



February 18, 2020

Reference No. 11207355

Andrew Martin, MCIP, RPP
Manager of Planning/EDO
Development Services Department
Township of Wilmot
60 Snyder's Road West, Baden, ON N3A 1A1

Dear Mr. Martin:

**Re: Peer Review for Pavement Design
Witmer Road, Proposed Hallman Pit to 1894 Witmer Road
New Hamburg, Township of Wilmot, ON**

The Township of Wilmot (Township) has engaged the services of GHD Limited (GHD) to undertake a peer review of a geotechnical investigation report prepared by CMT Engineering Inc. (CMT) dated May 7, 2019. CMT has prepared the geotechnical investigation report titled 'Witmer Road from the SW corner of #1894 to 1 km east, Township of Wilmot, Ontario' in support of an application to amend the Township zoning by-law to permit an aggregate extraction operation at 1894-1922 Witmer Road. The study also supports an application under the Aggregate Resources Act submitted to the Ministry of Natural Resources and Forestry.

The Township provided the following documents to GHD for supporting the peer review study:

- Geotechnical Investigation Report titled 'Witmer Road Pavement Assessment Queen Street to 1500 m West, Township of Wilmot, Ontario' dated May 2007 prepared by Naylor engineering Associates (Naylor).
- Report titled 'Jackson Harvest Farms, 1894 Witmer Road Transportation Impact Study' dated February 2019 prepared by Paradigm Transportation Solutions Limited (PTSL).

According to the Township, during zoning pre-consultation, the following scope of study was established for the geotechnical investigation by the Township's Public Works and Engineering Department:

1. Evaluate the existing pavement component thicknesses and subgrade soil conditions on Witmer Road from the west limit of the subject property to the west limit (Witmer Pit) of the improvements completed after 2007.
2. Provide geotechnical recommendations for pavement performance and improvements required due to the proposed increase in vehicular loading and frequency.
3. Review the improvements to Witmer Road completed per Naylor recommendation after 2007 on the Witmer road section between Witmer Pit and Queen Street to ensure they are adequate to support the additional vehicular loading and frequency generated by the new aggregate pit.



Summary of the Reviewed Documents:

- The Naylor Report referencing an undated PTSL traffic study discusses a traffic intensity and loading comprised of Average Annual Daily Traffic (AADT) of 300 with 20 percent trucks or 250,000 Equivalent Single Axle Loads (ESAL).
- The Naylor Report recommended an overlay of 50 mm hot laid asphalt HL4 or HL8 over the existing tar & chip treated roadway to bring its Granular Base Equivalency Value from 160 to 260 to meet the increased traffic loading due to the Witmer Pit. According to Naylor, a GBE of 250 mm is sufficient to meet the increased traffic loading.
- Naylor also discusses a Structural Number of 2.8 inches required using the simplified AASHTO¹ method to meet the increased traffic loading. With the 50 mm (2-inches) thick overlay, using the layer coefficient of 0.42 for hot-laid asphalt², the structural number however increases from existing 1.161 to 2.45 inches only. Naylor report does not discuss the Structure Number deficiency in its report.
- CMT measured the hot-laid asphalt thickness ranging from 55 mm to 75 mm with an average of 65 mm during the 2019 borehole investigation, which results in a GBE of 290 mm and Structural Number of 2.68 inches still short of the required Structural Number of 2.8.
- The Transportation Impact Study by PTSL has calculated an increased traffic of 73 trucks per day due to the proposed opening of the aggregate pit at 1894 Witmer Road with an extraction capacity of 750,000 tons/year and 23 trucks per day due to the operations at the Spring Farm Trout Farm i.e., a total of 96 trucks per day.
- PTSL carried out an actual traffic count at Queen Street/Witmer Road intersection for east/west bound and north/south bound traffics between the hours of 7:00 AM to 10:00 AM , 11:30 AM to 12 noon, 12 noon to 1:30 PM and 4:00 PM to 5:30 PM i.e., for a total of 3.5 AM hours and 3 PM hours.
- PTSL discusses a traffic growth rate of 1.5 percent based on pre-consultation with the Region of Waterloo.
- Using a weighted average of 3.2 Passenger Car Equivalents per Truck, the total two-way AM and traffic counted was 127 with 29 percent truck traffic and total PM traffic counted was 129 with 24 percent truck traffic.
- CMT has used a future AADT of 318 with 50.6 percent truck traffic, adjusted to AADT of 1609 with 10 percent truck traffic.
- For AADT of 1609 with 10 percent truck traffic CMT has recommended reconstructing Witmer Road using 100 mm hot laid asphalt (total thickness), 150 mm OPSS Granular 'A' base and 450 mm Granular B Subbase. This structure results in a GBE of 650 mm or a Structural Number of 104 mm.

¹ AASHTO (1993): Guidelines for Design of Pavements Structures

² Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions, Final Report (Revised March 19, 2008), Prepared by ERES Consultants for the Ontario Ministry of Transportation.



- CMT has provided three alternatives of rehabilitating existing Witmer Road, which results in GBE of 648, 655, and 655.
- Both Naylor and CMT have mentioned that the existing Witmer Road is in generally good condition except for some edge distresses.

GHD Peer Review Comments

- Per the discussion in the CMT, Naylor, and PTSL reports, all 96 loaded trucks will be travelling east towards the Queen Street intersection. The CMT AADT of 1609 with 10 percent truck traffic results in only 87 trucks (see attached Table 1). Although the difference is minor but as CMT is using the GBE approach which does not take it account the growth rate (1.5 percent) its effect can become significant over the 20 year design period.
- GHD has used mechanistic-empirical pavement design by AASHTO modified by MTO for Ontario conditions to verify the CMT pavement design. GHD designs are provided in the attached Table 1 and 2 using the CMT AADT i.e., 87 trucks (Table 1) and 96 trucks (Table 2). A rate of 1.5 percent of traffic growth was used, which resulted in structural numbers of 105 mm and 107 mm, which are marginally more than the structural number of 104 mm for any of the four options recommended by CMT. The deficiency of structural number of 3 mm can be made up by either by increasing the hot-laid asphalt thickness for any of the options by 10 mm, or Granular 'A' thickness by 25 mm to be conservative.
- Witmer Road between Queen Street to 1.5 km west, up to the existing Witmer Pit, has a Granular Base Equivalency (GBE) ranging from 160 to 460 mm with an average of 260 mm based on the study completed by CMT. The required GBE calculated by CMT is 630 mm, and by GHD is 680 mm. Due to the inconsistent subgrade elevation, base and subbase material, and subgrade quality encountered within the existing roadway, a complete re-construction is the recommended from Queen Street to #1894 Witmer Road.

GHD Comments Based on Discussion with the Township

1. It is understood the proposed pit at #1894 Witmer Road will be receiving construction debris such as concrete and asphalt to process it as recycled materials. According to the Township the Transportation Impact Study (TIS) is currently under the process of updating. The geotechnical design of the pavement should be updated once TIS is updated.



We trust the above is sufficient for your present needs. Please do not hesitate to contact the undersigned at Hassan.gilani@ghd.com or 519-340-3937 at your convenience.

Sincerely,

GHD

February 18, 2020

A circular professional seal for a Licensed Professional Engineer in the Province of Ontario. The seal contains the text 'LICENSED PROFESSIONAL ENGINEER' around the top and 'PROVINCE OF ONTARIO' around the bottom. In the center, the name 'S.H. GILANI' is printed. A blue ink signature is written across the seal, and a blue line extends from the signature towards the bottom left of the page.

Hassan Gilani, M.Sc., P.Eng.

HG/cd/1 (rev1)

Encl.



Table 1

Structural Number and Design Traffic Volume
Witmer Road, Township of Wilmot, Ontario

Number of Lanes in One Direction	2	RMOW	
AADT 2019	1609	CMT	
Annual Growth Rate AGR	1.5%	RMOW	
AADT 2023	1734	calculated	
One-way AADT	867	50% of AADT (2019)	
Lane Factor	1.0		
Design lane AADT	867	100% of one way AADT (2023)	Table 3-7, MTO MI-183
a- Passenger Vehicles	780	90% of design lane AADT	
b- Commercial Trucks	87	10% of design lane AADT	
2 Axle Trucks		Table D-3, MTO MI-183	
Truck Factor Passenger Vehicles	0.00000		
Truck Factor 5 Axle Trucks	1.6	Table 8-1, MTO MI 183	
ESAL	50633	$[\Sigma(\text{No. of vehicles} \times \text{Truck Factor})] \times 365$	
Analyses Period (years)	20		
ESAL [20 years at 2.5% annual Growth] W_{18}	1.17E+06	$\text{EASL} * [(1 + \text{AGR})^{\text{Analyses Period}} - 1] / \text{AGR}$	
Rehabilitation options			
Subgrade Resilient Modulus M_r (psi) =	4500	Table D-8, MTO MI 183	
Reliability =	0.9	RMOW	
Standard Normal Deviate Z_r =	-1.28		
Standard Deviation, S_o =	0.46	Table D-7, MTO MI 183	
Initial Pavement Servicing Index, p_o =	4.5	RMOW	
Terminal Pavement Servicing Index, p_t =	2.5	RMOW	
ΔPSI =	2		
Required Structural Number S.N. =	4.15	105 mm	
Allowable ESAL (calculation Check)	1.17E+06	> or = required ESAL (20 years)	

$$\log(W_{18}) = Z_r(S_o) + 9.36\log(\text{SN}+1) - 0.20 + \frac{[\log(\Delta\text{PSI}/(4.2-1.5))]}{0.40+1094/(\text{SN}+1)^{5.19}} + 2.32\log(M_r) - 8.07$$



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Annual Growth Rate AGR	1.5%	RMOW
AADT 2023	1734	calculated
One-way AADT	867	50% of AADT (2019)
Lane Factor	1.0	
Design lane AADT	867	100% of one way AADT (2023)
a- Passenger Vehicles	771	88.9% of design lane AADT
b- Commercial Trucks	96	11.1% of design lane AADT
2 Axle Trucks		Table D-3, MTO MI-183
Truck Factor Passenger Vehicles	0.00000	
Truck Factor 5 Axle Trucks	1.6	Table 8-1, MTO MI 183
ESAL	56202	$[\Sigma(\text{No. of vehicles} \times \text{Truck Factor})] \times 365$
Analyses Period (years)	20	
ESAL [20 years at 1.5% annual Growth] W_{18}	1.30E+06	$\text{EASL} * [(1 + \text{AGR})^{\text{Analyses Period}} - 1] / \text{AGR}$
Rehabilitation options		
Subgrade Resilient Modulus M_r (psi) =	4500	Table D-8, MTO MI 183
Reliability =	0.9	RMOW
Standard Normal Deviate Z_r =	-1.28	
Standard Deviation, S_o =	0.46	Table D-7, MTO MI 183
Initial Pavement Servicing Index, p_o =	4.5	RMOW
Terminal Pavement Servicing Index, p_t =	2.5	RMOW
ΔPSI =	2	
Required Structural Number S.N. =	4.22	107 mm
Allowable ESAL (calculation Check)	1.30E+06	> or = required ESAL (20 years)

$$\log(W_{18}) = Z_r(S_o) + 9.36 \log(\text{SN}+1) - 0.20 + \frac{[\log(\Delta\text{PSI}/(4.2-1.5))]}{0.40+1094/(\text{SN}+1)^{5.19}} + 2.32 \log(M_r) - 8.07$$