: challenges with inserting and obtaining a gas stop due to high flow conditions, potential damage to the bypass due to limited work space, potential third-party damage due to additional fittings being added to the NPS 30 main, potential for resource constraints around the holiday season and the potential for significant customer loss during the heating season should an outage occur on the line while the bypass option is being executed.

   Consideration and planning for the construction of the bypass was always within the project scope as an alternative tie-in method, if the planned maintenance shut-down timing could not be met in the original project schedule. The bypass option does not result in significant incremental costs to the overall project. The additional costs would be covered by the project contingency.

Additional Narrative:

Operational risks, network constraints and costs associated with performing the by-pass option are more fully discussed in the points that follow. The cost of the tie-ins is approximately $1.0 million. The cost of performing the by-pass option is approximately $1.9 million. Therefore the incremental cost associated with the by-pass option is approximately $0.9 million.

a) *Operational Risk - Challenges with inserting and obtaining a gas stop due to high flow conditions.*

   Enbridge Gas reached out to T.D. Williamson, an industry expert, to understand the flow rate limitations for the equipment utilized for a by-pass. The recommendation from this industry expert was that Enbridge Gas not complete a by-pass at a flow rate of over 9.0m/s. T.D. Williamson indicated that performing a by-pass at a flow rate higher than 9.0m/s would require that the equipment used to perform the by-pass (stopple equipment) be operated outside of safe operating limits. During the time the by-pass option would be completed (i.e. December and January) Enbridge Gas network analysis estimates that the flow rate would be 13.5m/s on the Don River Pipeline.

   T.D. Williamson indicated the flow rate limitation of the stopple equipment is due to the manner in which the plugging heads are set into and retracted out of the pipeline when performing a by-pass. The plugging heads are lowered into the pipeline on a cantilever beam. Higher flow rates have more force and thus have the potential to rip off the plugging heads. This can result in the plugging heads not creating a proper seal to stop gas flow and can also potentially damage the equipment that installs the plugging heads. Figure 1 shows a typical stopple fitting and corresponding equipment. The by-pass option requires four of these fittings and equipment to be installed (two on the east side of the Don River and two on the west side of the Don River).

   Based on the expected flow conditions of the Don River Pipeline during the time that the by-pass would occur, Enbridge Gas was concerned with the risk of not obtaining a gas stop due to high flow and/or damaging the equipment used to perform the by-passes. In the event that a gas stop was unsuccessful at either of the by-passes and there was an uncontrolled release of gas, the Don River Pipeline would have to be isolated resulting in the loss of customers.

b) *Operational Risk - Potential damage to the bypass due to limited work space.*

   Figures 2 and 3 provide the proposed bypass drawings for the east and west side of the Don River respectively.

   Enbridge Gas was concerned that the limited size of the work space in which the by-passes would be performed would increase the risk of damage to the by-passes once completed. This risk arises because the by-passes would be energized and flowing gas at the same time the tie-ins are constructed. The limited working space is a result of completing this work in a highly congested area. The equipment required for the by-pass option is large, resulting in the need for adequate clearances in order to operate safely. The size of the equipment adds to the congestion on site as a result of a limited working space. Figures 4 and 5 show a typical working area and an example of a crane that would be used for the by-pass option, in addition to the regular required construction equipment. Note: The working area shown in Figure 4 is substantially larger and provides more clearance for machinery and equipment than the working space where the by-passes would be utilized for the Project.

If there was damage to either of the by-passes, depending of the extent of the damage Enbridge Gas would need to isolate the Don River Pipeline which would result in the loss of customers. The by-pass(es) would then have to be reconstructed prior to the tie-in(s) being completed.

c) *Operational Risk - Potential third-party damage due to additional fittings being added to the NPS 30 main.*

   Adding the stopple fittings to the main is required for the bypass option. It reduces the depth of cover of the main by approximately 30cm. Due to the reduced depth of cover the potential for a future third party damage is higher as the main is no longer at the standard depth of cover (approximately 1.0m).

   If a third party damage were to occur to any of the stopple fittings, depending on the extent of the damage, Enbridge Gas would need to isolate the Don River Pipeline which would result in the loss of customers.

d) *Operational Risk - Potential for resource constraints around the holiday season.*

   With the by-pass option Enbridge Gas would be required to add an additional emergency crew on stand-by for the duration of the tie-in work. The additional cost of this crew is included in the cost of the by-pass option identified above.

e) *Network Constraint - Potential for significant customer loss during heating season should an outage occur on the line while the bypass option is being executed.*

   Please see the response to Question 3 for a discussion of expected customer losses related to a bridge failure and a by-pass failure or damage.

2. *An explanation of how Enbridge Gas will mitigate the risks of using the Utility Bridge for an additional 8 months, including how Enbridge Gas will reduce the impact of any outages for customers should the Bridge fail*

Enbridge Gas will not be using the Utility Bridge for an additional eight months. Enbridge was delayed in starting construction of the new NPS 30 pipeline due to permitting delays. In the original plan there were two options to tie-in the pipe: (1) to tie-in during the planned maintenance shut-down of a large volume customer, and (2) to use a bypass if the planned maintenance option was missed in Fall 2019. The permit delays have affected the entire project schedule including the timing of when the pipeline can be tied in. As a result, the earliest that the tie-ins could occur, if the bypass option is utilized, would be December 2019 with completion in Q1 2020. This option was evaluated and eliminated for the reasons discussed above which included consideration to reduce the risk of any customer outages. Therefore, the existing NPS 30 pipeline on the Utility Bridge will be in-service for up to an additional three months. Using the Utility Bridge for up to an additional three months does not outweigh the operational risks and network constraints associated with the bypass option as discussed above.

It is important to note that this Request to Vary does not impact the timing of the Utility Bridge removal which is still planned to commence in December 2021.

Additional Narrative:

Enbridge Gas' mitigation measures for continuing to use the utility bridge are set out in Exhibit B, Tab 1, Schedule 1, Page 6. As discussed in that narrative, Enbridge Gas executed a bridge abutment remediation plan which used Articulated Concrete Block mats to mitigate against further erosion of the river bank around the abutment. This work was completed in September of 2017 and reduced the probability of bridge failure in 5 years from 4.90% to 2.47%. This equates to a 50% reduction in the probability of bridge failure in 5 years. The probability of failure calculations are set out at Exhibit B, Tab 1, Schedule 1, Page 5, Table 4. The bridge abutment remediation plan is the short term solution to mitigating the risks associated with continuing to use the utility bridge and allows Enbridge Gas a few years to complete the long term solution of removing the Don River Pipeline from the utility bridge.

In the event that the bridge fails Enbridge Gas has developed a contingency plan to isolate the Don River Pipeline crossing. This contingency plan includes closing valves to isolate the pipeline should an emergency occur. This will result in customer losses. Enbridge Gas also monitors weather and water levels during periods of high rainfall.

3. *A comparison of the risks associated with performing the by-pass option versus the risks associated with prolonged use of the Utility Bridge, including quantitative analysis*

   As explained above, the tie-in during the large volume customer's planned maintenance shut down in April 2020 will result in the Utility Bridge being used for up to an additional three months. Due to the risks associated with the bypass option as discussed above, the bypass option is not preferred.

Additional Narrative:

Enbridge Gas has developed an estimate of the cost associated with two risk scenarios: a bridge failure and a by-pass failure. The by-pass failure scenario assumes that the Don River Pipeline would have to be isolated should any of the risks identified in the response to Question 1 (i.e. Operational Risks a), b) and c)) materialize. These estimates include assumptions related to expected customer losses, costs to make safe, re-light, etc. Table 1 summarizes the expected probability and cost associated with each scenario.

The risk of a bridge failure and therefore a pipe failure is 2.47%. A bridge failure would most likely occur during the late spring or early summer when water levels are high and the Don River could have debris. Enbridge Gas would note that the tie-ins will occur prior to the timeframe that significant flooding is most likely to occur. The impact of this event is described at Exhibit B, Tab 1, Schedule 1 , Page 18. A bridge failure would result in the loss of approximately 51,000 customers, including Portlands Energy Centre (PEC).

Enbridge Gas does not have readily available information on the likelihood of a by-pass failure. However, based on the information provided by T.D. Williamson, Enbridge Gas believes that operating the stopple equipment outside of safe operating limits would significantly increase the probability of a by-pass failure. A by-pass failure would occur in December and/or January. In this event the Don River Pipeline would be isolated, also resulting in a loss of customers. The impact of this event would be similar to the impact of a bridge failure in the middle of winter. This outcome is described at Exhibit B, Tab 1, Schedule 1, Page 17. Under design conditions this event would result in the loss of approximately 92,500 customers, including PEC.

Table 1: Risk Analysis

Option	Risk	Timing of Risk	Customer Losses	Cost ($ Millions)
(a)	(b)	(c)	(d)	(e)
Delay Tie-in	Bridge Failure in 5 Years	Spring	51,000	$19.1
Perform By-Pass	By-Pass Failure	Winter	92,500	$36.2

Should the Don Valley Pipeline have to be isolated, delaying the tie-ins results in the least amount of customer losses and requires the least cost to recover the customers lost. Based on this analysis delaying the tie-ins is the least risky option.

4. *A schedule for the by-pass option*

Due to the permitting delays, the bypass option would be executed starting in December 2019 with completion in Q1 2020.

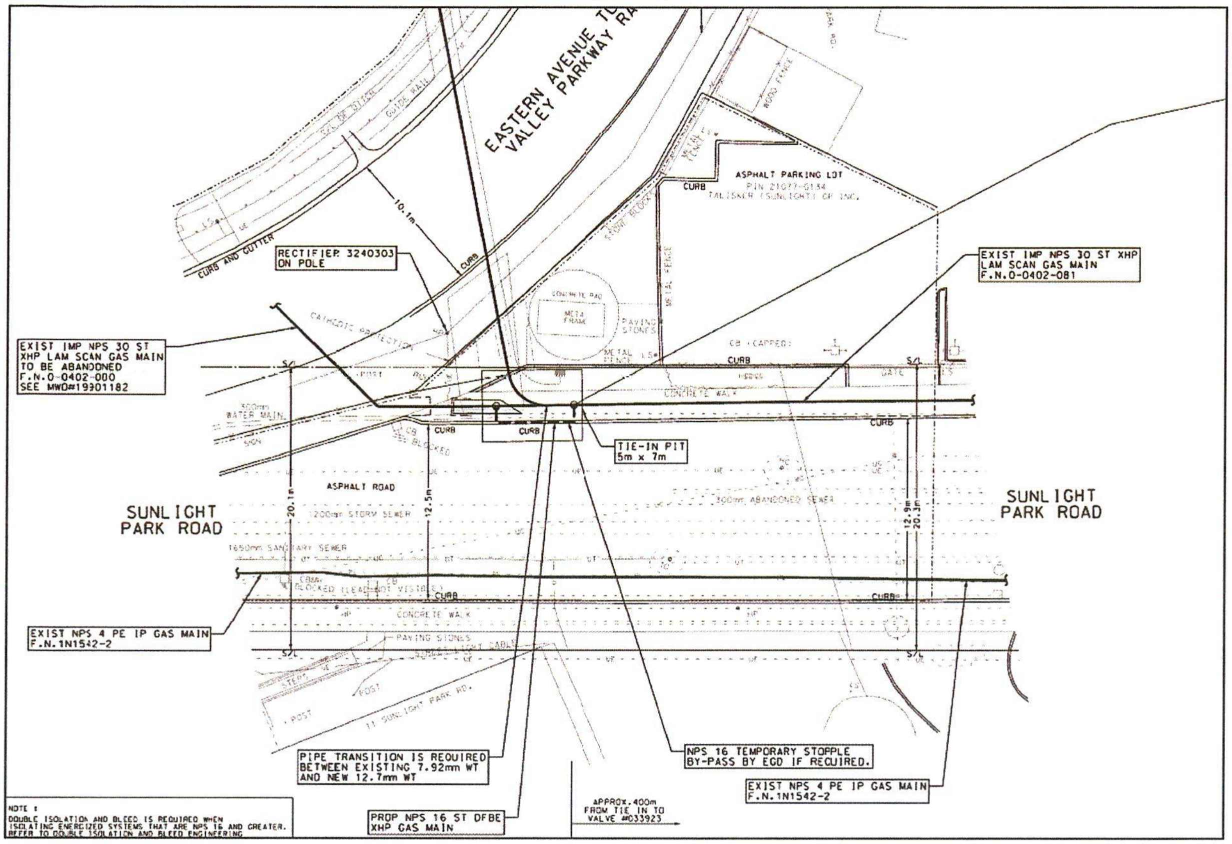
Please contact me if you have any questions.

Yours truly,

Joel Denomy
Technical Manager Regulatory Applications

Figure 1: Stopple Fitting

Figure 2: By-Pass Drawing – East Side of Don River



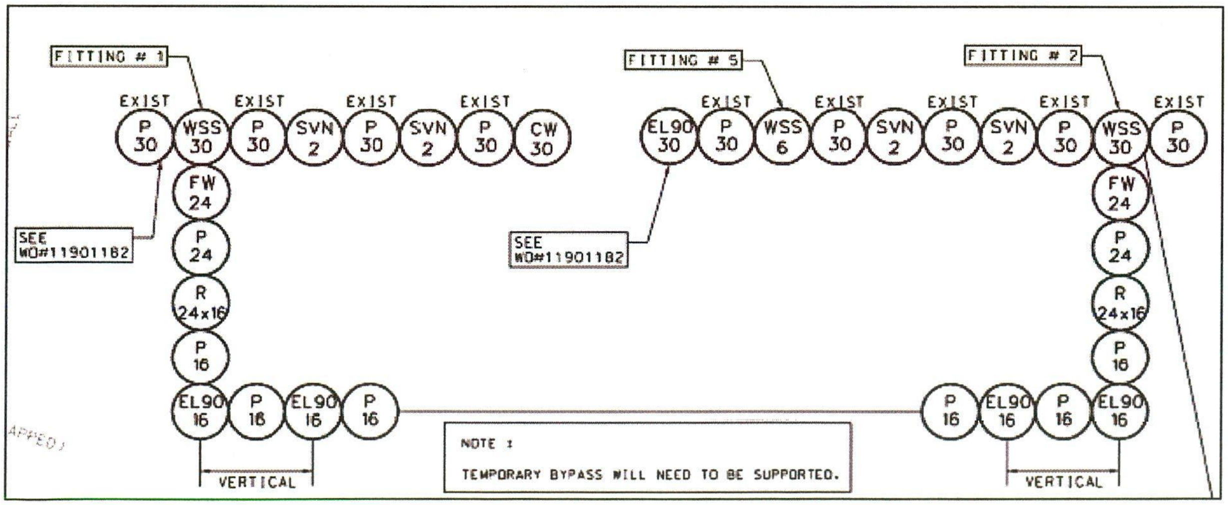


Figure 3: By-Pass Drawing – West Side of Don River

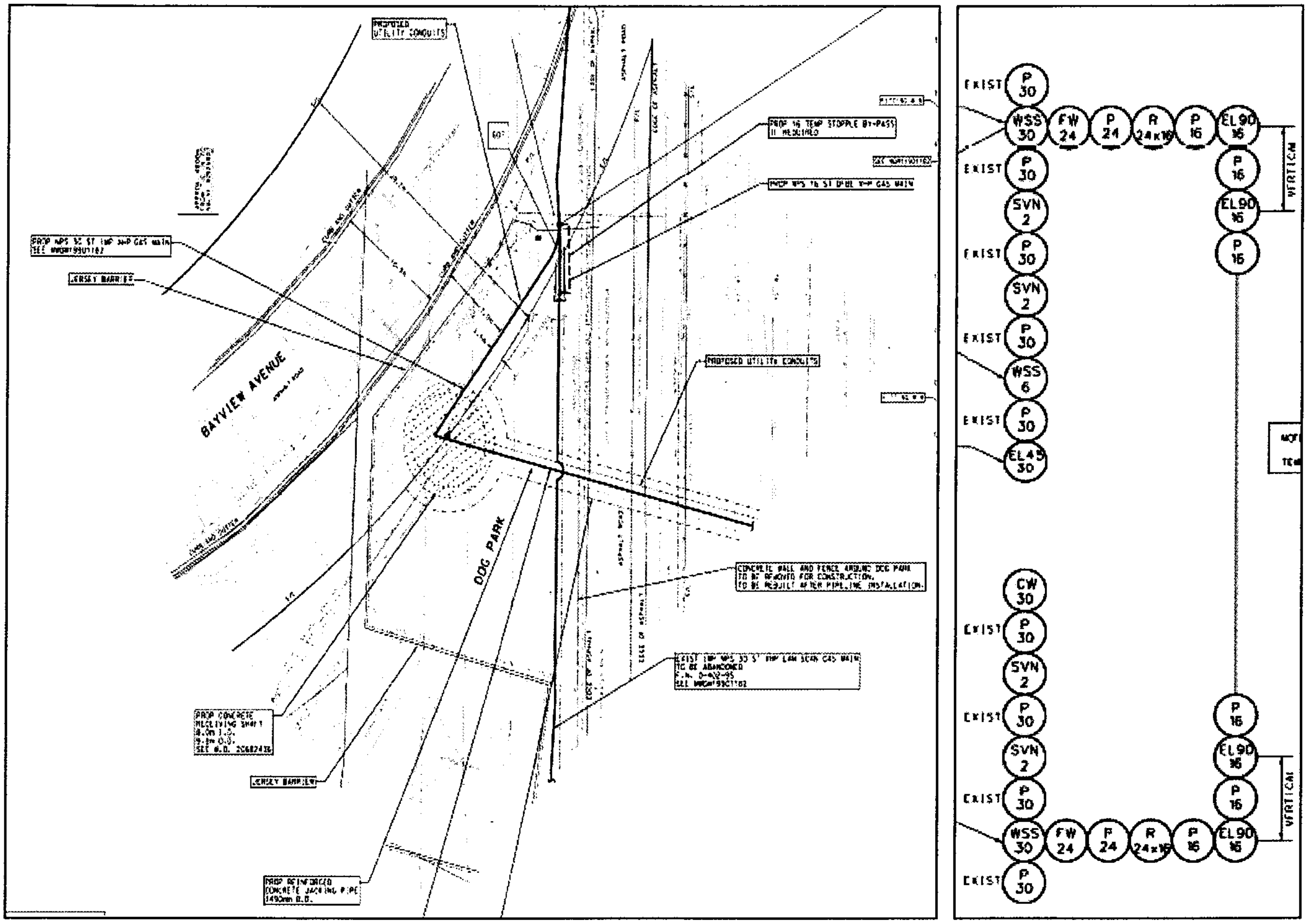
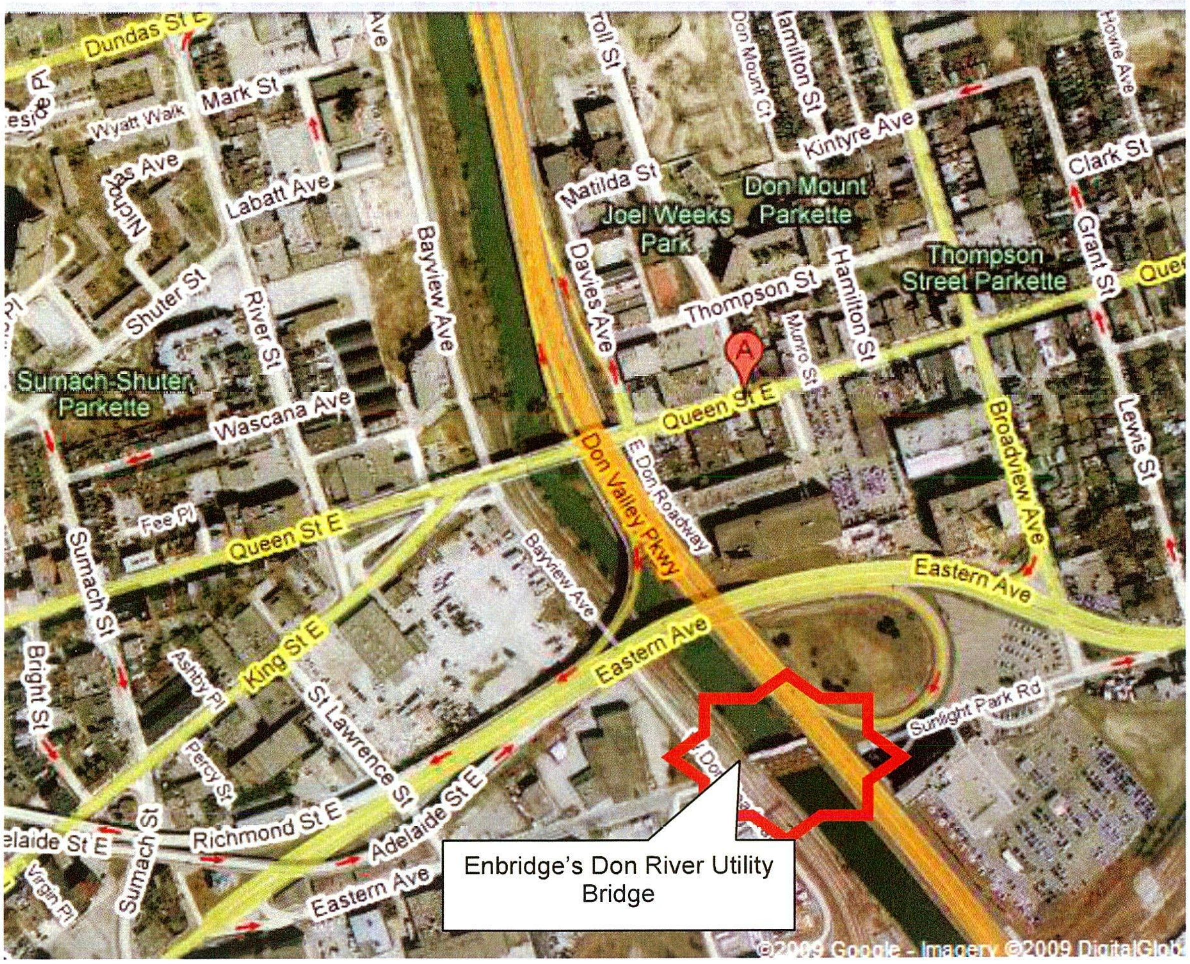


Figure 4: Typical Working Area and Stopple Fitting on Parkway North NPS 36

Figure 5: Typical Crane for Moving Fittings

Figure 1 Location of EGD Don River Utility Bridge



2 DON RIVER UTILITY BRIDGE

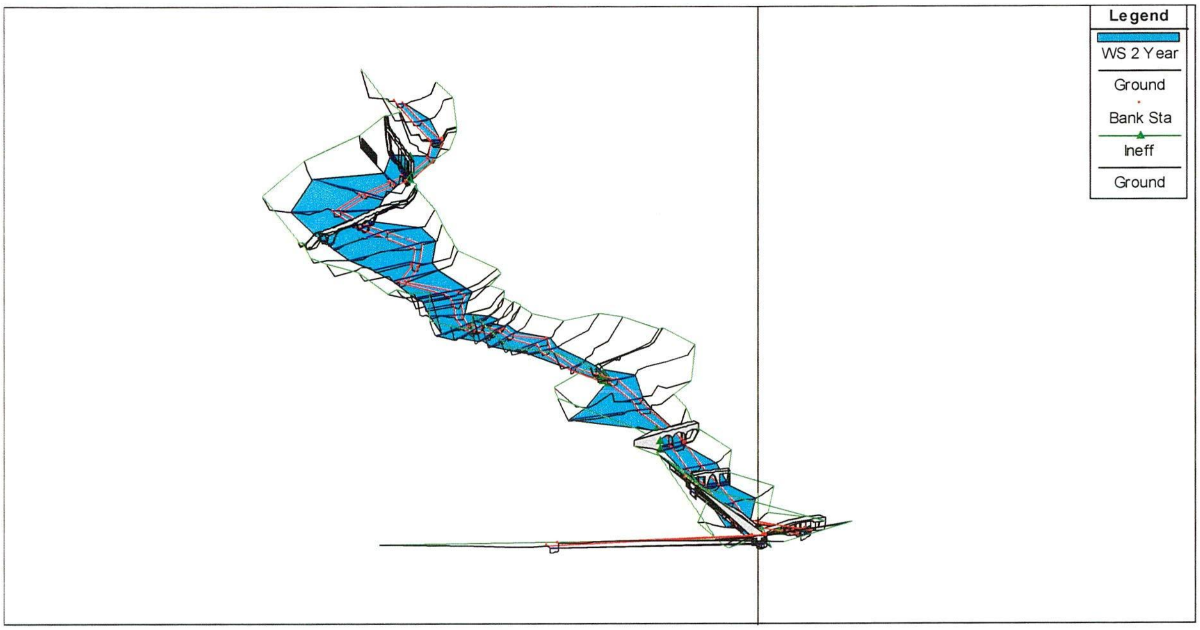
The utility bridge is located approximately 3 m immediately upstream of the former Eastern Avenue bridge (Figure A-1 and A-2 in Appendix A). The bridge is a concrete arch structure with suspended concrete deck and enclosed arch curtain walls. The bridge currently houses an active 30 inch EGD gas pipeline, an abandoned gas pipeline as well as a City of Toronto watermain (Figure A-3 – Appendix A). Other utility cables are attached to the exterior upstream face of the bridge near the waterline. The bridge opening from abutment to abutment is 39.9 m and the bottom cord of the bridge is at 77.5m asl. The average bed elevation of the Don River at the bridge is 73.70 m asl. It is important to note that the lower cord of the immediately adjacent abandoned road bridge is lower than that of the utility bridge by approximately 30 cm.

2.1 Don River Flooding Model

The TRCA and City of Toronto have embarked on a cooperative project to address flooding concerns along the Don River. To address flooding concerns in the lower Don, the Lower Don Flood Management Program is proposed to provide flood relief and discharge a portion of flood flows directly into the Keating channel, the receiving water at the mouth of the Don River (Figure A-4). The utility bridge is located in the Don 1 zone of TRCA Floodplain Mapping Program approximately 650 m upstream from the mouth of the Don River at the Keating Channel.

A hydraulic model, referred to as Don 48, was constructed in HEC-RAS to assess flooding conditions in the Don River. The 2006 model with edits in 2008 included the new proposed floodway and was forwarded by the TRCA to EGD for use in assessing flooding conditions associated with the utility bridge. The model incorporates 80 floodplain cross-sections extending from near the Keating Channel upstream approximately to the Bloor/Bayview off ramp from the Don Valley Parkway (DVP) south. The model transects range from 48.298 to 48.92. The utility bridge is included in the model as transect 48.365 along with nine other bridge structures. Transect 48.365 includes an upstream and downstream section referred to as U and D, respectively. It appears that the utility bridge downstream transect is in fact the downstream side of the adjacent abandoned road bridge and that both structures were modeled as one.

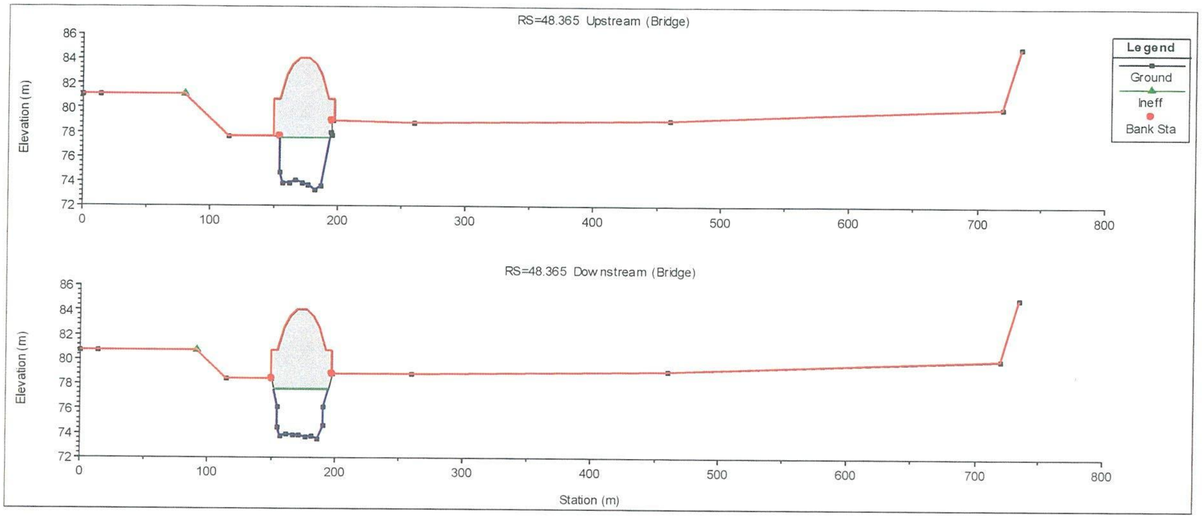
Figure 2 **Aspect view of model geometric profile looking upstream with river water level at the 2 year return period water surface**



2.2 Utility Bridge Flooding

The flood plain model presents existing conditions with the inclusion of the new proposed floodway diversion and a new proposed CN Rail bridge south of the utility bridge. Figure 3. presents both the upstream and downstream model cross-sectional transects for the utility bridge. To the right of the bridge is the DVP and adjacent flood plain and the left of the bridge is the proposed floodway and new embankment berm.

Figure 3 EGD Utility Bridge looking upstream



The flood plain model simulates condition for eight flow events ranging from the 2 year return period flow event to the Regional flood event. The Regional flood event is simulated from the rainfall and runoff associated with Hurricane Hazel. Table 1 presents the water surface elevation at the upstream face of the utility bridge as well as the average velocity, total flow beneath the utility bridge and total flow passing the bridge and flood plain.

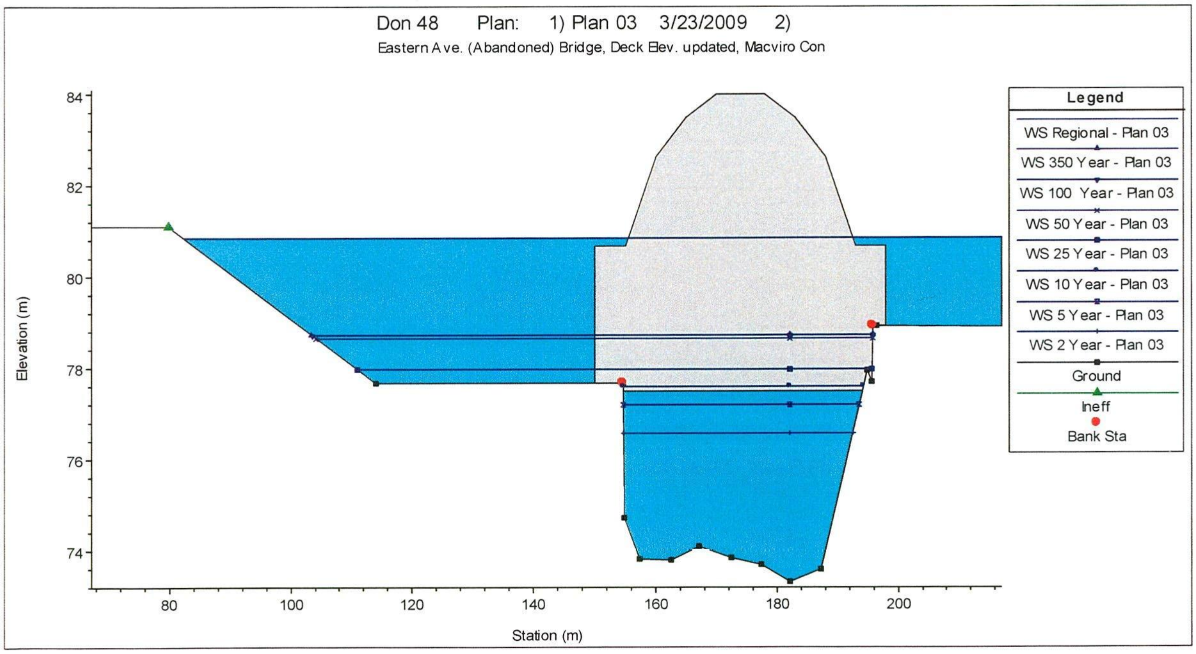
Table 1 Flooding event hydraulic conditions at the utility bridge

Flood event	Water Surface Elevation at upstream face (masl)	Average Water Velocity below bridge (m/s)	Total flow under bridge (m^3/s)	Total flow through flood plain (m^3/s)
2 year	76.56	1.63	160.31	160.31
5 year	77.18	1.92	235.45	235.45
10 year	77.60[1]	2.16	291.21	291.21
25 year	77.98	2.70	363.24	368.72[2]
50 year	78.65	2.86	384.72	426.51
100 year	78.72	3.26	439.23	492.50
350 year	78.73	3.92	528.31	593.50
Regional event	80.84[3]	3.05	410.33	1690.0

1 – Commencement of flow obstruction. The bottom cord of the bridge is modeled at 77.50 m
2 – Commencement of flow in the floodway immediately west of the bridge
3 – Activation of eastern portion of flood plain (DVP and east)

The utility bridge becomes an obstruction to flow at the 10 year event, at which the lower cord of the bridge is submerged by approximately 10 cm. However, at the 10 year flood threshold all flows remain in the main river channel and no adjacent flood way or floodplain area is activated. Figure 4 provides a view of the water surface elevations anticipated at the upstream face of the utility bridge. The proposed floodway immediately to the west is activated at the 25 year storm threshold and higher. The 50, 100 and 350 year return period floods are all relatively similar in water surface elevation at 78.65, 78.72 and 78.73 masl, respectively. The eastern portion of the floodplain over the DVP and east is only activated during the Regional flood event.

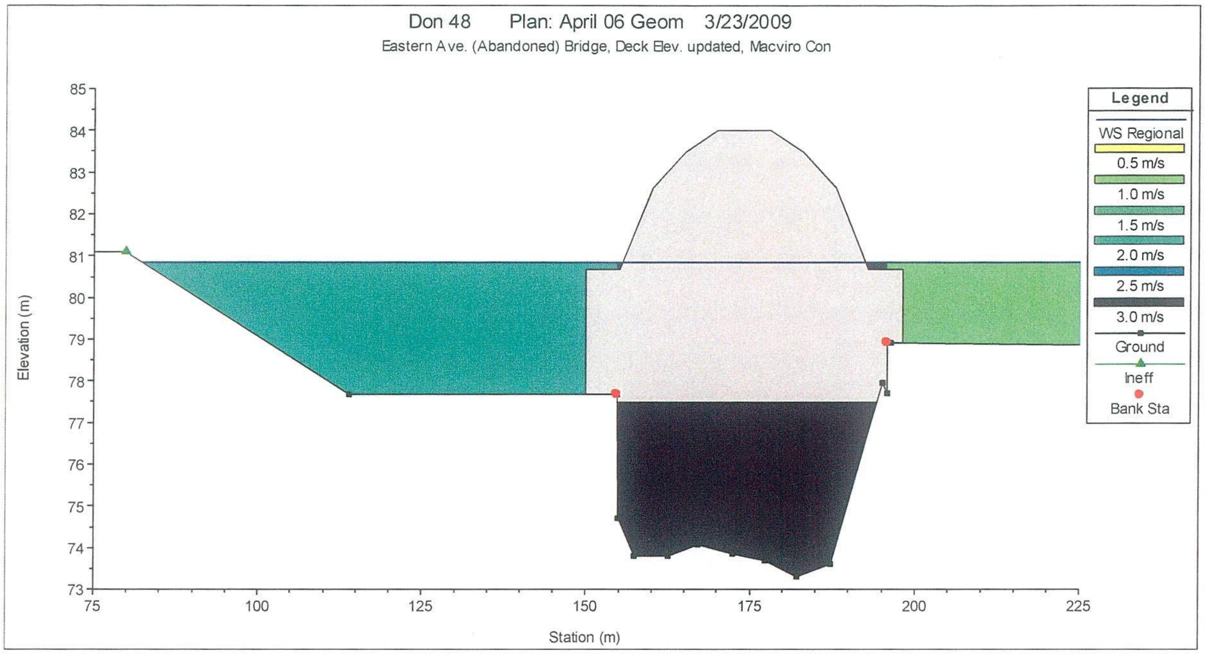
Figure 4 Water surface elevations at upstream face of the utility bridge



2.3 Hydraulic loads

Hydraulic loads are estimated based on the pressure acting on the utility bridge as a function of submerged depth and water velocity. Table 1 and Figure 4 indicate the water surface elevation of events from the 10 year flood event and greater result in partial submergence of the bridge structure. Table 1 provides the water velocity under the utility bridge for the flooding events. Figure 5 illustrates the differences in average Regional flood flow velocity under the bridge, in the floodway to the west and in the flood plain to the east.

Figure 5 Average Regional flood flow velocities at the utility bridge



Stream flow and ice pressures were estimated using methods found in Section 2.2.3 – Design Loads of the AREMA (2009) Manual for Railway Engineering.

Stream Flow Pressure

Stream pressure flow is comprised of hydraulic loads and further loads induced by the accumulation of drift against the utility bridge superstructure and piers. Both average and maximum pressures are estimated, however maximum pressures are used for the basis of design loading assessments and determinations. Hydraulic loads are calculated assuming a second-degree parabolic velocity distribution and thus a triangular pressure distribution using the following equation:

$$P_{avg} = K(V_{avg})^2 \qquad \text{(Equation 1)}$$

Where:

P_{avg} = average stream pressure in Pa

V_{avg} = average water velocity in m/s

K = a constant, being 725 for metric units for all square –ended piers and structures

Stream flow pressure is assumed to be triangular in distribution with maximum pressure located at the water surface elevation and zero pressure located at the flow line. Maximum flow pressure (P_{max}) is computed using the following equation:

$$P_{max} = 2(P_{avg}) \qquad \text{(Equation 2)}$$

When the water surface elevation is above the lower chord or beam elevation the stream flow pressure is calculated based on the pressure distribution over the exposed flow area on the pier or superstructure. However, it is typical in design cases to assume that the stream flow pressure acting on the superstructure is P_{max} with a uniform distribution (AREMA, 2009). Table 2 provides the P_{max} stream flow pressure on the utility bridge for flooding events from the 10 year to Regional flood events.

Ice Pressure Forces

Factors affecting horizontal dynamic ice forces include the angular inclination and area of the exposed structure and ice pressure. Dynamic ice forces were calculated using the following equation:

$$F = C_n ptw \qquad \text{(Equation 3)}$$

Where:

F = horizontal ice force on the pier or superstructure

C_n = Nose inclination coefficient (1.00 for angles of 0 - 15° from vertical)

p = ice pressure (MPa), 1.4 MPa based on assumption that ice break-up occurs at melting temperatures, but the ice moves in large pieces and is internally sound (See Figure A-4 in Appendix A.

t = thickness of ice in contact with pier or superstructure (mm), assumed to be 300 mm

w = width of pier or superstructure at the level of ice action (mm)

Ice pressure forces for flooding events from the 10 year flood to Regional Flood events are provided in Table 2.

Table 2 Hydraulic pressures and forces

Flooding Event	Average Stream Flow Pressure (P_{avg})(kPa)	Maximum Stream Flow Pressure (P_{max})(kPa)	Dynamic Horizontal Ice Forces (F)(kN)
10 year	3.383	6.765	16758[1]
25 year	5.285	10.571	19236
50 year	5.930	11.860	19236
100 year	7.705	15.410	19236
350 year	11.141	22.281	19236
Regulatory Flood	6.744[2]	13.489	20160

[1] = ice forces based on 39.9 m of span width. Ice contact width at the 25 – 350 year events is 45.8 m and 48.0 m at the Regulatory event

[2] = Stream flow pressures are less than the 100 or 350 year events due to lower channel velocities as a result of flows accessing the eastern flood plain zone.

3 CLOSURE

This report has been prepared for the sole benefit of Byrne Engineering and Enbridge Gas Distribution for the purposes of understanding existing flooding potential and hydraulic conditions at the EGD Don River Utility bridge. The report may not be used by any other person or entity without the express written consent of Jacques Whitford Stantec Limited, Byrne Engineering and Enbridge Gas Distribution.

Any uses that a third party makes of this report, or any reliance on decisions made based on it, are the responsibility of such third parties. Jacques Whitford Stantec Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions taken, based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions and recommendations presented in this report should not be construed as legal advice.

The conclusions presented in this report represent the best technical judgement of Jacques Whitford Stantec Limited based on the data obtained from the work. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

Respectfully Submitted,

JACQUES WHITFORD STANTEC LIMITED

DRAFT

Sheldon Smith MES., P.Geo.
Senior Hydrologist
Tel: 905-415-6405
Fax: 905-474-9889
sheldon.smith@stantec.com

SS/aek

P:\CMiC Jobs\1050xxx\1050175\Reports\Prliminary HydrotechReport\Draft EGD Don Utility bridge Existing Condition Hydrotech report.doc

APPENDIX A

Figures