APPENDIX 7

PAVEMENT EVALUATION REPORT

THURBER ENGINEERING LTD.

2022 GROWTH RELATED ROADS DETAILED DESIGN

PAVEMENT EVALUATION REPORT
PROJECT #: 2020-97

MILL STREET
FROM MISSISSAUGA ROAD TO CREDITVIEW ROAD

TOWN OF CALEDON, ONTARIO

Report to:

Town of Caledon

c/o

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THURBER

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TABLE OF CONTENTS

APPENDICES

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1 INTRODUCTION

It is understood that the Town of Caledon is implementing rehabilitation strategy on existing rural roads as part of their 2022 Growth Related Detailed Design project in order to support the increase in traffic use due to the continued growth of the population of Caledon. The project limits included in this report is Mill Street extending from the intersection at Mississauga Road to Creditview Road for a total of approximately 1.475 km of roadway.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1.1 Background Information

Currently, Mill Street consists of a two-lane rural roadway, with one lane in each direction. The existing pavement platform does not have defined shoulders, with a posted speed limit of 40 km/hr. Ditches along the existing roadway are not always visible, and where they were observed were overgrown with heavy vegetation.

It is noted that a bridge exists over the Credit River, which extends from Station 11+330 to 11+390. Furthermore, a pavement change exists approximately 30m west of the structure, with a similar pavement condition continuing to the Creditview Road.

For the purposes of this report, the roadway is considered to generally travel in the East-West orientation, with chainage established in the field extending from the western project limits at intersection with Mississauga Road (Station 10+000), increasingly easterly to the intersection with Creditview Road (Station 11+475). A key plan of the project limits is provided in Appendix A.

1.2 2019 Development Charge Study

A Development Charge (DC) Background Study was completed in 2019 by Watson and Associates and the Town provided a portion of that study to Thurber. The DC Study provided a recommended "Road Improvement Type" for each road and recommended that Mill Street receive a "Urban Road Reconstruction." The DC study provided a standard pavement design, as well as road and road related work unit quantities and costs, for an Urban Road Reconstruction project.

The standard pavement design was used to develop the appropriate rehabilitation method for Mill Street. The DC Study also recommended that the pavement platform be widened to 10.0 m width, with 3.5 m wide lanes and 1.5 m paved shoulders. The construction of a 10 m wide platform will require widening of the existing pavement.

2 FIELD INVESTIGATION

A field investigation was carried out in November 2020, which consisted of a visual pavement surface condition survey, borehole drilling and coring. Typical photographs of the existing roadway condition are provided in Appendix B.

A visual inspection of the pavement surface was completed in accordance with MTO Manual SP- 022, Condition Rating Manual for Flexible Pavement for Municipalities. Results of the visual condition survey are provided in Appendix C.

A total of 15 boreholes were advanced in the travel lanes at approximately 200 m intervals, staggered by direction. Pavement cores were extracted at three locations prior to drilling, with asbestos testing completed on the core sample extracted at Station 11+435. All boreholes were advanced to a depth of 2.0 m, with Standard Penetration Tests (SPT) completed at select locations. Shallow probeholes were advanced in the ditch at each borehole location to a depth of 300 mm. Upon completion of drilling, all boreholes were backfilled with auger cuttings and patched with cold mix asphalt. Soil samples were identified, placed in labelled containers and transported back to Thurber's laboratory for further examination. Pavement core logs (with photographs) are included in Appendix D, with test results for asbestos testing provided in Appendix E. Borehole logs are provided in Appendix F, with results of the laboratory testing provided in Appendix G.

Prior to the start of the drilling investigation, public utility clearances were obtained through Ontario One-Call. A Road Occupancy Permit was obtained prior to commencement of drilling. Traffic control was provided by Alliance Traffic Control, while the boreholes were advanced using truck-mounted hydraulic drill rig supplied and operated by Malone's Soil Samples Co. Ltd. The field investigation was carried out under the full-time supervision of Thurber technical staff.

Falling Weight Deflectometer testing was completed on 50 m intervals, with tests staggered by travel direction. The data collected by the FWD testing was analyzed by Thurber, with results provided in Appendix H.

2.1 Existing Pavement Condition

The existing pavement on Mill Street is considered in *Fair to Poor* condition for most of the corridor; however, at Station 11+300, the pavement changes from a rural to urban platform with the pavement in good condition for the remainder of the urban pavement platform area.

In the rural pavement area, the pavement distress observed include extensive, severe pavement edge cracking, with moderate severity potholes, wheelpath rutting, and longitudinal and transverse cracking. In this pavement section, the overall ride quality is rated to be 6 (out of 10), with a back-calculated average Pavement Condition Index (PCI) value based on the observed distress is 60 (out of 100).

In the urban pavement area, the general condition of the pavement surface is considered to be in good condition; although considerable random cracking was observed on the bridge deck over the Credit River. In the approach pavement sections, limited cracking was observed in the travel lanes; however, alligatored cracking was observed at the pavement edge.

2.2 Existing Pavement Structure

2.2.1 Asphalt

A total of 15 boreholes were advanced through the existing pavement structure on Mill Street to determine the thickness of each pavement layer. The asphalt thickness on Mill Street typically varied from 20 to 80 mm, with an average thickness of 50 mm; however, in the pavement section in Good condition, the asphalt thickness was 110 mm.

Visual inspection of the pavement cores in the thin asphalt section was paved in a single lift, while the core sample from Station 11+435 was paved in two lifts. Asbestos testing was completed on both lifts of asphalt from Station 11+435, where no traces of asbestos fibres observed.

2.2.2 Granular Materials

The asphalt layers were supported by a granular base and subbase layers that had an average combined thickness of 600 mm. The granular base consisted of crushed gravel with sand some silt, while the granular subbase consisted of crushed gravelly sand some silt. Laboratory test results on the granular material indicate that the existing granular generally met OPSS gradation requirements for Granular A; however, mostly all samples exceeded the allowable limit passing the 75 µm sieve size.

The granular base/subbase material was observed to be dry to moist with results of the natural moisture content testing ranging from 3 to 11 percent.

2.2.3 Subgrade Soils

The underlying subgrade soil varied from silty sand with clay to a clayey silty some sand. SPT testing was completed at select borehole locations to determine soil consistency. Result of the testing found the N values to range from 17 to 24 blows per 300 mm, indicative of very stiff soil.

The subgrade soil was observed to be moist, with measured water contents ranging between 9 and 26 percent. The laboratory test results indicate that the subgrade soil varied from low to moderate susceptibility to frost heaving and soil erodibility.

2.2.4 Topsoil

Topsoil measurements were taken in the ditch at each borehole location. Actual topsoil thickness measurements varied from 50 to 275 mm, with typical topsoil thickness ranging from 75 to 200 mm. The average topsoil thickness was 160 mm.

2.3 Falling Weight Deflectometer Testing

The structural adequacy of Mill Street was evaluated by Falling Weight Deflectometer (FWD) pavement load/deflection testing. The FWD tests were completed on 100 m intervals for each lane, with testing staggered by direction for improved coverage. At each test location, a series of four load applications was applied to the pavement surface. The first application was a "seating" load to ensure the FWD load plate was firmly resting on the pavement surface. The next three loads were approximately 35, 50, and 65 kN. Pavement surface deflections under the load were measured by sensors (velocity transducers) placed at fixed spacing from the load plate in accordance with SHRP testing protocols. Asphalt thickness from the pavement cores and boreholes, along with granular base thickness from subsurface investigation were used in the analysis of the FWD data.

The analysis of the FWD deflection data was completed in in accordance with the procedures outlined in the AASHTO Guide for Design of Pavement Structures (1993). The parameters calculated as part of this analysis include:

Normalized Deflection: The deflection (D0) measured at the centre of the load plate is a good indicator of overall pavement strength. The deflection at this location is a function of the pavement layer stiffness and the support capacity of the subgrade soil. Because deflection is a function of load and a slight variation in measured load at each test point, a linear extrapolation of the measured deflection is made to adjust deflections at all test locations to a “standard” load level of 40 kN.

Materials Characterization: The pavement thickness data from the boreholes was used in conjunction with the FWD results to estimate the stiffness (strength) of the existing pavement. Pavement layer stiffness back-calculation uses closed form models to estimate layer elastic modulus values, given the layer thickness and FWD data.

The procedure as outlined in the AASHTO 1993 Guide for Design of Pavement Structures, Part III, Chapter 5, was used to determine the properties of the as-constructed flexible pavements. The resultant data includes the composite elastic pavement modulus (Ep) for the combination of all bound layers above the subgrade (e.g., the asphalt concrete and granular bases), and the subgrade elastic modulus (Es). The subgrade resilient modulus (MR) is determined by reducing the value of Es by a conversion factor of 3.

Effective Structural Number: Based on the back-calculated pavement moduli, the effective structural number (SN_{Eff}) of the existing pavement was calculated using the 1993 AASHTO Guide for Design of Pavement Structures procedure.

Results of the pavement load/deflection testing and data analysis are summarized in Table 2.1, with detailed FWD test results provided in Appendix H.

Table 2.1. Summary of FWD Analysis Results

D_0 (µm)		M_R (MPa)		E_P (MPa)		SN_{Eff} (mm)	
Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
603	185	30	9	299	151	116	17

In general, the test results between the travel direction were comparable with normalized deflections for the travel lanes ranging from about 583 in the EB direction and 625 mm in the WB direction. The subgrade support strength along the length of the project average 30 MPa; however, locally values as low as 19 MPa were observed.

Back-calculation of the SN_{Eff} for Mill Street was calculated to be greater than 94 mm with an average of 116 mm.

3 PAVEMENT DESIGN ANALYSIS

A pavement design analysis was completed for Mill Street to determine the pavement structure required to support the anticipated traffic volumes, under the observed conditions. The results of the pavement design analysis are provided in Appendix I.

3.1 Traffic Analysis

Traffic information was provided by the Town of Caledon, which has been summarized in the table below.

Table 3.1. Traffic Information

Survey Date	AADT
Spring 2017	189

The 2017 AADT was forecasted to the assumed construction year of 2022. The forecasted 2022 AADT for Mill Street is 194. The percentage of heavy trucks is unknown at this time, however, a truck percentage of 3.0 % was used, which is consistent with previous reports. An average truck factor of 1.8 was used for estimating the anticipated pavement damage.

3.2 ESALs Calculations

The traffic data was used to determine the pavement damage caused by the anticipated traffic volumes. Using axle load equivalency factors (LEF), the pavement damage caused by different axle loads and axle groups are converted to a standard axle load known as an Equivalent Single Axle Loads (ESALs). The ESALs calculation was completed in accordance with the MTO Procedures for Estimating Traffic Loads for Pavement Designs. The design ESALs for the 20- year duration is estimated to be 48,383.

3.3 AASHTO Pavement Design

The pavement design analysis was carried out using the methodology outlined in the 1993 AASHTO “Guide for the Design of Pavement Structures”, as modified by the Ministry’s “Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions”, and the MTO “Pavement Design and Rehabilitation Manual”.

The AASHTO procedure for the design of flexible pavements determines a required Structural Number that characterizes the structural capacity of the pavement layers, for a given set of inputs. The following design inputs were used in the AASHTO design analysis.

Table 3.2. Input Parameters

Parameters	Input Values
Design ESALs	48,383
Initial serviceability, (Pi)	4.4
Terminal serviceability (Pt)	2.2
Reliability level (R)	90 %
Overall standard of deviation (So)	0.44

A subgrade strength of 30 MPa was used to represent the observed subgrade soil, which is consistent with the average strength back-calculated from the FWD testing.

Based on the design parameters, a required structural design number (SN_{Des}) of 64 mm was calculated, which represents the required strength of the rehabilitated pavement. The SN_{Des} was then distributed among the existing pavement layers to determine the minimum asphalt overlay required to support the anticipated traffic volumes and support conditions.

3.4 Pavement Rehabilitation Alternatives

It is understood that the Town of Caledon had previously completed an assessment of this roadway that provided preliminary pavement design recommendations for the rehabilitation of existing pavements. The preliminary pavement recommendations provided in the 2019 Development Charge (DC) Study, “Rural Road Upgrades” included:

40 mm	Asphalt Surface Course
90 mm	Asphalt Base Course
225 mm	Granular Base Material

It is understood that the recommended pavement rehabilitation strategy for Mill Street included the removal of existing pavement, followed by the placement of the recommended new pavement structure. A structural assessment was completed for the preliminary pavement design from the DC Study and determined to have a structural capacity (SN_{Des}) of 86 mm, which exceeds the design requirement calculated based on forecasted traffic volumes. Therefore, the structural capacity of the preliminary pavement design is sufficient to support anticipated traffic volumes over the local support conditions.

Furthermore, the results of the field investigation indicated that the granular base/subbase thickness within the existing pavement is of sufficient type and quality as required by the preliminary pavement design; therefore, replacement of existing granular material is not warranted.

An alternative to the removal of the existing asphalt and underlying granular is to pulverize the asphalt with the underlying granular material. This process commonly identified as Full Depth Reclamation (FDR), is often a more environmentally preferred strategy to asphalt removal, as all materials remain on- site and improve pavement strength by increasing the thickness of the granular base/subbase.

Based on existing asphalt thicknesses, an average depth of 150 mm would be required for the FDR operation, which will produce blended material that contain less than 50 percent of asphalt coated aggregate, as specified in OPSS.MUNI 330. Should the FDR be considered in the urban pavement platform from Station 11+300 to 11+475, processed material will need to be removed to match existing grades after the placement of the new hot mix asphalt (HMA).

In areas where pavement widening is required, the processed material can be used as granular base/subbase in the widening area to construct a consistent pavement subbase. New granular base would be placed as required across the entire new platform to meet desired grades.

3.5 Full Pavement Reconstruction

It is understood that the Town would like to consider the option to fully reconstruct the pavement on Mill Street. This strategy would involve excavating the existing asphalt and granular material to a depth of 355 mm and placing the following:

40 mm	Asphalt Surface Course
90 mm	Asphalt Base Course
225 mm	Granular Base Material

The option would improve the functional and structural needs for the pavement on Mill Street and require minimal maintenance for the 20-year service life.

3.6 Life Cycle Cost Analysis

Based on the discussion of viable rehabilitation strategies, a practical and cost-effective solution for rehabilitating the existing road to improve the functional and structural needs for the pavement on Mill Street is FDR, with new asphalt. The FDR rehabilitation strategy was compared to the full pavement reconstruction strategy using a Life Cycle Cost Analysis (LCCA) in terms of their Net Present Worth (NPW). This LCCA approach calculates the initial construction costs for each strategy and predicts future maintenance and rehabilitation costs. The LCCA calculated the rehabilitation and maintenance cost for the entire project length of 1.5 km.

The recommended rehabilitation pavement designs were used to estimate costs associated with the initial treatment. The timing and quantities of future maintenance and pavement preservation treatments used in the LCCA are consistent with the Ministry's report, "*The Benefits of New Technologies and Their Impact on Life-Cycle Models*". A discount rate of 4.5 percent was applied to all future expenditures over the 30-year analysis period.

Based on the available information, a LCCA was completed to evaluate the overall costs anticipated by the Town to maintain the Mill Street pavement over the 30-year analysis period. A summary of the cost estimates is provided in the table below, with detailed results of the LCCA provided in Appendix J.

Table 3.3: Results of Life Cycle Cost Analysis

Rehabilitation Strategy	Initial Construction Costs	Maintenance Costs	Life Cycle Costs	LCC Cost Difference
Full Depth Reclamation	$443,100	$131,537	$574,637	-
Full Pavement Reconstruction	$566,484	$131,537	$698,021	+ 21.5%

The results of the LCCA indicate that a full depth reclamation strategy is estimated to have the lowest life cycle cost by 21.5 percent as compared to the full pavement reconstruction option.

4 PAVEMENT RECOMMENDATIONS

4.1 Existing Pavement Rehabilitation

4.1.1 Station 10+000 to 11+300

In consideration of the observed pavement condition, and the extent of moderate to severe cracking in the rural pavement section, it is recommended that the rehabilitation strategy for this roadway include pulverizing the existing asphalt with the underlying granular material (FDR), grading the processed material as required for the placement of a new 130 mm asphalt. The recommended strategy eliminates existing distresses in the asphalt and provides more granular material on-site for grading purposes, reducing the amount of soil to be removed from site.

This rehabilitation strategy consists of FDR processing of the existing asphalt to a thickness of 150 mm, with the blended material graded and compacted, as required, prior to paving with new

HMA. The FDR process should be completed in accordance with OPSS.MUNI 330. Additional new Granular A base material may be required, which will depend on desired grades, widening requirements, and the thickness of the blended material graded into the widening area.

The recommended asphalt type and lift thicknesses should consist of:

40 mm	HL 3
90 mm	HL 8 (in two lifts)

4.1.2 Station 11+300 to 11+475

In the urban pavement area with curb and gutters, the recommended rehabilitation strategy includes removal of the existing asphalt, with the exposed granular material graded as required for the placement of 130 mm of new HMA. Similar to the adjacent pavement section, the recommended asphalt type and lift thicknesses should consist of:

40 mm	HL 3
90 mm	HL 8 (in two lifts)

In consideration of the pavement condition on the Credit River structure, it is recommended that the existing structure and approach slabs be resurfaced as part of this project, with the recommended resurfacing strategy including 40 mm partial depth milling, followed by the paving of 40 mm HL 3 asphalt.

4.2 Pavement Reconstruction

In consideration of the anticipated roadway improvements, full-depth reconstruction may be required to meet geometric constraints. In these areas where the existing pavement is to be reconstructed, the following pavement structure is recommended:

40 mm	HL 3
90 mm	HL 8 (in two lifts)
300 mm	Granular A Base (19 mm CRLS)

It is noted that additional granular thickness may be required in transition areas where the new pavement connects to the existing. This additional granular base thickness is required to maintain subsurface drainage throughout the reconstruction limits.

It is understood that grade adjustments will be required to the existing pavement profile, with localized areas requiring grade lowered by as much as 1.0 m. Given the existing granular

thickness, full pavement reconstruction should be considered in areas the grade lowering exceeds 200 mm.

4.3 Pavement Widening

4.3.1 Conventional Pavement Widening Design

In consideration of the narrow travel lanes and limited shoulder width, consideration should be given to widen the existing pavement to improve pavement edge conditions and provide a more durable, long-life pavement. Should widening of the existing pavement be considered, it is recommended that excavation for the new pavement commence at the current pavement edge and extend for the width of the widening. In this area, the surficial topsoil should be removed with the underlying subgrade graded as required.

The grading for the top of subgrade in pavement widening areas must match, or exceed, the thickness of the adjacent existing pavement to maintain lateral drainage at the top of subgrade. The average excavation depth in the widening area should be 700 mm.

To save project costs, the additional granular material in the widening excavation (for drainage purposes) can be substituted with Select Subgrade Material (SSM); however, in order to maintain structural adequacy, a minimum of 225 mm of new Granular A (or FDR processed) material will be required. The recommended pavement structure for widening along Mill Street shall consist of:

40 mm	HL3
90 mm	HL8 (in two lifts)
225 mm	Granular A Base or FDR Material
345 mm	SSM

The pulverized material may be graded from the adjacent lane and partially comprise the new granular base layer. Design considerations in pavement widening areas must consider the minimum pavement structure required to meet the traffic and subgrade design requirements; however, subsurface drainage at the top of subgrade must also be maintained across the widening areas. The recommended total pavement thickness should meet the average thickness of the existing pavement; however, localized deepening may be required and should be completed using Granular A, FDR processed material, or SSM.

This conventional pavement widening design is often applicable when widening in fill sections, where embankment widening is required. Excavation for the new pavement should commence at the edge of pavement with an excavation slope of 1(H): 1(V) to the required. The top of

subgrade should be graded with a 3 percent slope across the width of the embankment. Fill material in the embankment widening below the top of subgrade can be constructed using suitable earth material from cut sections within the project limits.

A typical cross-section for a conventional pavement widening design is provided in Figure 4.1.

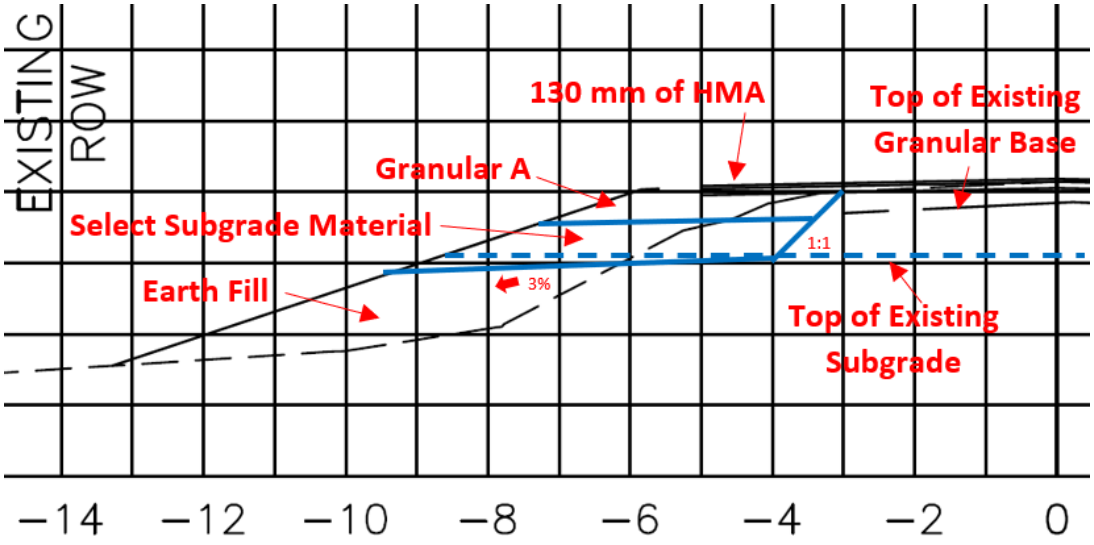

Figure 4.1: Typical Conventional Pavement Widening Cross-Section

4.3.2 Pavement Widening in Cut Sections

It is understood that conventional pavement widening may not be possible in cut sections, as the available roadway Right-Of-Way (ROW) in these areas may not permit an appropriate ditch depth. An alternative to reduce the depth of excavation in cut areas, while maintaining adequate drainage, includes the installation a new subdrain beneath the new ditch and grade the top of subgrade across the widening area toward the new subdrain.

A typical cross-section of the pavement widening design is provided in Figure 4.2.

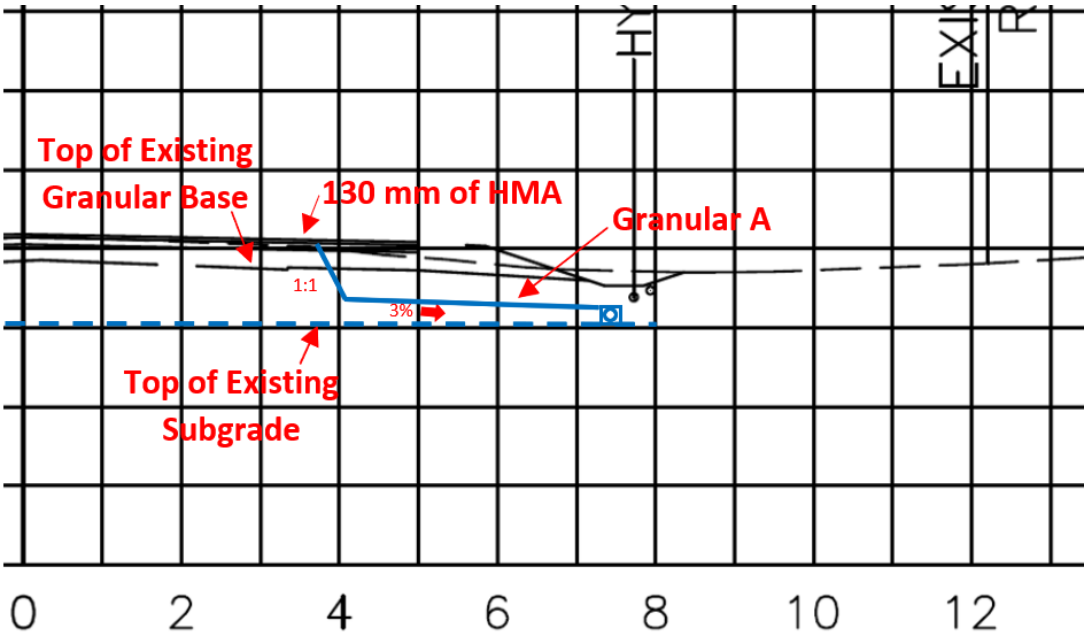

Figure 4.2: Proposed Alternate Pavement Widening Cross-Section

Excavation for the pavement widening should commence at the edge of existing pavement, and extend to the required depth, with an excavation slope of 1(H): 1(V). The depth of the new subdrain should be installed beneath the new ditch at the top of subgrade. Across the widening area, the top of subgrade should be sloped toward the subdrain at a 3 percent grade, which should be installed at a minimum depth of 700 mm. The new pavement structure should consist of:

40 mm	HL3
90 mm	HL8 (two lifts)
225 mm	Granular A Base or FDR Material
345 mm	SSM

This design approach improves the constructability of the pavement widening areas by providing a consistent excavation and subdrain depths and better compaction of subgrade soils, while reducing the potential of deeper excavations encountering unstable soil conditions in areas with higher groundwater levels. Other benefits to this design approach, include reduced vertical excavation at edge of pavement, reduced potential to undermine existing pavement at widening interface, reduced clearance of traffic to edge of excavation, and improving sub-surface drainage beneath the existing pavement by reducing distance to the outside ditch. In addition to the identified benefits to this design approach, it is expected that there should be no effect to the

pavement integrity, strength, or life cycle, as long as subgrade crossfall and compaction is completed in accordance with construction specifications.

4.4 Pavement Materials

4.4.1 New Hot Mix Asphalt

All HMA materials should meet the requirements of OPSS.MUNI 310, OPSS.MUNI 1150 and the Town of Caledon Special Provisions, as applicable. All new HMA should be compacted to at least 92 percent of the Maximum Relative Density (MRD) for HL 3 material and 91 percent of the MRD for the HL 8 material. An asphalt cement binder grade of PG 58-28 is required for both asphalt mixes. A tack coat shall be utilized between the asphalt lifts, all vertical faces, and at all tie-in to existing locations. Recycled Asphalt Pavement (RAP) material may be used in HL 3 or HL 8 asphalt mixes, at a maximum mix content of 20 percent.

4.4.2 New Granular Material

New granular material will be required for the pavement widening, grade raises, and full pavement reconstruction sections, as well as for grading of the new gravel shoulders and shoulder rounding. All granular base material should consist of new Granular A 19 mm virgin crusher run limestone in accordance with OPSS.MUNI 1010, as modified by Town of Caledon Special Provisions. The Granular A Base material can be substituted with Granular B (Type II) Subbase material with an equivalent layer thickness; however, a minimum of 100 mm of Granular A is required beneath the asphalt for fine-grading purposes.

Placement of the granular material should be completed in accordance with OPSS.MUNI 314 and should be compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) within 2 percent of Optimum Moisture Content (OMC) in accordance with the requirements of OPSS.MUNI 501.

4.4.3 Existing Granular Material

Pulverized material produced by the FDR operation can be used as new granular base material in the widening area, provided that the processed material meets the requirements of OPSS.MUNI 330. Furthermore, laboratory testing of the existing granular base material generally meets OPSS required for Granular A base material; therefore, existing granular base material in pavement reconstruction areas can remain on site as new granular base material, provided that the contractor verifies adequate thickness exists and meets design requirement. Furthermore, the existing granular base material can be removed and reused as suitable Granular base/subbase material in new pavement construction, provided that the removed granular material is not contaminated and meets the gradation requirements of OPSS.MUNI 1010 during

placement. In cut sections where existing granular subbase material is to be removed, it is recommended at this material be reused as earth fill or granular subbase material in embankment widening areas.

4.5 Drainage

Drainage of the pavement is critical for improved long-term performance. In pavement widening/reconstruction areas, the new pavement structure should be constructed to provide positive cross lateral drainage at the top of subgrade, as well as at the pavement surface. The top of subgrade should be sloped at a minimum 3.0 percent grade fall towards the outside ditches or subdrains (where applicable), while the pavement surface should be constructed with a minimum 2 percent crossfall.

4.5.1 Open Ditches

Ditching should be constructed along the toe of slope within the new alignment area to allow for pavement drainage. Ditching should be in accordance with OPSD 200.020; however, in consideration of the site conditions the depth of the new ditches can be reduced to a minimum of 300 mm below the new pavement thickness and subdrain provided below the ditch. Drainage of new ditches should be directed toward an appropriate outlet.

In cut section where new ditch depths cannot be achieved due to property constraints, consideration can be given to install a subdrain at the appropriate ditch depth. This additional subdrain should be a wrapped flexible pipe with a diameter of 150 mm and backfill with clear stone or Rip Rap material.

In addition to new ditch construction, a review of the existing ditches observed many areas where existing ditches have been over-grown with heavy vegetation growth or where limited ditch depth exist. In areas with heavy vegetation growth, it is recommended that ditch clean out be considered as part of the pavement rehabilitation.

4.5.2 Culvert Installation

New culverts may be required as part of the roadway improvements. Prior to placement of the pipe bedding, the base of the trench should be maintained in a dry condition, free of loose or disturbed material. The pipe must be placed on a uniformly competent subgrade and bedding material. Pipe bedding materials, compaction and cover should follow OPSD 802.030 to 803.034, and/or Town of Caledon specifications.

In areas where a less competent subgrade is encountered, it may be necessary to increase the pipe bedding thickness. Any excessively soft, loose or compressible materials at the pipe

subgrade should be sub-excavated and replaced with OPSS Granular A material compacted to at least 98 percent of SPMDD.

Trench backfill materials should be placed and compacted as per OPSS.MUNI 401. Where the trench is located beneath the roadway, OPSS Granular A or B material, or unshrinkable fill should be employed as backfill. Frost tapers should be considered where the depth of the culvert is at or above the frost penetration depth of 1.4 m. Design of frost tapers should be in accordance with OPSD 803.030 and 803.031, with ***f*** – 1.4 m representing the frost penetration depth and ***d*** = 0.7 m reflecting the thickness of the existing granular material.

4.6 Backslope Design and Erosion Protection

Based on the type and condition of the subgrade soil identified by the field investigation and the Ontario Health & Safety (OHS) Guidelines and Regulations these existing soils along the roadway corridor are considered a Type 3 Soil. As a result, the design of ditches and backslopes should not exceed a slope of 2H:1V and should be protected from erosion as soon as practical. Steeper slopes can be considered; however, granular sheeting, Rip Rap, or mechanical stabilization (geosynthetics) will be required for reinforcement of the slopes.

In consideration of the erosion potential at the shoulder rounding should existing shoulders be paved, consideration should be given to seal the granular material on the shoulder rounding in accordance with OPSS.MUNI 305. Alternatively, consideration can be given to use 100 percent RAP material on the surface of the shoulder rounding to reduce potential erosion of the exposed granular material.

Stripping of topsoil in pavement/embankment widening areas is expected to vary from 50 to 275 mm, with an average stripping depth of 160 mm.

5 ENVIRONMENTAL TEST RESULTS

5.1 Completed Analysis

Selected soil samples were submitted to a qualified laboratory for analytical testing to assess the environmental quality of the road base materials at the sampling locations and to assess preliminary disposal options, if required, for excess excavated granular materials.

The analytical testing was performed by AGAT Laboratories, an independent laboratory that meets the requirements of Section 47 of O.Reg. 153/04, as amended. A summary of the completed analytical testing, sample locations and material types are presented in Table 5.1 below. The laboratory certificates of analysis are presented in Appendix K.

Table 5.1: Samples Selected for Environmental Testing

Borehole ID	Sample ID	Soil Type	Analysis
Station 10+150 EB 1.5m RT OEP	Mill Street, BH2 (0.2-1.5 m)	Sand and Silt, some Clay	O.Reg 153/(511) Metals and Inorganics
	Mill Street, BH2 (1.5–2.1 m)	Sand and Silt with Clay	O.Reg 153(511) PHC
Station 11+145 WB 2.2m LT OEP	Mill Street, BH12 (0.2-1.5 m)	Silt and Clay trace Sand	O.Reg 153(511) Metals and Inorganics
	Mill Street, BH12 (1.5-2.1 m)	Sandy Silt some Clay	O.Reg 153(511) PHC

Additionally, one sample from borehole location at Station 10+150 EB 1.5 m RT OEP (Sample ID: BH 2 (0.2-1.5 m)) was submitted for Toxicity Characteristic Leachate Procedure (TCLP) analysis of metal parameters in accordance with O.Reg.558, as amended, in order to provide preliminary information to classify materials for potential transfer to an Ontario Ministry of Environment, Conservation and Parks (MECP) licenced waste management facility.

At the time of investigation, it was understood that the preferred construction method for the upgrades to Mill Street include primarily “shave and pave” operations and therefore excess soils are not anticipated as part of the construction activities. Therefore, the analytical testing that was completed as part of this investigation was completed as preliminary screening and does not meet the testing requirements of O.Reg. 406/19, as amended, “On-site and Excess Soil Management”, as this was beyond the scope of this assignment and may or may not be applicable depending on the final project design, reuse of the materials, and schedule. Additional analytical testing of excavated soils may be required prior to or during construction to further evaluate the environmental quality of the soil, confirm reuse and disposal options, and meet the requirements of re-use on-Site and/or the receivers of excess soils off-Site. Additional filing of reports with MECP by an O.Reg. 153/04 Qualified Person (QP) may be required if it is determined that the O.Reg. 406/19 is applicable based on the final project design and schedule. O.Reg. 406/19 does not apply to the reuse of excavated soils on site, or to the handling of waste that is regulated by O.Reg. 558, as amended, “General – Waste Management”.

5.2 Analytical Results and Discussion

In general, visual, and olfactory examination of the soil samples recovered from the field investigation program revealed no unusual staining or odours indicative of hydrocarbon impact or other contamination.

For preliminary characterization of the soil samples the “bulk sample” analytical data was compared to the generic Site Condition Standards provided under O.Reg. 153/04 in MECP’s document “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of

Environmental Protection Act", April 15, 2011 ("2011 MECP Document"). The analytical results were compared to the MECP's Table 2: Full Depth Generic Site Condition Standards for Use in a Potable Ground Water Condition for Residential / Parkland / Institutional Property Uses (MECP Table 2 Standards).

The reported concentrations of the tested parameters from the collected samples on Mill Street were below MECP Table 2 Standards, with the exception of Mercury, Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR) concentrations summarized below:

Table 5.2: Summary of Analytical Exceedances

Borehole ID	Sample ID	Parameter	Table 2 RPI Standard	Test Results
Station 10+150 EB 1.5m RT OEP	Mill Street, BH 2 (0.2-1.5 m)	Conductivity (mS/cm)	0.7	1.46
		Sodium Adsorption Ratio	5	22.6
Station 11+145 WB 2.2m LT OEP	Mill Street, BH12 (0.2-1.5 m)	Mercury (µg/g)	0.27	0.41
		Conductivity (mS/cm)	0.7	1.0
		Sodium Adsorption Ratio	5	7.5

*Note: Results compared to the MECP Table 2 Standards ("Full Depth Generic Site Condition Standards in a Potable Ground Water Condition" for Residential/Park/Institutional Property Use with coarse textured soils)

The results of the analytical testing are provided in the laboratory certificates of analysis in Appendix K.

The EC and SAR values likely result from de-icing salt applied to the roadway for safety purposes. The presence of EC and SAR does not impose a risk to human health, but rather may only impact the physical composition of the soil which could affect the growth of vegetation. Further, where salt has been applied by a government or municipal authority, salt-related impacts are exempt, and the applicable site condition standard is deemed not to be exceeded under Section 48 (3) of O. Reg. 153/04. Therefore, based on the preliminary test results, the excavated materials are anticipated to be acceptable for reuse in engineering applications on site (i.e. site grading fill or backfill) pending geotechnical approval. The material should not be used in landscaped areas with sensitive vegetation and plant species. Where Mercury is exceeded, additional testing is required during construction to confirm the limit of Mercury contamination.

Review of the results of the TCLP analyses for fill materials collected from BH 2 at (0.2-1.5 m depth), met the respective Schedule 4 criteria provided under O.Reg. 558, as amended, therefore materials may generally be disposed of as non-hazardous waste. Additional analytical testing of these materials may be required in order to satisfy the acceptance criteria of the selected waste management facility and anticipated volume of soil to be disposed of.

Additional testing will be required during the detailed design stage to confirm these preliminary recommendations regarding management of excavated soils. In particular, additional testing and preparation of additional planning documents may be necessary to meet the O. Reg. 406/19 “Excess Soil Regulation” requirements if excess soils are to be generated during construction.

Where excavation of existing pavement structures is required, asphalt should be removed separately from granular materials and recycled at an approved recycling facility or disposed of appropriately off-Site. Asphalt should not be mixed with excess excavated soil; fill receivers may not accept excess excavated soils if it contains asphalt.

No statement made herein should be construed as relieving the Contractor’s responsibility to comply with all applicable federal and provincial regulations, municipal by-laws and guidelines related to the handling or disposal/discharge of excavated materials and/or extracted groundwater. It should be noted that the current regulatory requirements that were considered in this report are subject to change over time.

6 CONSTRUCTION CONSIDERATIONS

The successful performance of the pavement and road works will depend largely on good workmanship and quality control during construction. It is therefore recommended that material testing and inspection be provided by qualified personnel during construction. The inspection and testing should include observation and inspection of subgrade condition, full depth reclamation, granular placement and asphalt paving and sampling as well as onsite recommendation and coordination.

7 CLOSURE

The pavement recommendations in this report were developed based on provided information and results of the pavement investigation, supplemented by our experience with the performance and rehabilitation of municipal flexible pavements in Southern Ontario. The information and design recommendations provided in this report are intended for the purposes of the Town of Caledon staff, and their designers.

We trust our report provides the information required and is considered complete. However, should you have any questions regarding this report, please feel free to contact our offices.

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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APPENDIX A

Project Key Map

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Mill Street Pavement Investigation
From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)
Caledon, Ontario

Project Key Plan

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APPENDIX B

Photographs of Typical Conditions

Photographs of Typical Conditions

Typical Photograph # 1
Mill Street - Station 10+025 - EB Lane

Typical Photograph # 2
Mill Street - Station 10+220 - EB Lane

Photographs of Typical Conditions

Typical Photograph # 3
Mill Street - Station 10+420 - EB Lane

Typical Photograph # 4
Mill Street - Station 10+540 - EB Lane

Photographs of Typical Conditions

Typical Photograph # 5
Mill Street - Station 10+815 - EB Lane

Typical Photograph # 6
Mill Street - Station 11+025 - EB Lane

Photographs of Typical Conditions

Typical Photograph # 7
Mill Street - Station 11+290 - EB Lane

Typical Photograph # 8
Mill Street - Station 11+420 - EB Lane

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APPENDIX C

Pavement Conditions Survey

THURBER ENGINEERING LTD.

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM (MUNICIPALITIES)

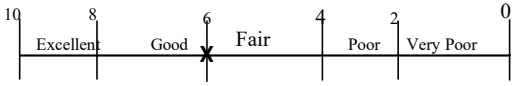
Mill Street

Road No. (Street): Mill Street **Location From:** Mississauga Road (Station 10+000) **To:** Creditview Road (Station 11+475)

Section Length: 1.5 **(Km)** **Survey Date:** December 22, 2020 **Traffic Direction:** B (B (Both Directions); N (North); S (South); E (East); W (West))

Contract No: **Work Project No:** 29577 **Class:** M (F: Freeway, C: Connecting Link, A: Major Arterial, M: Minor Arterial, R: Residential)

Pavement Condition Rating: 60 **Riding Condition Rating:** 6.0 **Evaluated by:** Abdul Nasri



Pavement Distress Manifestation			Weighting	Severity of Distress: Slight	Severity of Distress: Moderate	Severity of Distress: Severe	Density of Distress (Extent of Occurrence, %): Intermittent	Density of Distress (Extent of Occurrence, %): Frequent	Density of Distress (Extent of Occurrence, %): Extensive	DMI
			(wi)	1	2	3	<20	20-50	>50	
Surface Defects	Ravelling	1	3.0							0.0
	Flushing	2	0.5							0.0
	Potholes	3	1.0		X				X	5.0
	Pavement Edge Breaks	4	1.5			X			X	9.0
	Manholes & Catchbasins	5	1.0		X		X			3.0
Surface Deformations	Rippling and Shoving	6	1.0							0.0
	Wheel Track Rutting	7	3.0		X				X	15.0
	Distortion	8	1.0							0.0
	Utility Trenches	9	1.0		X		X			3.0
Cracking	Longitudinal	10	1.0		X			X		4.0
	Transverse	11	1.0		X			X		4.0
	Pavement Edge	12	1.0			X			X	6.0
	Map	13	1.5		X			X		6.0
	Alligator	14	3.0		X			X		12.0

Ride Comfort Rating (RCR) from 0-10: 6.0 **TOTAL DMI** 6.8

Back-calculated PCI Value: 58

Shoulder Distress Manifestion			Severity of Distress: Right Slight	Right Moderate	Right Severe	Left Slight	Left Moderate	Left Severe	Density of Distress (Extent of Occurrence, %): Right <20	Right 20-50	Right >50	Left <20	Left 20-50
Dominant Type		Distress											
Paved Full		Pavement Edge											
		Paved Shoulder Separation											
Paved Partial		Cracking											
Surface Treated		Breakup and Potholes											
		Distortion											
Primed		Pavement Edge Curb Separation											

Maintenance Treatment							
Pavement	Extent of Occurrence, %: <20	20-50	>50	Shoulder	Extent of Occurrence, %: <20	20-50	>50
	1	2	3		1	2	3
Manual Patching				Manual Patching			
Machine Patching		X		Manual Spray Patching			
Manual Spray Patching				Manual Chip Seal			
Manual Chip Seal				Crack Rout & Seal			
Machine Chip Seal							
Fog Seal							
Surface Treatment							
Manual Burn & Seal							
Crack Rout & Seal							

Distress comments (Items not covered above): Extensive moderate severity potholes is observed throughout the project limits. Pavement Change observed at Station 11+300 with pavement in good condition to Station 11+475.

Other Comments (e.g. subsections, additional contracts): Urban Pavmeent platform exists from Station 11+300 to 11+475.

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APPENDIX D

Pavement Core Logs and Typical Photographs

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Mill Street Pavement Investigation

From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

Caledon, ON

Pavement Core Log

Mill St

Station	Direction	Lane	Asphalt Layer Thickness(mm)			Crack Width	Crack Depth	Comments
			Surface	Binder	Total			
10+640	WB	Lane	20		20			
11+240	EB	Lane	20		20			
11+435	WB	Lane	50	60	110			

Mill Street Pavement Investigation
From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)
Caledon, Ontario

Pavement Core Photographs

Pavement Core Photo # 1

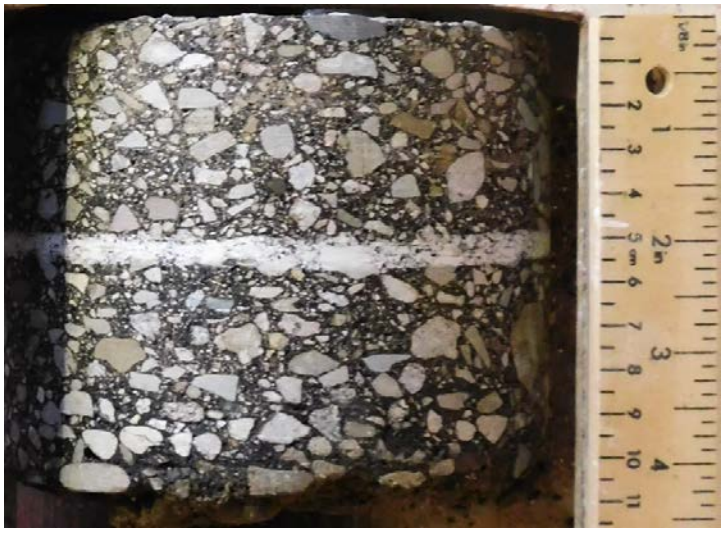
Mill Street
Station 10+640 - WB Lane

Layer	Thickness (mm)
Surface	20
Total	**20**

Pavement Core Photo # 2

Mill Street
Station 11+240 - EB Lane

Layer	Thickness (mm)
Surface	20
Total	**20**



Pavement Core Photo # 3

Mill Street
Station 11+435 - WB Lane

Layer	Thickness (mm)
Surface	50
Binder	60
Total	**110**

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APPENDIX E

Asbestos Test Results

Thurber Engineering Ltd. (Oakville)
ATTN: RANDY POMERLEAU
2010 Winston Park Drive
Unit 103
Oakville ON L6H 5R7

Date Received: 18-DEC-20
Report Date: 30-DEC-20 13:24 (MT)
Version: FINAL

Client Phone: 905-829-8666

Certificate of Analysis

Lab Work Order #: L2542227

Project P.O. #: NOT SUBMITTED
Job Reference: 29577- CALEDON GROWTH RELATED ROADS DETAILED DESIGN
C of C Numbers:
Legal Site Desc:

Amanda Overholster
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2542227-1 MAIN STREET-STATION 11+435(BH-15)-SB LANE-SURFACE(0-50MM) Sampled By: CLIENT on 17-DEC-20 @ 15:05 Matrix: SOLID							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		30-DEC-20	R5328077
Other Non Fibrous: Filler and Tar	100		1.0	%		30-DEC-20	R5328077
Report Remarks : No asbestos fibres were observed.							
L2542227-2 MAIN STREET-STATION 11+435(BH-15)-SB LANE-BASE (50-90MM) Sampled By: CLIENT on 17-DEC-20 @ 15:15 Matrix: SOLID							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		30-DEC-20	R5328077
Other Non Fibrous: Filler and Tar	100		1.0	%		30-DEC-20	R5328077
Report Remarks : No asbestos fibres were observed.							
L2542227-3 MILL STREET-STATION 11+435(BH MI-15)-WB LANE-SURFACE(0-50MM) Sampled By: CLIENT on 17-DEC-20 @ 15:25 Matrix: SOLID							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		30-DEC-20	R5328077
Other Non Fibrous: Filler and Tar	100		1.0	%		30-DEC-20	R5328077
Report Remarks : No asbestos fibres were observed.							
L2542227-4 MILL STREET-STATION 11+435(BH MI-15)-WB LANE-SURFACE(50-110) Sampled By: CLIENT on 17-DEC-20 @ 15:35 Matrix: SOLID							
Asbestos/Quartz/Other Fibres							
Asbestos By Point Count	< .1		0.10	%		30-DEC-20	R5328077
Other Non Fibrous: Filler and Tar	100		1.0	%		30-DEC-20	R5328077
Report Remarks : No asbestos fibres were observed.							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ASBESTOS-PTCT-WP	Bulk	Quantitation of asbestos by point count	EPA/600/R-93/116

Bulk samples are examined under a stereoscopic microscope. Individual fibers or fibre bundles are mounted in refractive index liquids and are observed under a polarized light microscope with a special dispersion staining objective. The dispersion staining colours are compared to reference samples of known asbestiforms.

Polarized microscopy is not a definitive technique for negative results for non-friable organically bound material (i.e.floor tiles).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2542227 Report Date: 30-DEC-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed

Quality Control Report

Workorder: L2542227 Report Date: 30-DEC-20

Client: Thurber Engineering Ltd. (Oakville)
2010 Winston Park Drive Unit 103
Oakville ON L6H 5R7
Contact: RANDY POMERLEAU

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2542227-COFC

COC Number: 17 -

Page 1 of

Report To	Contact and company name below will appear on the final report
Company:	Thurber Engineering Limited
Contact:	Randy Pomerleau
Phone:	647-330-1552
	Company address below will appear on the final report
Street:	103, 2010 Winston Park Drive
City/Province:	Oakville ON
Postal Code:	L6H 5R7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☑ NO
Company:	Thurber Engineering Limited
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☐ YES ☑ NO
☑ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ajewison@thurber.ca
Email 2	rpomerleau@thurber.ca
Email 3	

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	29577 - Caledon Growth Related Roads Detailed Design
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): L2542227 RD

ALS Contact: **Sampler:**

- Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☑ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: As soon as possible

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	ASBESTOS-PTCT-WP (Quantitation of asbestos by point count)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Main Street - Station 11+435 (BH-15) - SB Lane - Surface Course (0mm-50mm)	17-Dec-20	3:05pm	Solid		R		
	Main Street - Station 11+435 (BH-15) - SB Lane - Base Course (50mm-90mm)	17-Dec-20	3:15pm	Solid		R		
	Mill Street - Station 11+435 (BH Mi-15) - WB Lane - Surface Course (0mm-50mm)	17-Dec-20	3:25pm	Solid		R		
	Mill Street - Station 11+435 (BH Mi-15) - WB Lane - Base Course (50mm-110mm	17-Dec-20	3:35pm	Solid		R		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☑ NO

Are samples for human consumption/ use?
☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				7.8			

SHIPMENT RELEASE (client use)		
Released by:	Date:	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 12/18/20	Time: 8:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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APPENDIX F

Borehole Logs

Mill Street Pavement Investigation

From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

Caledon, ON

Mar 11, 2021

Borehole Logs

Mill St

Station 10+035 WB 2.5m LT OEP Lane

0 - 40	Asph	
40 - 350	Br Si(y) Sa W Cr Gr	Moist
		w @ 0.2m = 9%
		Percent Passing 4.75 mm = 74%
		75 µm = 31%
		Finer Than Granular B, Type I
350 - 870	Dk Br Cr Gr(y) Sa W Si	Moist
		w @ 0.6m = 5%
		Percent Passing 4.75 mm = 66%
		75 µm = 24%
		Finer Than Granular B, Type I
870 - 1.5	Dk Br Sa W Si Some Cl Tr Gr	Moist
1.5 - 2.1	Br Cl and Si Tr Gr (Firm)	Moist
	Nvalue=7 blows / 300mm	
		w @ 1.8m = 26%
		Percent Passing 4.75 mm = 100%
		75 µm = 91%
		5 µm = 51%
		Frost Susceptibility = MSFH
		Soil Erodibility = 0.26
		W_L = 32.49%
		W_P = 18.8%
		P_I = 13%
		MTC Soil Classification = CL
	TPS = 50mm (1m RT OEP)	
	UTM Zone 17T N 4843831 E 586039	

Station 10+150 EB 1.5m LT OEP Lane

0 - 50	Asph	
50 - 410	Br Sa(y) Cr Gr Some Si	Moist
410 - 700	Dk Br Sa W Si Some Cl Tr Gr	Moist
700 - 1.5	Br Sa and Si Some Cl	Moist
1.5 - 2.1	Br Sa and Si Some Cl (Stiff)	Moist
	Nvalue=12 blows / 300mm	
	TPS = 200 (4m RT CL)	
	UTM Zone 17T N 4843917 E 586111	

Station 10+240 WB 2.4m LT OEP Lane

0 - 60	Asph	
60 - 350	Br Sa(y) Cr Gr Some Si	Moist
350 - 600	Dk Br Sa W Si Some Cl Tr Gr	Moist
600 - 1.5	Dk Gry Si and Cl Tr Sa	Moist
1.5 - 2.1	Dk Gry Si and Cl Tr Sa (V.Stiff)	Moist
	Nvalue=24 blows / 300mm	
	TPS = 75mm (1m RT OEP)	
	UTM Zone 17T N 4843995 E 586167	

Station 10+335 EB 1.3m LT OEP Lane

0 - 65	Asph	
65 - 230	Br Sa(y) Cr Gr Some Si	Moist
		w @ 0.1m = 3%
		Percent Passing 4.75 mm = 49%
		75 µm = 10%
		Acceptable Granular A
230 - 600	Dk Br Sa W Si Some Cl Tr Gr	Moist
		w @ 0.4m = 9%
		Percent Passing 4.75 mm = 92%
		75 µm = 47%
		5 µm = 18%
		Frost Susceptibility = LSFH
		Soil Erodibility = 0.18
600 - 1.5	Br Sa and Si Some Cl	Moist
1.5 - 2.1	Br Sa and Si Some Cl (Firm)	Moist
	Nvalue=7 blows / 300mm	
		w @ 1.8m = 26%
		Percent Passing 4.75 mm = 99%
		75 µm = 54%
		5 µm = 12%
		Frost Susceptibility = MSFH
		Soil Erodibility = 0.36
	TPS = 275mm (5m RT CL)	
	UTM Zone 17T N 4844067 E 586230	

Station 10+425 EB 1.4m LT OEP Lane

0 - 70	Asph	
70 - 320	Br Sa(y) Cr Gr Some Si	Moist
320 - 670	Dk Br Sa W Si Some Cl Tr Gr	Moist
670 - 1.5	Br Cl and Si Tr Gr	Moist
1.5 - 2.1	Br Cl and Si Tr Gr (Stiff)	Moist
	Nvalue=15 blows / 300mm	
	TPS = 175mm (5m RT CL)	
	UTM Zone 17T N 4844143 E 586286	

Station 10+540 EB 1.4m LT OEP Lane

0 - 70	Asph	
70 - 470	Br Sa(y) Cr Gr Some Si	Moist
470 - 850	Dk Gry Si and Cl Tr Sa	Moist
850 - 1.5	Br Sa and Si Some Cl	Moist
1.5 - 2.1	Br Sa and Si Some Cl (Stiff)	Moist
	Nvalue=13 blows / 300mm	
	TPS = 100mm (5m RT CL)	
	UTM Zone 17T N 4844228 E 586351	

Station 10+640 WB 1.3m LT OEP Lane

0 - 20	Asph	
	Core only due to utility conflict. TPS = 100mm (1m RT OEP)	
	UTM Zone 17T N 4844314 E 586412	

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Mill Street Pavement Investigation

From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

Caledon, ON

Mar 11, 2021

Borehole Logs

Station 10+860 EB 1.6m LT OEP Lane

0 - 30	Asph	
30 - 620	Br Cr Gr W Sa Some Si	Moist
	w @ 0.3m = 3%	
	Percent Passing 4.75 mm = 42%	
	75 µm = 13%	
	Slightly Finer Than Granular A	
620 - 1.5	Br Sa and Si Some Cl	Moist
	w @ 1.1m = 14%	
1.5 - 2.1	Gry Si and Cl Tr Sa (V.Stiff)	Moist
	Nvalue=26 blows / 300mm	
	w @ 1.8m = 14%	
	Percent Passing 4.75 mm = 100%	
	75 µm = 93%	
	5 µm = 43%	
	Frost Susceptibility = MSFH	
	Soil Erodibility = 0.31	
	W_L = 22.7%	
	W_P = 14.3%	
	P_I = 9%	
	MTC Soil Classification = CL	
	TPS = 175mm (4m RT CL)	
	UTM Zone 17T N 4844422 E 586593	

Station 10+975 WB 2.5m LT OEP Lane

0 - 50	Asph	
50 - 250	Br Cr Gr(y) Sa Some Si	Moist
	w @ 0.2m = 3%	
	Percent Passing 4.75 mm = 67%	
	75 µm = 14%	
	Finer Than Granular A	
250 - 950	Dk Br Si(y) Sa Some Cl Tr Gr	Moist
	w @ 0.6m = 11%	
	Percent Passing 4.75 mm = 90%	
	75 µm = 48%	
	5 µm = 16%	
	Frost Susceptibility = LSFH	
	Soil Erodibility = 0.27	
950 - 1.5	Br/Red Sa W Si W Cl Some Gr	Moist
	w @ 1.2m = 14%	
	Percent Passing 4.75 mm = 87%	
	75 µm = 47%	
	5 µm = 22%	
	Frost Susceptibility = LSFH	
	Soil Erodibility = 0.21	
	W_L = 27.4%	
	W_P = 15.8%	
	P_I = 11%	
	MTC Soil Classification = CL	
1.5 - 2.1	Br/Red Sa W Si W Cl Some Gr (Stiff)	Moist
	Nvalue=13 blows / 300mm	
	TPS = 125mm (2m RT OEP)	
	UTM Zone 17T N 4844411 E 586709	

Station 11+040 WB .3m LT OEP Lane

0 - 20	Asph	
20 - 200	Br Cr Gr W Sa Some Si	Moist
200 - 650	Dk Br Cr Gr(y) Sa W Si	Moist
650 - 1.5	Dk Br Sa and Si Some Cl	Moist
1.5 - 2.1	Dk Br Sa and Si Some Cl (Firm)	Moist
	Nvalue=5 blows / 300mm	
	TPS = 125mm (2m RT OEP)	
	UTM Zone 17T N 4844445 E 586735	

Mill Street Pavement Investigation

From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

Caledon, ON

Mar 11, 2021

Borehole Logs

Station 11+145	**WB 2.2m LT OEP**	**Lane**
0 - 30	Asph	
30 - 240	Br Cr Gr W Sa Some Si	Moist
240 - 550	Dk Br Cr Gr(y) Sa W Si	Moist
550 - 700	Dk Gry Si and Cl Tr Sa	Moist
700 - 1.5	Br Si(y) Sa Some Cl Tr Gr	Wet
1.5 - 2.1	Red Sa(y) Si Some Cl (Firm)	Moist
	Nvalue=4 blows / 300mm	
	w @ 1.8m = 22%	
	Percent Passing 4.75 mm = 100%	
	75 µm = 64%	
	5 µm = 11%	
	Frost Susceptibility = MSFH	
	Soil Erodibility = 0.46	
	W_L = 25.2%	
	W_P = 15.4%	
	P_I = 10%	
	MTC Soil Classification = CL	
	TPS = 150mm (2m RT OEP)	
	UTM Zone 17T N 4844551 E 586755	

Station 11+240	**EB 1.3m LT OEP**	**Lane**
0 - 20	Asph	
20 - 300	Br Cr Gr W Sa Some Si	Moist
300 - 600	Dk Br Sa W Si Some Cl Tr Gr	Moist
600 - 1.5	Br Si(y) Sa Some Cl Tr Gr	Moist
1.5 - 2.1	Br Si(y) Sa Some Cl Tr Gr (Firm)	Moist
	Nvalue=4 blows / 300mm	
	w @ 1.8m = 16%	
	TPS = 250mm (2m RT OEP)	
	UTM Zone 17T N 4844642 E 586779	

Station 11+315	**EB 2.1m LT OEP**	**Lane**
0 - 80	Asph	
80 - 500	Br Cr Gr W Sa Some Si	Moist
500 - 900	Dk Br Sa W Si Some Cl Tr Gr	Moist
	w @ 0.7m = 17%	
900 - 1.5	Br Si(y) Sa Some Cl Tr Gr	Moist
1.5 - 2.1	Br Si(y) Sa Some Cl Tr Gr (Stiff)	Moist
	Nvalue=9 blows / 300mm	
	TPS = 250mm (2m RT OEP)	
	UTM Zone 17T N 4844731 E 586793	

Station 11+435	**WB 2.8m LT OEP**	**Lane**
0 - 110	Asph	
110 - 380	Br Cr Gr W Sa Some Si	Moist
	w @ 0.2m = 9%	
380 - 1.5	Gry Si and Cl Tr Sa	Moist
	w @ 0.9m = 18%	
1.5 - 2.1	Gry Si and Cl Tr Sa (Firm)	Moist
	Nvalue=6 blows / 300mm	
	TPS = 150mm (1m RT OEP)	
	UTM Zone 17T N 4844815 E 586851	

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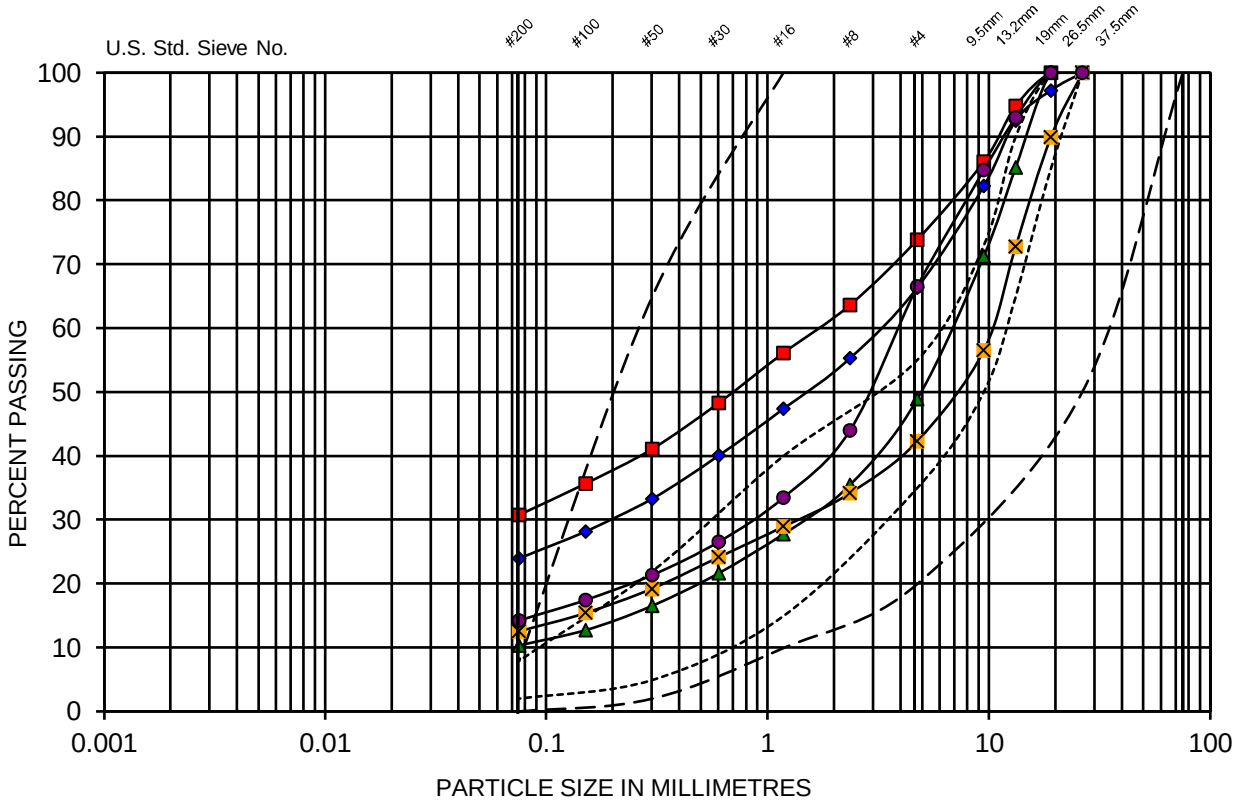
APPENDIX G

Laboratory Test Results

Mill Street Pavement Investigation
From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

GRAIN SIZE DISTRIBUTION



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	Cob Size
FINE GRAINED	SAND			GRAVEL		

Legend

- Granular A - OPSS Specification Limits
- Granular B, Type I - OPSS Specification Limits
- Mill St - 10+035 - WB Lane - 40-350
- Mill St - 10+035 - WB Lane - 350-870
- Mill St - 10+335 - EB Lane - 65-230
- Mill St - 10+860 - EB Lane - 30-620
- Mill St - 10+975 - WB Lane - 50-250

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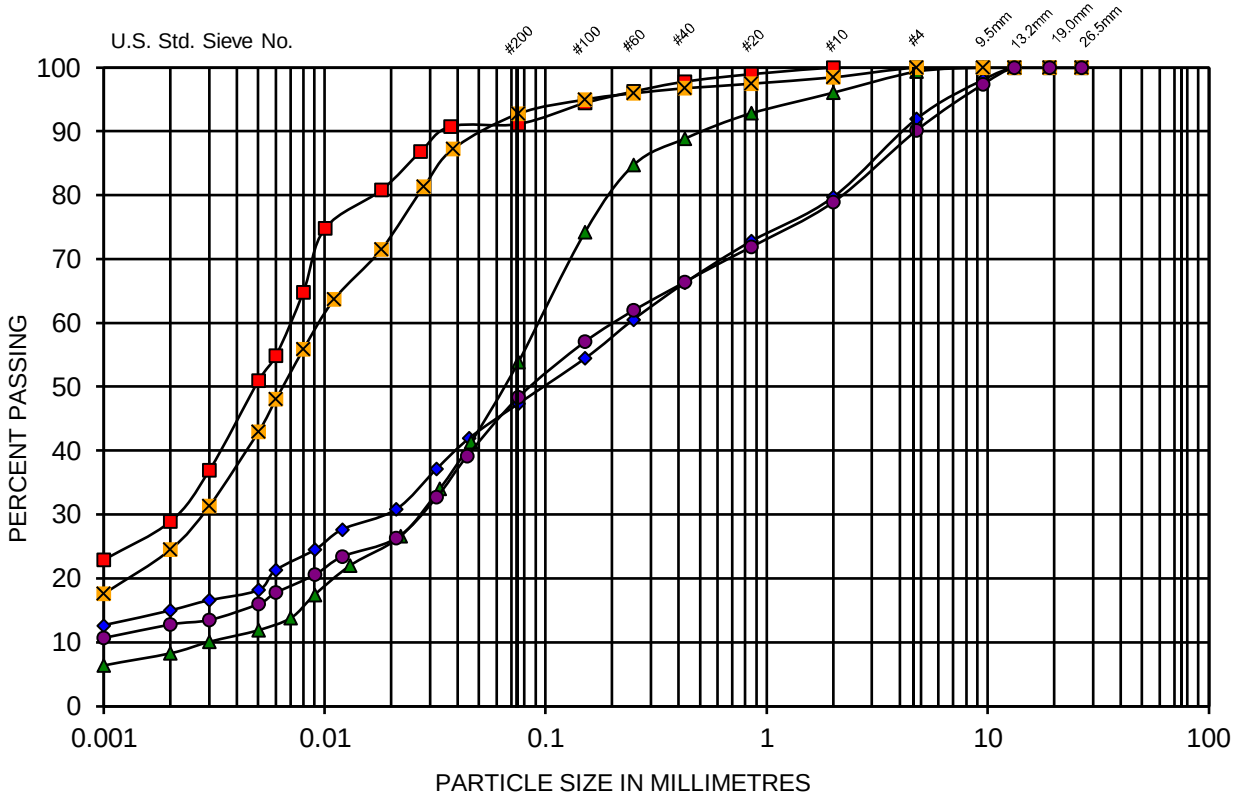
Mill Street Pavement Investigation
From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

PARTICLE SIZE DISTRIBUTION



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	Cob Size
FINE GRAINED	SAND			GRAVEL		

Legend

- Mill St - 10+035 - WB Lane - 1500-2100
- Mill St - 10+335 - EB Lane - 230-600
- Mill St - 10+335 - EB Lane - 1500-2100
- Mill St - 10+860 - EB Lane - 1500-2100
- Mill St - 10+975 - WB Lane - 250-950

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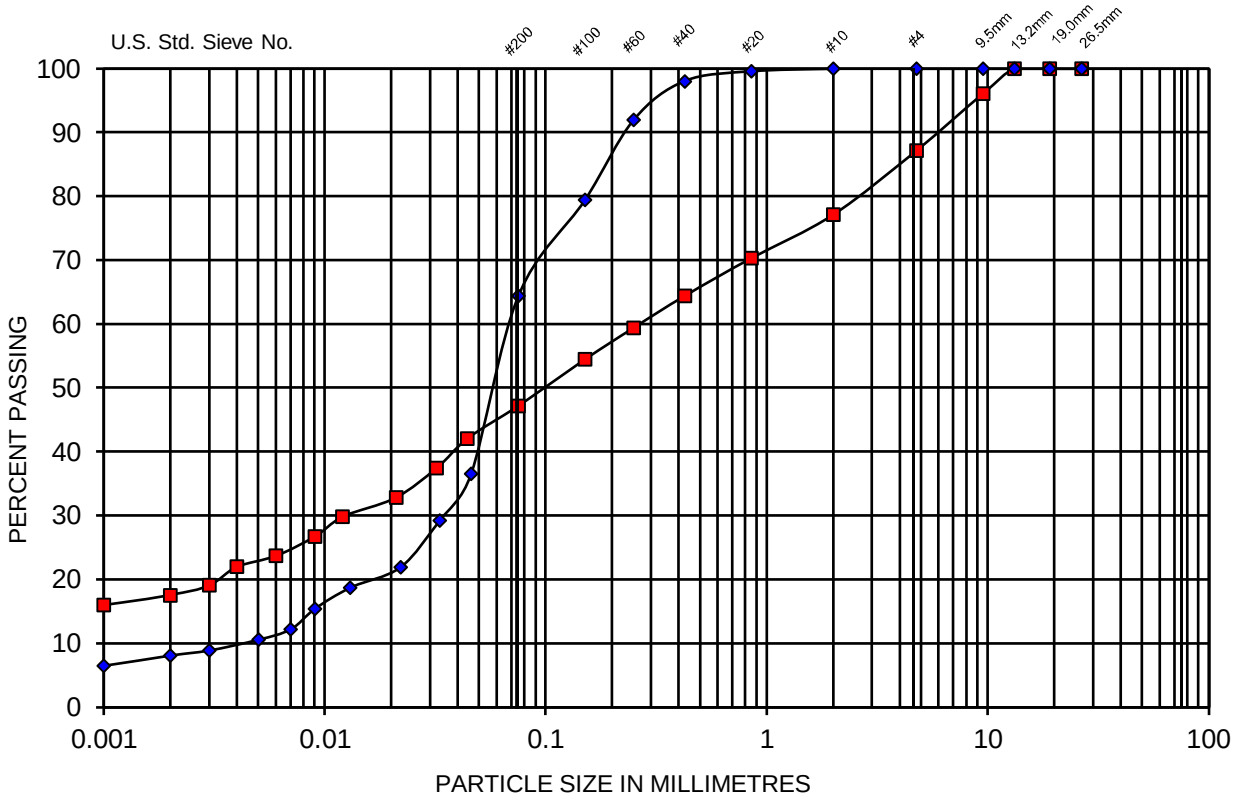
Mill Street Pavement Investigation
From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

PARTICLE SIZE DISTRIBUTION



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	Cob Size
FINE GRAINED	SAND			GRAVEL		

Legend

- Mill St - 10+975 - WB Lane - 950-1500
- Mill St - 11+145 - WB Lane - 1500-2100

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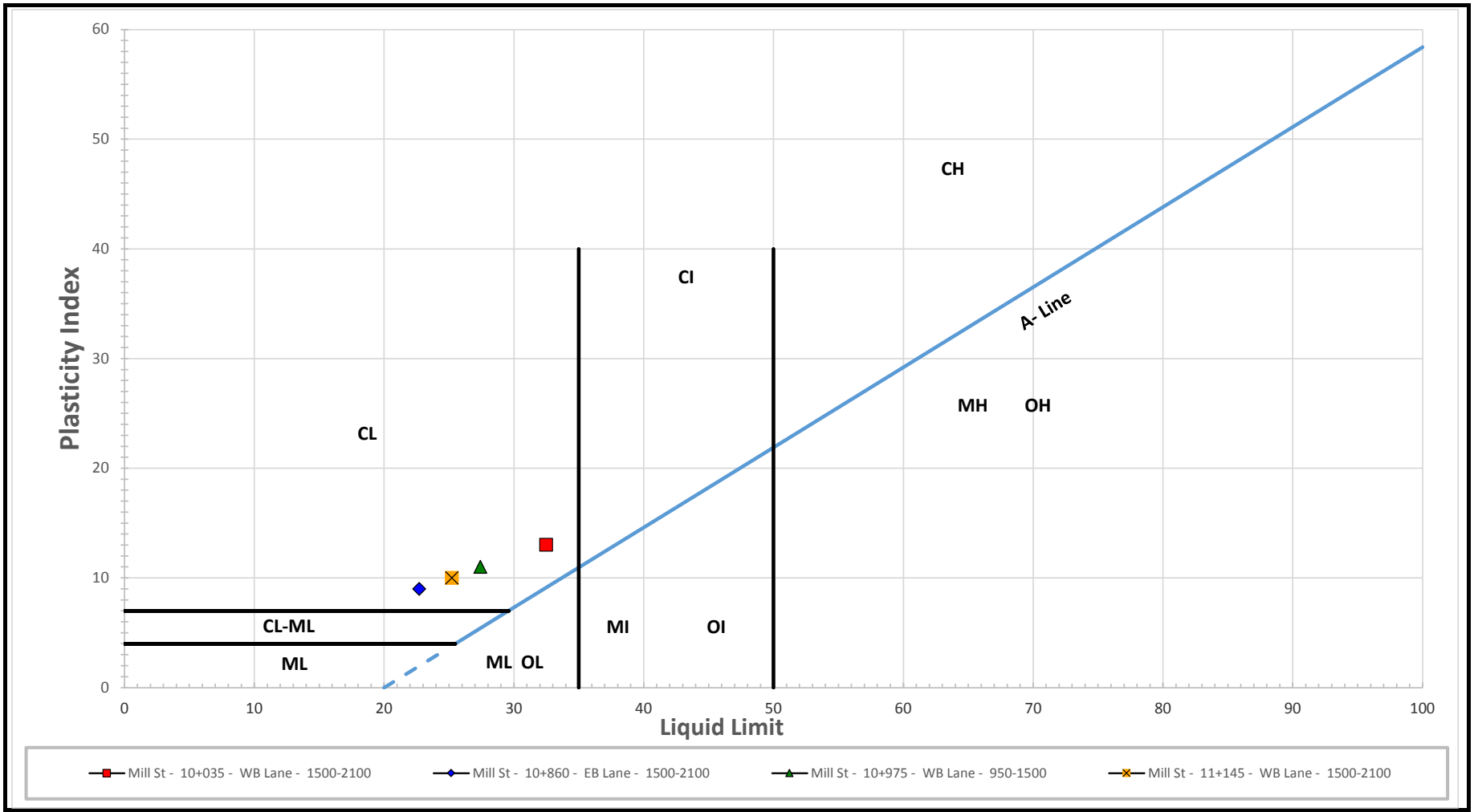

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Atterberg Limit Determination (LS-703 & 704)

Mill Street Pavement Investigation

From Mississauga Road (Station 10+000) to Creditview Road (Station 11+475)

Figure No. 1

Project No.: 29577

THURBER

APPENDIX H

Falling Weight Deflectometer Test Results

THURBER

Asphalt Resurfacing Program
Mill Street from Mississauga Road to Creditview Road
Town of Caledon, Ontario
FWD Test Results

Station	Direction	Normalized Deflection (μm)	M_R (MPa)	E_P (MPa)	SN_{Eff} (mm)	SN_{Des} (mm)	SN_{ol} (mm)	Required Asphalt Overlay (mm)
10.025	EB	523	28	309	120	64	-56	0
10.050	WB	815	19	194	103	64	-39	0
10.100	EB	819	20	187	101	64	-37	0
10.150	WB	690	25	221	107	64	-43	0
10.200	EB	881	21	169	98	64	-34	0
10.250	WB	992	20	147	94	64	-30	0
10.300	EB	789	23	191	102	64	-38	0
10.350	WB	546	35	272	115	64	-51	0
10.400	EB	694	22	231	109	64	-45	0
10.450	WB	474	33	336	123	64	-59	0
10.500	EB	531	21	338	124	64	-60	0
10.550	WB	810	23	186	101	64	-37	0
10.600	EB	568	37	258	113	64	-49	0
10.655	WB	640	26	245	111	64	-47	0
10.700	EB	663	32	217	107	64	-43	0
10.750	WB	839	27	171	98	64	-34	0
10.800	EB	584	31	262	113	64	-49	0
10.850	WB	474	39	315	121	64	-57	0
10.900	EB	478	46	303	119	64	-55	0
10.950	WB	417	54	345	124	64	-60	0
11.000	EB	596	25	270	115	64	-51	0
11.050	WB	782	23	195	103	64	-39	0
11.100	EB	644	25	243	111	64	-47	0
11.150	WB	790	21	196	103	64	-39	0
11.200	EB	476	35	325	122	64	-58	0
11.250	WB	435	34	370	127	64	-63	0
11.300	EB	398	50	371	127	64	-63	0
11.345	WB	291	31	678	156	64	-92	0
11.400	EB	424	36	376	128	64	-64	0
11.450	WB	381	29	470	138	64	-74	0
11.460	EB	254	28	881	170	64	-106	0

Note: Highlighted cells indicate a subgrade modulus of less than 30 MPa

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APPENDIX I

Pavement Design Analysis

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
Thurber Engineering Ltd.

Flexible Structural Design Module

Mill Street - Mississauga Road to Creditview Road
Pavement Rehabiliation and Design
Full Depth Reclaimation
20-Year Design

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	48,383
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	64 mm

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	194
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	3 %
Average Initial Truck Factor (ESALs/truck)	1.8
Annual Truck Factor Growth Rate	0 %
Annual Truck Volume Growth Rate	2.4 %
Growth	Compound
Total Calculated Cumulative ESALs	48,383

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New HMA	0.42	1	105	-	44
2	Processed Material	0.14	1	150	-	21
3	Existing Base	0.1	0.95	350	-	33
Total	-	-	-	605	-	98

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
1	New HMA	0.42	1	-	25	2,500,000	-	64	27
2	Processed Material	0.14	1	150	-	250,000	-	150	21
3	Existing Subbase	0.12	0.95	350	-	225,000	-	350	40
Total	-	-	-	-	-	-	-	564	88

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APPENDIX J

Life Cycle Cost Analysis

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Life Cycle Cost Analysis for Pavement Rehabilitation
Mill Street
Mississauga Road to Creditview Road
Full Depth Reclamation with New HMA
Cost for Full Project Length (1.5 km)

40 mm	HL 1
90 mm	HDBC
150 mm	FDR

Task/ Item	Thickness	Quantities	Pay Item Price $	Total Cost
Pavement Rehabilitation				
FDR	150 mm	10,500 m^2	$9.00	$94,500
HDBC	90 mm	10,500 m^2	$20.00	$210,000
HL 1	40 mm	10,500 m^2	$12.00	$126,000
Tack Coat (per layer)	2 applications	21,000 m^2	$0.60	$12,600
			Total Initial Construction Cost	**$443,100**

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities/km		Pay Item Price $	Cost/km $	Present Worth
1	*Initial Construction Cost*					*$443,100*
8	Rout and Seal Cracks	150	m	$5.00	$750.00	$527
	Mill (50 mm) and 50-mm Patch (5%)	525	m^2	$35.00	$18,375.00	$12,921
13	Rout and Seal Cracks	225	m	$5.00	$1,125.00	$635
17	Rout and Seal Cracks	150	m	$5.00	$750.00	$355
	Mill (50 mm) and 50-mm Patch (5%)	1,050	m^2	$35.00	$36,750.00	$17,389
20	Mill (50 mm)	10,500	m^2	$6.50	$68,250.00	$28,299
	Full Depth Asphalt Base Repairs (10%)	1,050	m^2	$50.00	$52,500.00	$21,769
	Resurface with New HMA (50 mm)	10,500	m^2	$12.00	$126,000.00	$52,245
	Tack Coat	10,500	m^2	$0.60	$6,300.00	$2,612
25	Rout and Seal Cracks	150	m	$5.00	$750.00	$250
28	Rout and Seal Cracks	300	m	$5.00	$1,500.00	$437
	Mill (50 mm) and 50-mm Patch (10%)	525	m^2	$35.00	$18,375.00	$5,358
30	Salvage Value	2	years	-$21,087.50	-$42,175.00	-$11,261
				Total Life Cycle Cost Analysis Worth		**$574,637**

Notes: **1.** Discount rate of 4.5 % has been assumed for expenditures in the 30 years post construction horizon.

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Life Cycle Cost Analysis for Pavement Rehabilitation
Mill Street
Mississauga Road to Creditview Road
Full Pavement Reconstruction
Cost for Full Project Length (1.5 km)

40 mm	HL 1
90 mm	HDBC
225 mm	Granular A

Task/ Item	Thickness	Quanitities	Pay Item Price $	Total Cost
Removals/ Preparations				
Excavate	355 mm	3,728 m^3	$27.62	$102,954
Pavement Reconstruction				
Granular A	225 mm	5,670 tonne	$20.27	$114,931
HDBC	90 mm	10,500 m^2	$20.00	$210,000
HL 1	40 mm	10,500 m^2	$12.00	$126,000
Tack Coat (per layer)	2 applications	21,000 m^2	$0.60	$12,600
		Total Initial Construction Cost		**$566,484**

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities		Pay Item Price $	Cost/km $	Present Worth
1	*Initial Construction Cost*					*$566,484*
8	Rout and Seal Cracks	150	m	$5.00	$750.00	$527
	Mill (50 mm) and 50-mm Patch (5%)	525	m^2	$35.00	$18,375.00	$12,921
13	Rout and Seal Cracks	225	m	$5.00	$1,125.00	$635
17	Rout and Seal Cracks	150	m	$5.00	$750.00	$355
	Mill (50 mm) and 50-mm Patch (10%)	1,050	m^2	$35.00	$36,750.00	$17,389
20	Mill (50 mm)	10,500	m^2	$6.50	$68,250.00	$28,299
	Full Depth Asphalt Base Repairs (10%)	1,050	m^2	$50.00	$52,500.00	$21,768.75
	Resurface with New HMA (50 mm)	10,500	m^2	$12.00	$126,000.00	$52,245
	Tack Coat	10,500	m^2	$0.60	$6,300.00	$2,612
25	Rout and Seal Cracks	150	m	$5.00	$750.00	$250
28	Rout and Seal Cracks	300	m	$5.00	$1,500.00	$437
	Mill (50 mm) and 50-mm Patch (5%)	525	m^2	$35.00	$18,375.00	$5,358
30	Salvage Value	2	years	-$21,087.50	-$42,175.00	-$11,261
				Total Life Cycle Cost Analysis Worth		**$698,021**

Notes: **1.** Discount rate of 4.5 % has been assumed for expenditures in the 10 years post construction horizon.

THURBER

APPENDIX K

Environmental Test Results

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: THURBER ENGINEERING LTD
SUITE 103, 2010 WINSTON PARK DRIVE
OAKVILLE, ON L6H5R7
(905) 829-8666
ATTENTION TO: Abdul Nasri
PROJECT: Caledon Roads
AGAT WORK ORDER: 20T694130
SOIL ANALYSIS REVIEWED BY: Jacky Zhu, Spectroscopy Technician
TRACE ORGANICS REVIEWED BY: Pinkal Patel, Report Reviewer
DATE REPORTED: Jan 05, 2021
PAGES (INCLUDING COVER): 14
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

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AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2020-12-22 **DATE REPORTED: 2021-01-05**

				SAMPLE DESCRIPTION:	Main Street, Lane, BH23 (0.2m-1.5m)	Main Street, Ditch, BH23 (0.3m-0.4m)	Main Street, Lane, BH32 (0.2m-1.5m)	Mill Street, BH2 (0.2m-1.5m)	Mill Street, BH12 (0. 2m-1.5m)	Humber Station Rd, BH22 (1. 5m-2.1m)	Humber Station Rd, BH29 (1. 5m-2.1m)	Mountainview Rd., BH16 (0. 1m-0.6m)
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	2020-12-22 10:15	2020-12-22 10:15	2020-12-22 10:45	2020-12-22 11:45	2020-12-22 12:15	2020-12-21 09:30	2020-12-21 12:30	2020-12-21 03:15
Parameter	**Unit**	**G / S**	**RDL**		**1882544**	**1882545**	**1883012**	**1883013**	**1883018**	**1883081**	**1883082**	**1883085**
Antimony	µg/g	7.5	0.8		<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1		4	4	3	6	3	5	6	4
Barium	µg/g	390	2		59	89	34	80	53	104	108	49
Beryllium	µg/g	4	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	0.8	1.0	<0.5
Boron	µg/g	120	5		<5	6	6	9	6	7	6	<5
Boron (Hot Water Soluble)	µg/g	1.5	0.10		0.27	0.31	0.13	0.48	0.44	0.21	<0.10	0.18
Cadmium	µg/g	1.2	0.5		<0.5	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	160	5		16	13	9	16	11	26	30	13
Cobalt	µg/g	22	0.5		5.9	4.7	3.9	6.8	3.9	12.4	13.7	5.7
Copper	µg/g	140	1		18	43	19	29	18	21	32	22
Lead	µg/g	120	1		16	23	12	21	16	10	13	7
Molybdenum	µg/g	6.9	0.5		0.5	0.6	<0.5	0.8	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g	100	1		10	10	6	12	8	24	29	10
Selenium	µg/g	2.4	0.4		0.5	1.5	<0.4	0.5	<0.4	0.5	0.6	0.4
Silver	µg/g	20	0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	23	0.5		<0.5	<0.5	<0.5	0.6	<0.5	0.8	0.6	<0.5
Vanadium	µg/g	86	1		26	21	15	21	17	35	42	26
Zinc	µg/g	340	5		60	114	40	46	32	58	70	36
Chromium, Hexavalent	µg/g	8	0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide, Free	µg/g	0.051	0.040		<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10		<0.10	0.19	<0.10	<0.10	**0.41**	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.7	0.005		**2.47**	**3.66**	0.627	**1.46**	**1.00**	**0.826**	**6.53**	**1.69**
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	N/A		**10.9**	**15.4**	**9.54**	**22.6**	**7.50**	1.01	**12.2**	**14.2**
pH, 2:1 CaCl2 Extraction	pH Units	5.0-9.0	NA		7.35	7.08	7.76	7.90	7.84	7.71	7.35	8.04

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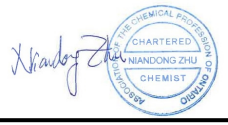

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Certificate of Analysis

AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

SAMPLING SITE:Caledon, ON

ATTENTION TO: Abdul Nasri

SAMPLED BY:Abdul Nasri

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2020-12-22

DATE REPORTED: 2021-01-05

				Mountainview Rd., BH26 (0.	Willoughby Road, BH13	Willoughby Road, BH4
			SAMPLE DESCRIPTION:	5m-1.5m)	(0.3m-1.5m)	(0.1m-1.5m)
			SAMPLE TYPE:	Soil	Soil	Soil
			DATE SAMPLED:	2020-12-21 15:45	2020-12-22 09:15	2020-12-22 08:30
Parameter	Unit	G / S	RDL	1883087	1883090	1883091
Antimony	µg/g	7.5	0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	6	4	3
Barium	µg/g	390	2	41	54	33
Beryllium	µg/g	4	0.5	0.5	<0.5	<0.5
Boron	µg/g	120	5	<5	5	<5
Boron (Hot Water Soluble)	µg/g	1.5	0.10	0.13	0.16	0.12
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5
Chromium	µg/g	160	5	17	11	13
Cobalt	µg/g	22	0.5	6.3	5.0	4.5
Copper	µg/g	140	1	19	30	25
Lead	µg/g	120	1	8	9	5
Molybdenum	µg/g	6.9	0.5	0.7	<0.5	0.6
Nickel	µg/g	100	1	11	8	7
Selenium	µg/g	2.4	0.4	<0.4	0.4	<0.4
Silver	µg/g	20	0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4
Uranium	µg/g	23	0.5	0.5	<0.5	0.5
Vanadium	µg/g	86	1	28	19	24
Zinc	µg/g	340	5	31	32	26
Chromium, Hexavalent	µg/g	8	0.2	<0.2	<0.2	<0.2
Cyanide, Free	µg/g	0.051	0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.7	0.005	**1.08**	**1.18**	**1.57**
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	N/A	**13.0**	**22.1**	**21.7**
pH, 2:1 CaCl2 Extraction	pH Units	5.0-9.0	NA	7.81	7.94	8.02

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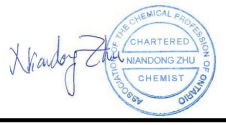

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AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

O. Reg. 153(511) - Metals & Inorganics (Soil)

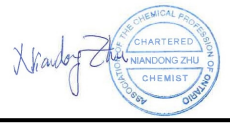
DATE RECEIVED: 2020-12-22 **DATE REPORTED: 2021-01-05**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Coarse Textured Soils **pH range listed applies to surface soil only**
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

1882544-1883091 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



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AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

O. Reg. 558 Metals and Inorganics

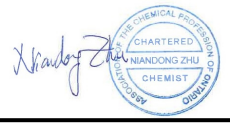
DATE RECEIVED: 2020-12-22 **DATE REPORTED: 2021-01-05**

SAMPLE DESCRIPTION:				Main Street, Lane, BH23 (0.2m-1.5m)	Mill Street, BH2 (0.2m-1.5m)	Humber Station Rd, BH22 (1. 5m-2.1m)	Mountainview Rd., BH16 (0. 1m-0.6m)	Willoughby Road, BH4 (0.1m-1.5m)
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2020-12-22 10:15	2020-12-22 11:45	2020-12-21 09:30	2020-12-21 03:15	2020-12-22 08:30
Parameter	**Unit**	**G / S**	**RDL**	**1882544**	**1883013**	**1883081**	**1883085**	**1883091**
Arsenic Leachate	mg/L	2.5	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Barium Leachate	mg/L	100	0.100	0.691	0.656	0.824	0.419	0.284
Boron Leachate	mg/L	500	0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium Leachate	mg/L	0.5	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium Leachate	mg/L	5	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead Leachate	mg/L	5	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Mercury Leachate	mg/L	0.1	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium Leachate	mg/L	1	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Silver Leachate	mg/L	5	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium Leachate	mg/L	10	0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Fluoride Leachate	mg/L	150	0.05	0.10	0.32	0.06	0.19	0.22
Cyanide Leachate	mg/L	20	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
(Nitrate + Nitrite) as N Leachate	mg/L	1000	0.70	<0.70	<0.70	<0.70	<0.70	<0.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 558 - Schedule IV Leachate Quality Criteria
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



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AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2020-12-22

DATE REPORTED: 2021-01-05

SAMPLE DESCRIPTION:				Main Street, Lane, BH23 (1.5m-2.1m)	Main Street, Ditch, BH23 (0.3m-0.4m)	Main Street, Lane, BH32 (1.5m-2.1m)	Mill Street, BH2 (1.5m-2.1m)	Mill Street, BH12 (1. 5m-2.1m)	Humber Station Rd, BH22 (1. 5m-2.1m)	Humber Station Rd, BH29 (1. 5m-2.1m)	Mountainview Rd., BH16 (1. 5m-2.1m)
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2020-12-22 10:15	2020-12-22 10:15	2020-12-22 10:45	2020-12-22 11:50	2020-12-22 12:15	2020-12-21 09:30	2020-12-21 12:30	2020-12-21 15:15
Parameter	**Unit**	**G / S**	**RDL**	**1882542**	**1882545**	**1883011**	**1883016**	**1883017**	**1883081**	**1883082**	**1883083**
Benzene	µg/g	0.21	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	µg/g	2.3	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g	1.1	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
m & p-Xylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylenes (Total)	µg/g	3.1	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g	55	5	<5	<5	<5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	55	5	<5	<5	<5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	98	10	<10	<10	<10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	300	50	<50	<50	97	<50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g	2800	50	<50	<50	<50	<50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	2800	50	NA	NA	NA	NA	NA	NA	NA	NA
Moisture Content	%		0.1	38.5	63.2	67.6	16.9	19.1	18.4	13.9	7.9
Surrogate	**Unit**	**Acceptable Limits**									
Terphenyl	%	60-140		76	82	64	86	83	121	73	81

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2020-12-22

DATE REPORTED: 2021-01-05

SAMPLE DESCRIPTION:				Mountainview Rd., BH26 (1.5m-2.1m)	Willoughby Road, BH13 (1.5m-2.1m)	Willoughby Road, BH4 (1.5m-2.1m)
SAMPLE TYPE:				Soil	Soil	Soil
DATE SAMPLED:				2020-12-21 15:45	2020-12-22 09:15	2020-12-22 08:30
Parameter	**Unit**	**G / S**	**RDL**	**1883086**	**1883089**	**1883096**
Benzene	µg/g	0.21	0.02	<0.02	<0.02	<0.02
Toluene	µg/g	2.3	0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g	1.1	0.05	<0.05	<0.05	<0.05
m & p-Xylene	µg/g		0.05	<0.05	<0.05	<0.05
o-Xylene	µg/g		0.05	<0.05	<0.05	<0.05
Xylenes (Total)	µg/g	3.1	0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g	55	5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	55	5	<5	<5	<5
F2 (C10 to C16)	µg/g	98	10	<10	<10	<10
F3 (C16 to C34)	µg/g	300	50	<50	<50	<50
F4 (C34 to C50)	µg/g	2800	50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	2800	50	NA	NA	NA
Moisture Content	%		0.1	13.2	10.2	3.5
Surrogate	**Unit**	**Acceptable Limits**				
Terphenyl	%	60-140		84	102	81

Certified By: Jinkal Patel

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Certificate of Analysis

AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2020-12-22 **DATE REPORTED: 2021-01-05**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Coarse Textured Soils **pH range listed applies to surface soil only**
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

1882542-1883096 Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.
C6–C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.
The calculated parameters are non-accredited. The parameters that are components of the calculation are accredited.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contribution.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: 

AGAT Laboratories

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Exceedance Summary

AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Abdul Nasri

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
1882544	Main Street, Lane, BH23 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	2.47
1882544	Main Street, Lane, BH23 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	10.9
1882545	Main Street, Ditch, BH23 (0.3m-0.4m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	3.66
1882545	Main Street, Ditch, BH23 (0.3m-0.4m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	15.4
1883012	Main Street, Lane, BH32 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	9.54
1883013	Mill Street, BH2 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	1.46
1883013	Mill Street, BH2 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	22.6
1883018	Mill Street, BH12 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	1.00
1883018	Mill Street, BH12 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Mercury	µg/g	0.27	0.41
1883018	Mill Street, BH12 (0.2m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	7.50
1883081	Humber Station Rd, BH22 (1.5m-2.1m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	0.826
1883082	Humber Station Rd, BH29 (1.5m-2.1m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	6.53
1883082	Humber Station Rd, BH29 (1.5m-2.1m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	12.2
1883085	Mountainview Rd., BH16 (0.1m-0.6m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	1.69
1883085	Mountainview Rd., BH16 (0.1m-0.6m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	14.2
1883087	Mountainview Rd., BH26 (0.5m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	1.08
1883087	Mountainview Rd., BH26 (0.5m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	13.0
1883090	Willoughby Road, BH13 (0.3m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	1.18
1883090	Willoughby Road, BH13 (0.3m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	22.1
1883091	Willoughby Road, BH4 (0.1m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.7	1.57
1883091	Willoughby Road, BH4 (0.1m-1.5m)	ON T2 S RPI CT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio (2:1) (Calc.)	N/A	5	21.7

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Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD
AGAT WORK ORDER: 20T694130
PROJECT: Caledon Roads
ATTENTION TO: Abdul Nasri
SAMPLING SITE:Caledon, ON
SAMPLED BY:Abdul Nasri

Soil Analysis

RPT Date: Jan 05, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	1885770		<0.8	<0.8	NA	< 0.8	100%	70%	130%	107%	80%	120%	82%	70%	130%
Arsenic	1885770		4	4	NA	< 1	115%	70%	130%	105%	80%	120%	107%	70%	130%
Barium	1885770		69	69	0.0%	< 2	103%	70%	130%	99%	80%	120%	100%	70%	130%
Beryllium	1885770		0.6	0.5	NA	< 0.5	100%	70%	130%	111%	80%	120%	101%	70%	130%
Boron	1885770		14	14	NA	< 5	71%	70%	130%	110%	80%	120%	77%	70%	130%
Boron (Hot Water Soluble)	1882544	1882544	0.27	0.31	NA	< 0.10	94%	60%	140%	100%	70%	130%	93%	60%	140%
Cadmium	1885770		<0.5	<0.5	NA	< 0.5	96%	70%	130%	104%	80%	120%	101%	70%	130%
Chromium	1885770		24	24	NA	< 5	96%	70%	130%	104%	80%	120%	99%	70%	130%
Cobalt	1885770		7.3	7.7	5.3%	< 0.5	98%	70%	130%	107%	80%	120%	96%	70%	130%
Copper	1885770		14	14	0.0%	< 1	89%	70%	130%	108%	80%	120%	89%	70%	130%
Lead	1885770		6	6	0.0%	< 1	107%	70%	130%	104%	80%	120%	94%	70%	130%
Molybdenum	1885770		<0.5	<0.5	NA	< 0.5	107%	70%	130%	103%	80%	120%	108%	70%	130%
Nickel	1885770		19	18	5.4%	< 1	96%	70%	130%	105%	80%	120%	90%	70%	130%
Selenium	1885770		<0.4	<0.4	NA	< 0.4	125%	70%	130%	99%	80%	120%	104%	70%	130%
Silver	1885770		<0.2	<0.2	NA	< 0.2	106%	70%	130%	107%	80%	120%	96%	70%	130%
Thallium	1885770		<0.4	<0.4	NA	< 0.4	105%	70%	130%	103%	80%	120%	94%	70%	130%
Uranium	1885770		0.8	0.8	NA	< 0.5	112%	70%	130%	105%	80%	120%	102%	70%	130%
Vanadium	1885770		28	28	0.0%	< 1	96%	70%	130%	101%	80%	120%	100%	70%	130%
Zinc	1885770		32	33	3.1%	< 5	99%	70%	130%	107%	80%	120%	95%	70%	130%
Chromium, Hexavalent	1881229		<0.2	<0.2	NA	< 0.2	98%	70%	130%	85%	80%	120%	84%	70%	130%
Cyanide, Free	1883085	1883085	<0.040	<0.040	NA	< 0.040	94%	70%	130%	107%	80%	120%	95%	70%	130%
Mercury	1885770		<0.10	<0.10	NA	< 0.10	111%	70%	130%	100%	80%	120%	97%	70%	130%
Electrical Conductivity (2:1)	1882544	1882544	2.47	2.56	3.6%	< 0.005	107%	80%	120%						
Sodium Adsorption Ratio (2:1) (Calc.)	1882544	1882544	10.9	11.0	0.9%	NA									
pH, 2:1 CaCl2 Extraction	1882545	1882545	7.08	7.09	0.1%	NA	100%	80%	120%						
O. Reg. 558 Metals and Inorganics															
Arsenic Leachate	1882544	1882544	<0.010	<0.010	NA	< 0.010	100%	70%	130%	107%	80%	120%	110%	70%	130%
Barium Leachate	1882544	1882544	0.691	0.684	1.0%	< 0.100	110%	70%	130%	112%	80%	120%	117%	70%	130%
Boron Leachate	1882544	1882544	<0.050	<0.050	NA	< 0.050	98%	70%	130%	97%	80%	120%	76%	70%	130%
Cadmium Leachate	1882544	1882544	<0.010	<0.010	NA	< 0.010	97%	70%	130%	95%	80%	120%	98%	70%	130%
Chromium Leachate	1882544	1882544	<0.010	<0.010	NA	< 0.010	97%	70%	130%	103%	80%	120%	104%	70%	130%
Lead Leachate	1882544	1882544	<0.010	<0.010	NA	< 0.010	98%	70%	130%	88%	80%	120%	86%	70%	130%
Mercury Leachate	1882544	1882544	<0.01	<0.01	NA	< 0.01	101%	70%	130%	102%	80%	120%	91%	70%	130%
Selenium Leachate	1882544	1882544	<0.010	<0.010	NA	< 0.010	108%	70%	130%	110%	80%	120%	107%	70%	130%
Silver Leachate	1882544	1882544	<0.010	<0.010	NA	< 0.010	99%	70%	130%	100%	80%	120%	95%	70%	130%
Uranium Leachate	1882544	1882544	<0.050	<0.050	NA	< 0.050	99%	70%	130%	97%	80%	120%	93%	70%	130%
Fluoride Leachate	1882544	1882544	0.10	0.10	NA	< 0.05	102%	90%	110%	103%	90%	110%	93%	70%	130%
Cyanide Leachate	1882544	1882544	<0.05	<0.05	NA	< 0.05	94%	70%	130%	107%	80%	120%	101%	70%	130%

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Quality Assurance

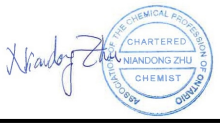
CLIENT NAME: THURBER ENGINEERING LTD
AGAT WORK ORDER: 20T694130
PROJECT: Caledon Roads
ATTENTION TO: Abdul Nasri
SAMPLING SITE:Caledon, ON
SAMPLED BY:Abdul Nasri

Soil Analysis (Continued)

RPT Date: Jan 05, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(Nitrate + Nitrite) as N Leachate	1882544	1882544	<0.70	<0.70	NA	< 0.70	97%	80%	120%	94%	80%	120%	94%	70%	130%

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:



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AGAT WORK ORDER: 20T694130

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ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

Trace Organics Analysis

RPT Date: Jan 05, 2021			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	1888971		< 0.02	< 0.02	NA	< 0.02	104%	50%	140%	105%	60%	130%	95%	50%	140%
Toluene	1888971		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	107%	60%	130%	91%	50%	140%
Ethylbenzene	1888971		< 0.05	< 0.05	NA	< 0.05	97%	50%	140%	102%	60%	130%	86%	50%	140%
m & p-Xylene	1888971		< 0.05	< 0.05	NA	< 0.05	99%	50%	140%	104%	60%	130%	87%	50%	140%
o-Xylene	1888971		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	101%	60%	130%	97%	50%	140%
Xylenes (Total)	1888971		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	102%	60%	130%	92%	50%	140%
F1 (C6 to C10)	1888971		< 5	< 5	NA	< 5	87%	60%	140%	87%	60%	140%	99%	60%	140%
F2 (C10 to C16)	1881438		< 10	< 10	NA	< 10	114%	60%	140%	95%	60%	140%	99%	60%	140%
F3 (C16 to C34)	1881438		65	59	NA	< 50	103%	60%	140%	85%	60%	140%	90%	60%	140%
F4 (C34 to C50)	1881438		< 50	< 50	NA	< 50	105%	60%	140%	98%	60%	140%	101%	60%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: Jinkal Patel

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Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, Free	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6036	modified from MSA PART 3, CH 14 and SM 2510 B	EC METER
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Arsenic Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Barium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Boron Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Cadmium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Chromium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS

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Method Summary

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AGAT WORK ORDER: 20T694130

PROJECT: Caledon Roads

ATTENTION TO: Abdul Nasri

SAMPLING SITE:Caledon, ON

SAMPLED BY:Abdul Nasri

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Lead Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Mercury Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Selenium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Silver Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Uranium Leachate	MET-93-6103	EPA 1311 & modified from EPA 6020B	ICP-MS
Fluoride Leachate	INOR-93-6018	EPA 1311 & modified from SM4500-F-C	ION SELECTIVE ELECTRODE
Cyanide Leachate	INOR-93-6052	EPA 1311 modified from MOE 3015 SM 4500 CN-I,G387	TECHNICON AUTO ANALYZER
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA 1311 & modified from SM 4500-NO3-I	LACHAT FIA
Trace Organics Analysis			
Benzene	VOL-91-5009	modified from EPA SW-846 5035C & 8260D	(P&T)GC/MS
Toluene	VOL-91-5009	modified from EPA SW-846 5035C & 8260D	(P&T)GC/MS
Ethylbenzene	VOL-91-5009	modified from EPA SW-846 5035C & 8260D	(P&T)GC/MS
m & p-Xylene	VOL-91-5009	modified from EPA SW-846 5035C & 8260D	(P&T)GC/MS
o-Xylene	VOL-91-5009	modified from EPA SW-846 5035C & 8260D	(P&T)GC/MS
Xylenes (Total)	VOL-91-5009	modified from EPA SW-846 5035C & 8260D	(P&T)GC/MS
F1 (C6 to C10)	VOL-91-5009	modified from CCME Tier 1 Method	P&T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	modified from CCME Tier 1 Method	P&T GC/FID
F2 (C10 to C16)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F3 (C16 to C34)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F4 (C34 to C50)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID