

THIS IS EXHIBIT "C"
REFERRED TO IN THE AFFIDAVIT OF
DR. WILLIAM TAPE, P.E., P. ENG.
SWORN BEFORE ME THIS 24TH DAY
OF JULY, 2020.



.....
A Commissioner, etc.



May 7, 2020

The Corporation of the County of Essex
360 Fairview Avenue West
Essex, Ontario
N8M 1Y6

Attention: Ms. Jane Mustac, P. Eng, County Engineer
Ms. Krystal Kalbol, P.Eng., Manager, Transportation Planning & Development

**RE: REVIEW OF ENBRIDGE SUBMISSION FOR NEW GAS LINE ON
COUNTY ROAD 46
Our Project No.: 20-163**

Ms. Mustac, Ms. Kalbol,

Subsequent to the request of your office we have undertaken a review of the Enbridge Pipeline vehicle loading analysis dated May 1, 2020 in addition to Ms. Kalbol's memo of April 27, 2020. The following will outline the results of our review.

1. Background

It is our understanding from the above noted documents (2) that Enbridge is preparing to replace 29 kilometers of high-pressure gas line with the County of Essex's right of way. This work will occur on County Road 46 within the Municipalities of the Town of Tecumseh and the Town of Lakeshore.

The April 27 memo notes the recommendation of the Transportation Association of Canada (TAC) guidelines for such works with specific reference to the minimum encased and non-encased depth of bury. Given the pressure we have confirmed that the following memo's values are consistent with our investigation results:

- Non-Encased – 1.5m below paved surfaces but not less than 1m below ground elevation
- Encased – 1.2m below paved surfaces but not less than 0.9m below ground elevation

Enbridge's documents (calculations) suggest a buried depth of 1m and included calculations per CSA Z662-15 *Oil and Gas Pipeline Systems*.

Both parties note the proposed construction will be located outside the current main roadway driving path but will come within 2m of the existing road edge. However, it is our understanding that the Country Road 46 will experience road widening over the course of the pipelines life placing the proposed service within the drive path. Moreover, the existing shoulder is considered a travelled portion based on use of this region for maintenance activities and other motorist access needs.

Page 2
May 7, 2020

2. Our Assessment

Our assessment included a review of the documents received and the TAC recommendations as they form an established standard for works within the right of way. We also assessed the results of the Enbridge analysis against loading analysis for buried pipes and conduits (consistent with the Canadian Highway Bridge Code) and fundamentals for buried structures.

3. Observations

The following observations were made specific to our assessment:

Calculation Specific

- The Enbridge calculations provided for a 10% wheel load imbalance and an impact factor of 1.5. Furthermore, their analysis calculated the resulting hoop stresses under a truck with an axial load of up to 198,000lbs (880kN), which is ten times greater than their reported standard load.
- The Enbridge calculations were based on the vehicle crossing over (perpendicular) to the service with a wheel to wheel center of 157" (4m).
- The higher end of the load analysis presented by Enbridge yields results in excess of that following the prescribed loading criterion set forth by the Bridge Code's CL-625ONT vehicle or any evaluation vehicle defined in CAN/CSA S6.
- The Enbridge analysis assumed a modulus of soil reaction of 250psi (1.724 MPa). Such a value would be consistent for a fine-grained soil with a liquid limit of less than 50. However, such values should be field verified by a qualified Geotechnical Engineer. Note, if the liquid limit was greater than 50 would zero (Bureau of Reclamation). Failure to confirm this value in situ would be considered contrary to good Engineering practices; moreover, should a lower value exist the capacity of the pipe could be in question.
- The density of the soil carried by Enbridge was 120 pcf which is reasonable for the regional clay soil conditions significantly changing the analysis results.
- Consideration, with respect to soil response, does not include areas that have been disturbed and are formed with non-native soil to form the road, driveways and road shoulders over the years, to name a few instances of disturbance.
- The analysis completed by Enbridge's Engineer was to Z662-15; however, there is a more current version of this standard at Z662-19.

Page 3
May 7, 2020

Review of Relevant Standards and Guidelines

Transportation Association of Canada

- Section 4.11 of the TAC Guidelines for geometric design (TAC 2017) specifically speaks to the placement of utilities in the right-of-way, included in this list, found in Section 4.11.1 – *Technical Foundation* is “Gas Lines”. In this same section they note that the location of utilities is dependent on “several factors” inclusive of:
 - Designation of the road
 - Maintenance requirements
 - Public safety, and future stages improvements for the road.

(TAC 2017)

- Given the proposed long-term expansion of the right-of-way as per 4.12 of TAC 2017 best practices would call to “*Determine the initial requirements and select the dimensions so as to allow for future expansion*”, an action currently being under taken by the County as the designated Road Authority.
- TAC’s guideline for Underground Utilities Installation (March 2013) states in the forward:

“... the responsibility of road authorities includes operating the highway rights-of-way in a manner that ensures the safety, traffic-carrying ability and physical integrity of their installations. The presence of a utility within the right-of-way can affect these characteristics, so it is necessary for road authorities to reasonably regulate the presence of utilities.”

Such statements, place emphasis of the responsibility of the Road Authority (County) to ensure compliance with the recommendations set forward by industry, such as the TAC guidelines.

- The function of the TAC guidelines is to “*assist the various road authorities in establishing and administering uniform criteria for the accommodation of utilities crossing highway (and freeway) rights-of-way*” (TAC March 2013 – Underground Utilities Installation). As a member of the Association the County must as a measure of good practice assess, and as appropriate, apply the recommendations and guidelines of this organization.
- The “intended audience” for the TAC – Underground Utilities installation (TAC March 2013) includes “*Consulting engineers practicing in the highway/utility field*” however, such assessment was not observed from a review of the Enbridge submission suggesting this guideline was not referenced prior to submission.
- Per Clause 4.1.8 of TAC March 2013 the recommend values are presented in Table 1 of document, but this clause further states that:

“The minimum utility cover depths specified by a road authority may be greater when installed within freeway rights-of-way. The road authority may approve other protection designed by the utility in lieu of the minimum cover depth specified.”

By requesting compliance with Table 1 of the present document the County fails to create a condition of undo hardship on Enbridge, albeit, the County would be within its rights, as the Road Authority, to implement and mandate a standard requiring greater depths of bury then those in Table 1.

Page 4
May 7, 2020

- Provided Enbridge proceeds in accordance with Z662-19 and applies the 1.2m depth (discussion to follow under Z662-19), and following from TAC March 2013, the County could accept the 1.2m depth per Table 1 provided the main was encased. Such encasement would further protect the line from loading criterion and other hazards faced by underground utilities within the right-of-way.

CAN/CSA Z662-19 National Standard of Canada – Oil and Gas Pipeline Systems

- Following the latest Z662-19, within Table 4.9 – Cover and clearance, the applicable guidelines governing Enbridge specifically note a minimum depth of bury, “*below travelled surface (road)*” of 1.2m; a value which is more than that currently proposed by Enbridge.
- Specific to Z662-19 Clause 1.4 the statement is made that “*This standard is intended to establish essential requirements and minimum standards for the design, construction....*” Emphasis should be placed on the declaration of minimum, thus in the presence of other guidelines specific to the zone of construction the most stringent should be considered in the interest of best engineering practice and public safety.
- Clause 4.11.1 of Z662-19 notes that “*cover requirements for buried pipelines shall not be less than the values given in Table 4.9*” contrary to the proposal of Enbridge.

4. Recommendations

The following recommendations are based on our review and assessment:

Calculation Specific

- The ten times analysis performed by Enbridge was conservative seeing a maximum concentrated wheel load of 16.5 (1.5 x 1.1 x 10) times their base value. Such conservative approaches far exceed those prescribed in other standards.
- The analysis by Enbridge does support that the proposed material is able to carry the applied loads under hoop stress.
- Given that hoop stresses are the only analysis performed care should be given during construction to ensure that the bedding of the pipe is free of any large or stiff elements that may cause beam actions resulting in longitudinal and shearing stresses which, when combined with the hoop stress, (ie Van Mises Stress Theory) could result in a principal stress far in excess of that of the pipes capacity.
- There should be some geotechnical verification of the soil assumptions made, specifically the modulus of soil reaction.
- Care should be taken in confirming adequacy of the pipe in non-clay soils albeit the modulus of soil reaction and overall soil response would tend to improve in a granular system.

Page 5
May 7, 2020

Guidelines Review Discussion

The following discussion will set the design calculations aside and considering the applicable industry recommendations. Following the TAC Guidelines, outlined previously, such recommendations are formed based on the input of the industry and as such form the same value to practicing Engineers and Road Authorities as a given CSA (Canadian Standards Association) document. Consideration should also be given to the mission of the Transportation Association of Canada which is *"to promote the provision of safe, secure, efficient, effective and environmentally and financially sustainable transportation services in support of Canada's social and economic goals"* (TAC Guidelines Dec 2011). The focus of the mission being in part "safe" and as such the recommendations are set to provide the best possible solutions for such safety. Moreover, TAC is a widely accepted authority in the industry and as such its standards and guidelines form the basis of good right of way management with the realm of engineering and roadway management.

Given the above, and the consideration that the proposed pipeline will lay within the driving surface within the life span of the proposed new construction the minimum depth measured from drive surface (or anticipated drive surface) should be 1.5m versus the proposed 1.0m depth if compliance with the TAC guidelines is to be consistently applied by the County within its right of ways.

Specific to Z662-19 Enbridge appears through the current proposal to have failed to meet the minimum standards set forth in the latest document. Moreover, as noted in observations the current standard provides only the minimum cover requirements and as such makes no consideration for assessment of other appropriate standards and guidelines. As such and in the presence of both Z662-19 and the current TAC standards the greater requirement of the two would be considered the most appropriate value.

With regard to liability, should in the unfortunate situation an event occur which creates a threat or risk to the public, specific to the proposed gas line, failure to adhere to the TAC recommendations could result in the County being in part liable for failure to follow best practices. Such legal discussions should obviously be had with the County legal team; however, failure to follow guidelines does create a situation of increased risk and liability.

Speaking to the previous point care by the County should also be taken to not deviating from the TAC standards as it is a standard adhered to by the County itself on all other projects inclusive its own. Failure to consistently follow an established standard with the County, and in general most every Road Authority, also increases liability.

Page 6
May 7, 2020

5. Summary and Conclusions

Following from the above, the calculations submitted by Enbridge do confirm structural capacity based on the assumptions made; however, from the second portion of the discussion, failure to address the risk imposed by deviating from a standard regularly applied by the County and other similar Authorities will incur increased liability in the short and long term conditions. Moreover, the proposed construction appears to be in contravention of the current standards governing the actions of Enbridge itself.

The situation specific to County Road 46 expansion within the pipeline's life span is further support to follow the current guidelines and maintain a depth of cover that represents the most conservative approach in the interest of public safety, specifically 1.5m as this would also be supportive of the statements made in Z662-19 and the TAC guidelines.

Following from the above, and in the interest of trying to validate the most appropriate action in the current condition one only need to assess the reverse condition. Under the current standards and guidelines the following depths of bury are recommended, TAC -1.5m and Z662-19 -1.2m; should the case have been 1.5m requirement by Z662 and TAC permitted a shallower bury of 1.2m Enbridge would have been remiss to construct their plant at the lesser depth of 1.2m and would not have been alleviated from their professional responsibility or the legal obligations by doing so. As such, in the interest of best engineering practices, and good right-of-way management, the County and Enbridge itself, must assess the condition not in isolation but against all appropriate guidelines to ensure the best end results. Blindly ignoring the recommendations of an origination such as the Transportation Association of Canada, and its guidelines, is tantamount to negligence on the part of any party doing so. The provisions previously noted in the recommendation discussion specifically noted that the 1.2m is a minimum prescribed in Z662-19 and not a mandated maximum. The function of the various standards and guidelines making declarations of minimum is the committee's means of ensuring that a responsible professional will follow their professional, ethical and legal obligations to ensure the public trust and protection by the application of all best practices.

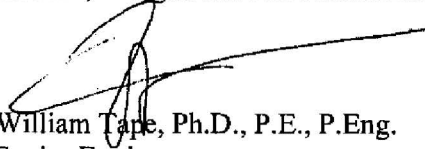
Based on our review and in the interest of shielding the County from liability while maintaining a consistent application of policy, and in the interest of good engineering and right-of-way management practices, we formal recommend that Enbridge be directed to adhere to the requirements set forth by your office as the Road Authority; as such compliance with the TAC guidelines should occur without further discussion.

Page 7
May 7, 2020

6. Closing

We trust that the above meets your needs at this time. Should you have any questions or comments please do not hesitate to contact our office.

Yours Truly
Haddad, Morgan and Associates Ltd.



William Tape, Ph.D., P.E., P.Eng.
Senior Engineer