Preliminary Design Report for the Reconstruction of Peel Street North and Bay Street West

Reconstruction Feasibility Report

Project Location:
Peel Street North, Thornbury, ON

Prepared for:
Town of the Blue Mountains
32 Mill Street, P.O. Box 310 Thornbury, ON

Prepared by:
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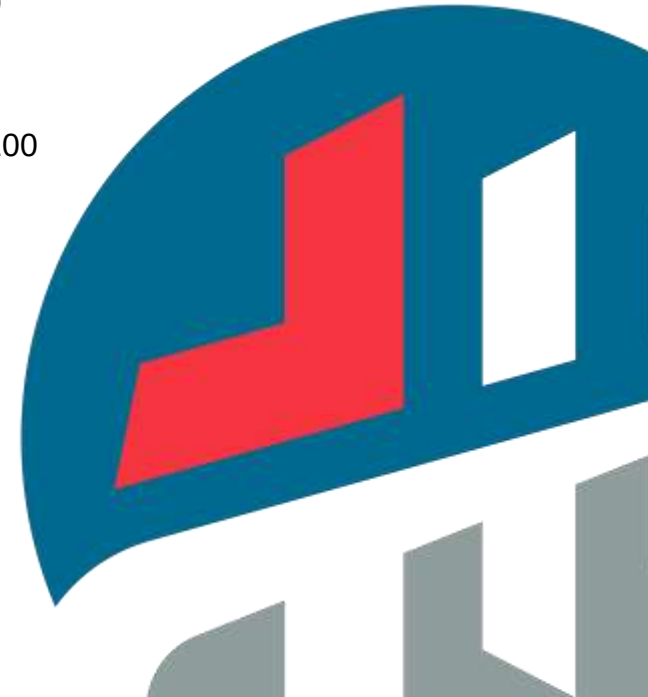
March 25, 2021

MTE File No.: 44383-100



Engineers, Scientists, Surveyors.

Contents

Figures

Tables

Appendices

1.0 Introduction

MTE Consultants Inc. (MTE) was retained by the Town of the Blue Mountains (The Town) for the Preliminary Design of Peel Street North. The preliminary design includes a full reconstruction of the road structure, a new stormwater conveyance system, and adjustments to the existing watermain in order to accommodate changes to the existing road profile. The project limits are Peel Street North, from Arthur Street West (Highway 26), to Georgian Bay and Bay Street West, from Peel Street North to the Little Beaver River as presented in Figure 1.0 below. Peel Street runs in a north east to south west direction.

The purpose of this preliminary design report is to provide an overview of the proposed project scope to the Town of The Blue Mountains based on the existing geotechnical conditions (as determined in MTE's Geotechnical Report – Appendix A), existing storm drainage system condition, wastewater system condition and water distribution system condition. In addition to these underground design elements, surface elements such as the curb and gutter, boulevards, and multi-use trail facility are considered with the utmost importance. All of these design elements are being carefully integrated in order to support the development of adjacent areas and local needs.

Figure 1.0: Site Location Plan

2.0 Design of Water Distribution System

The existing water distribution system within the project limits includes the filtration plant located on Bay Street West. This plant feeds a 400mm diameter PVC watermain that runs north-west to Peel Street North and runs southeast along Bay Street, crossing under the Little Beaver River towards Lansdowne Street North. The 400mm diameter distribution watermain reduces to a 300mm diameter PVC watermain at approximately station 0+400 on Peel Street. The 300mm watermain extends southwest to Highway 26. From station 0+400 where the watermain reduces, there is also a local 150mm PVC watermain that runs northeast towards Bay Street. The local 150mm watermain in the area of Cameron Street, Peel Street and Bay Street has been abandoned in place by the Town, and all services have been connected to the trunk watermain.

2.1 Condition of the Existing Water System

The water system currently consists of PVC pipe throughout. The profile of the existing watermain follows the existing road profile at a consistent depth of 2.5m except at the raised hill from Sta. 0+170 to 0+280 where the watermain is approximately 1.7m deep (minimum required depth of cover for the Town of The Blue Mountains.

2.2 Concerns with Existing Water System

The existing water distribution system is in good condition with no concerns regarding longevity or reliability.

An issue that has been identified is the area between STA 0+170 and 0+280 where the road profile is planned to be lowered through reconstruction. The lowering of the road profile will leave insufficient cover for the watermain as per the Town of the Blue Mountains design specifications.

2.3 Water System Design Considerations

The lowering of the road profile between stations 0+170 to 0+280 will result in the need to lower the watermain in this section. The Town has a minimum allowable depth of cover for watermains of 1.7m. In this particular area, the grading works and change in profile for improved traffic safety will reduce the existing cover by up to 1.5m and based on field measurements. To meet the minimum requirements for cover, the existing watermain will require replacement at an installation depth of 2.2 as shown in Figure 2. The existing watermain will need to be kept in service until the new piece of watermain is installed, and shut down of the feedermain will only be allowed for short duration in order to make the connections. The watermain replacement will need to be completed before the road grades can be lowered.

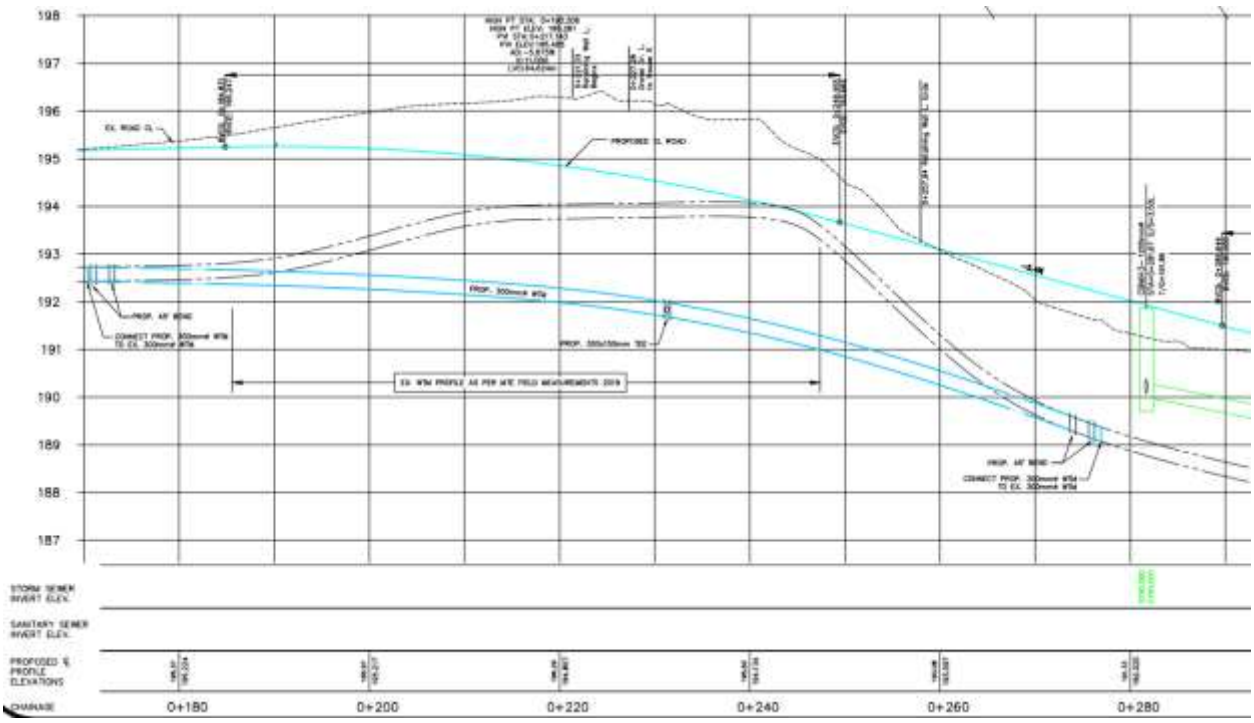


Figure 2.0: Existing and Proposed Road and Watermain Profiles

2.4 Municipal Class EA for Drinking Water Storage and Pumping Capacity Deficiencies in West Pressure Zone 1, 2 and 3

The Town is currently completing a Municipal Class Environmental Assessment for the watermain system in the western portion of the Blue Mountains. This EA will determine whether an additional trunk watermain will be required along Peel Street between the water treatment plant and Highway 26. The final design of the Peel Street project will not advance until the watermain needs are understood. Installation of the new watermain would be included as part of the detailed design should it be warranted.

3.0 Design of Wastewater Collection System

The existing wastewater collection is divided into 2 sub catchments:

- Sanitary flow from High Bluff Lane is directed towards Peel Street, and heads south west towards Highway 26 through a 450mm trunk sewer.

- Sanitary flow northeast of Timber Lane heads towards Bay Street through a 300mm diameter sewer, and along Bay Street where it discharges to the sanitary pumping station.
    - The pump station discharges flow through a 150mm diameter forcemain along Bay Street, under the Little Beaver River to the gravity system on Huron Street.
    - The sanitary flows from Timber Lane come through an easement approximately 50m northeast of Timber Lane.

- There is no sanitary sewer between the existing MH at Station 0+405 that the sanitary discharges to, and the MH at the intersection of High Bluff Lane at Station 0+140.

3.1 Condition of Existing Wastewater Collection System

The existing wastewater collection system was deemed to be appropriate at this time, however, as development continues along Peel Street, the adequacy of the sanitary collection system may be further evaluated. With 265m of Peel Street not serviced by sanitary sewer and 3 properties fronting this section of the road, the sanitary servicing needs must be understood before the road can be reconstructed.

3.2 Wastewater Collection Design Considerations

The design of Peel Street considered the location of the existing sanitary sewer to prevent conflicts between the existing sanitary infrastructure and the proposed roadworks. No changes are necessary in order to maintain the existing wastewater collection system, however, a complete review of the sanitary collection system should be completed during detailed design to ensure that the design meets the future servicing needs.

4.0 Design of Storm Drainage System

The existing storm drainage system is currently split into two catchments, divided at the existing high point at STA 0+220.

The east portion of the system consists of open roadside ditches and driveway culverts that range from 200mm diameter pipes to 600mm diameter pipes. This portion of the system conveys the stormwater to Georgian Bay at the east end of Peel Street, and part of it is diverted along Bay Street West and into the existing creek which separates the two sections of Bay Street West.

The west portion of the system consists of open roadside ditches and 600mm diameter driveway culverts that convey the runoff to the existing watercourse that runs parallel to Highway 26.

Throughout the corridor, the existing storm drainage system has no capability to provide sufficient drainage of the road structure, and will not support the reconstructed Peel Street.

The proposed design of the drainage system will look into implementing methods of runoff conveyance that differ from ditches. Through urbanization of Peel Street, a larger volume of runoff will be created, and this will require proper drainage of the road structure, and a storm drainage system capable of handling the runoff from the various transportation surfaces that are being considered for the design.

4.1 Existing Condition of Storm Drainage System

The majority of the existing storm drainage system is formed by open ditches that collect the roadway runoff and convey the water to nearby bodies of water. With the urbanization of Peel Street, the existing storm drainage system is not capable of handling the increased stormwater runoff with a paved roadway, nor is it capable of allowing adequate drainage of the road structure if maintained in its current state.

4.2 Storm Drainage Design Considerations

The cross section for the preferred alternative includes curb and gutter, and will utilize an underground stormwater collection system to replace the existing ditches. The project area is divided into two catchment areas, splitting at the high point of Peel Street just northeast of High Bluff Lane.
The southwest drainage area will be collected by curb and gutter and discharged into an existing 600mm culvert, and eventually to the existing waterway that parallels the Georgian Trail.

The northeast drainage area will be collected by curb and gutter into catchbasins, and head toward Bay Street. Flows will be treated by an Oil Grit Separator (OGS), before being discharged to a proposed ditch on the north side of Peel Street and to Georgian Bay. The proposed ditch outlet to the lake provides some additional treatment of the stormwater runoff.

These systems should be designed to meet all specifications as required by the Town of the Blue Mountains Design Standards. Where minimum cover cannot be met, the pipe will be insulated. All pipe crossings will have a minimum separation of 0.30m and the distance between structures will be maximized in order to limit the number of required structures.

5.0 Design of Right-of-Way (Plan and Profile)

5.1 Condition of Existing Right-of-Way

Peel Street currently consists of a 20m ROW, with an approximately 8.5m wide gravel roadway with roadside ditches, and there are no pedestrian or cycling facilities. Additionally, the profile of Peel Street North has a large vertical crest that prevents optimal sightlines for drivers of oncoming traffic, pedestrians and cyclists. The development of Timber Lane and High Bluff Lane have resulted in substantial construction traffic along Peel Street, which has contributed to the decline in the condition of Peel Street. Currently, Peel Street requires regular maintenance from Town staff, including substantial dust control measures.

5.1.1 Pavement Structure and Geotechnical Conditions

An in-depth look at the existing pavement structure and geotechnical conditions can be found in the geotechnical report written by MTE Consultants for the Town of the Blue Mountains in October 2018. In summary, it was determined that the granular base and subbase soils were significantly below the OPSS 1010 specifications for Granular 'B' Type 1 soils due to high fines content. Fill, glacial till and sand were all encountered in different areas within the project limits. Additionally, with the truck traffic from ongoing construction activities in the area, the contamination of the granular material will continue, increasing the fines content.

In terms of Stormwater management design and overall constructability, there are indications of permanent saturated conditions and groundwater is not expected to drop below 1.5m to 3.1m depths (Note: Groundwater levels can vary and are subject to seasonal fluctuations and local variations). During detailed design, consideration should be given to potential bleeding out of perched water table within the cut section of the road.

The existing granular is contaminated with winter sand of two samples of existing road structure. More than 10% passing the #200 sieve is contaminated and therefore cannot be used.

5.1.2 Active Transportation Elements

Currently, Peel Street North and Bay Street West do not have any dedicated pedestrian or cycling infrastructure. In the absence of dedicated cyclist and pedestrian infrastructure, cyclists and pedestrians use the roadway, which raises significant safety concerns given the increase in traffic and insufficient sight lines along Peel Street. This risk is increased at night as there are no streetlights. These factors are major causes for concern that put the safety of the public at risk and should be mitigated through design.

5.1.3 Lighting Elements

The existing ROW does not have any form of street lighting along Peel Street North.

5.2 Right of Way Design Considerations

5.2.1 Cross Section/Functional Design

The preliminary design looked at both the Town's Standard Urban, and Standard Rural Cross Sections. The initial expectation was that Peel Street would be reconstructed to the Town's Standard Urban Cross Section to meet the needs of development along Peel Street, Timber Lane and High Bluff Lane. When the standard urban cross section was applied and presented to the public, there was overwhelming feedback that the urban cross section would detract from the rural aesthetic of the neighbourhood. Additionally, application of the Town's Standard Rural Cross Section, which includes roadside ditches, resulted in back slopes on the ditches extending well beyond property lines, and having significant impacts on the grading of private property. Through the public feedback, and council direction, it was determined that neither of the existing Town's design standards would be appropriate for Peel Street, and that additional design alternatives should be created for Peel Street.

MTE and Town staff, along with input from Council, conducted an iterative design process to develop alternative cross section designs, incorporating elements that would ultimately provide an urban and rural aesthetic. The preferred cross-section was chosen from three additional design options that were hybrids of the rural and urban design standards. Included in the hybrid options, was a multi-use trail, which is not included in either the rural or urban design standard for the Town, but was included to address connectivity for active transportation, and separation of cyclists and pedestrians from vehicular traffic.

The cross section shown below in Figure 3 was approved by Council. The proposed cross section includes:

- Narrowing of the road to reduce speed (3.5m lanes)
- Barrier curb and gutter – including storm sewer
- 2.7m Multi-Use Trail (MUT) on the north side of Peel Street
- Street lighting – meeting the Town's standards. Final location could vary.

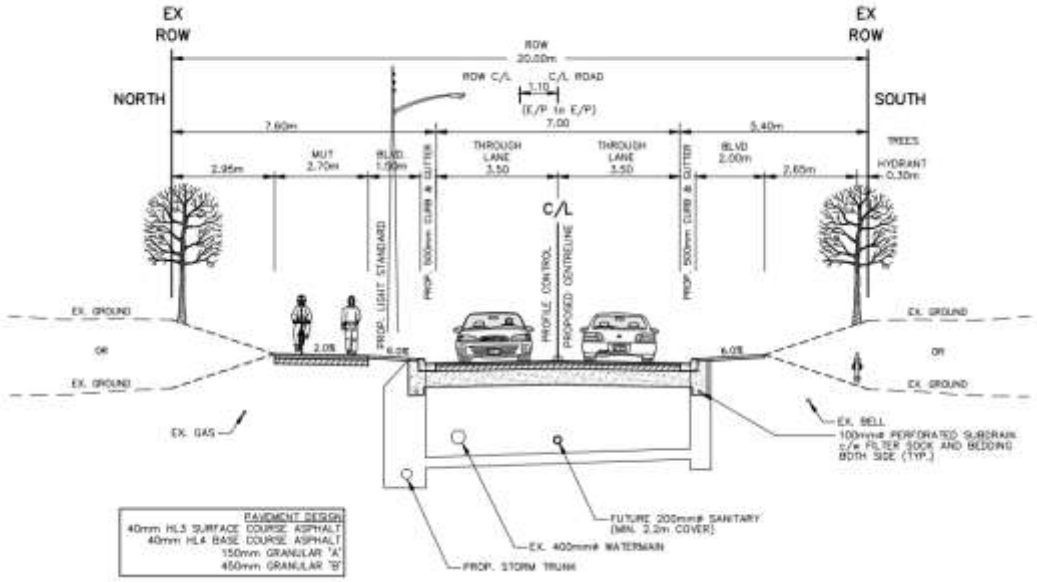


Figure 3.0: Proposed Cross-Section for Peel Street

Another feature of the proposed functional design of Peel Street is the modified profile of the road. The crest that occurs just north of High Bluff Lane acts as a visual barrier to oncoming traffic. Conversely, drivers heading towards Arthur Street (Highway 26) are not able to see oncoming vehicles. The adjustment to the profile will improve visibility and drivability of the Peel Street, however, it will result in significant cut and fill of the roadway, along with grading of the cut and fill areas.

5.2.2 Pavement Structure

Due to the existing granular road base being contaminated with winter sand (as discussed in 5.1.1) a full replacement of the pavement structure is required. The granular layers and road base will be constructed to meet the required specifications that have been outlined in the Geotechnical Report (Appendix A). This also allows for the regrading of some of the problematic areas that have insufficient sightlines. A thorough and detailed explanation of the required pavement structure design can be found in Appendix A, but the summarized pavement structure is as follows:

Table 1 - Recommended Pavement Structure

Pavement Component	Depth
Asphalt Hot Mix	90mm
OPSS 1010 Granular 'A' Base	150mm
OPSS 1010 Granular 'B' Subbase	450mm

5.2.3 Active Transportation Elements

The Town has requested that the design implements different transportation infrastructure in order to mitigate the risk associated with pedestrians and cyclists using the same lanes as the vehicular traffic. The design has integrated a 2.70m multi-use trail along the entire length of the north side of Peel Street North. This multi-use trail will connect existing trails and sidewalks in order to expand the active transportation network in the Town.

In addition to the multi-use trail, a 1.50m boulevard will be constructed on the north side to provide snow storage, as well as separation between cyclists, pedestrians and traffic. On the south side, a 2.00m boulevard will be constructed for the purpose of snow storage.

5.2.4 Lighting Elements

The Town has requested that street lighting elements are added to the cross section of Peel Street North in order to mitigate the dangers that pedestrians and cyclists face during the night. The proposed lighting elements will meet all specifications as per the Town's design manual and should be designed in order to minimize any light pollution. As part of the detailed design process, a Photometric Illumination Study should be conducted to determine lighting levels, and type of lighting as per Town standards. The final location of the poles within the cross section could be moved as street and pedestrian lighting may be used to ensure all safety requirements are met and the light pollution is adequately minimized so as not to disturb any residents.

6.0 Utilities

Utility providers have been consulted and information regarding their infrastructure is included in the 30% design drawing package. It is expected that further coordination with EPCOR with regards to the location of hydro and street lighting will be done during detailed design.

7.0 Conclusions and Recommendations

In summary, the preliminary design for Peel Street North has focused on the following aspects:

i) The preliminary design includes improvements to the profile of Peel Street which will improve sightlines, specifically between STA 0+170 to 0+280.

ii) A portion of the existing watermain, between STA 0+170 to 0+280 must be lowered in order to maintain the required depth of cover as a result of the profile adjustment.

iii) The safety of pedestrians and cyclists should be addressed in detailed design, a 2.7m wide multi-use trail is currently shown on the north side of Peel Street. Lighting design must also be preformed in accordance with Town standards.

iv) Based on the Geotechnical Report, the pavement structure should be replaced in order to meet the current standards.

v) The urbanization of Peel Street North will require an underground storm drainage system that can convey the 5-year storm, while maintaining the existing outlets.

These elements have been addressed in the preliminary 30% design and should be further evaluated in the detailed design phase to meet current Town of The Blue Mountains Standards.

Prior to final detailed design, the following aspects of the project must be considered:

i) The Town of the Blue Mountains must determine if a watermain is required.

ii) The Town of the Blue Mountains must determine if a sewer is required.

iii) The final design must consider the existing infrastructure which has inconsistent running lines along Peel Street.

iv) An arborist report is required to determine the trees that are impacted by the final design, if trees need to be removed due to the health, age or location of the existing vegetation.

v) The final design must consider the location of the streetlighting poles in order to maximize the illumination of the road and multi-use trail, and should include a photometric analysis.

vi) Detailed grading plans to accommodate changes to road profile.

All of which is respectfully submitted,

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Appendix A

Geotechnical Report

PEEL STREET NORTH AND BAY STREET WEST RECONSTRUCTION

Geotechnical Investigation Report

Project Location:
Peel Street North and Bay Street West
Blue Mountains, ON

Prepared for:
The Corporation of the Town of the Blue Mountains
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October 3, 2018

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TABLE OF CONTENTS

TABLES

APPENDICES

1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained by The Corporation of the Town of the Blue Mountains to conduct a geotechnical investigation for the reconstruction of Peel Street North and Bay Street West in Blue Mountains, Ontario, as shown on **Figure 1 in Appendix A**.

The project will involve the full reconstruction of Peel Street North from the Arthur Street West intersection to the west end of the street, and the portion of Bay Street West south of the water treatment facility, Municipal Number 230. The project will incorporate the reconstruction of Peel Street North and Bay Street West from rural gravel roads to a hard surface pavement structure. It is understood that the reconstruction may include the replacement of sanitary and water services, and new curbs and sidewalks on both sides of the roadways. The final roadway design was not available at the time of this report.

The purpose of this geotechnical investigation is to determine the soil and groundwater conditions along Peel Street North and Bay Street West, and provide geotechnical engineering recommendations for site servicing, excavations and dewatering, pavement structure design, and drainage requirements.

2.0 FIELD AND LABORATORY PROGRAMS

The fieldwork for this investigation was carried out on September 11, 2018 and involved the drilling of one borehole along Bay Street West (Borehole BH101-18) and four boreholes along Peel Street North (Boreholes BH102-18 to BH105-18) to depths ranging from 4.8 to 5.2 m. The locations of the boreholes are shown on the Site Plan, **Figure 2 in Appendix A**.

Public utility companies were contacted prior to the start of drilling activities in order to isolate underground utilities near the boring locations. It is noted numerous water and sanitary services were identified throughout the road cross section of both streets.

The boreholes were advanced with a D50T track mounted drill rig equipped with continuous flight hollow stem augers supplied and operated by London Soil Test Ltd.

Representative soil samples were recovered throughout the depths explored. Standard Penetration Tests (SPT) were carried out during sampling operations in the boreholes using conventional split spoon equipment. The SPT N-values recorded are plotted on the borehole logs in **Appendix B.**

Cohesive soil samples were tested using a pocket penetrometer to determine approximate shear strengths. The results of the penetrometer testing are plotted on the appended borehole logs.

Upon completion of drilling, the boreholes were backfilled with soil cuttings and bentonite in accordance with Ontario Regulation 468/10 (formerly O. Reg. 903) under the provinces Water Resources Act.

The fieldwork was monitored throughout by a member of our geotechnical engineering staff, who directed the drilling procedures; conducted SPT and pocket penetrometer tests; documented the soil stratigraphies; monitored the groundwater conditions; and transported the recovered soil samples back to our office for further classification.

The ground surface elevations at the borehole locations were surveyed by MTE OLS Ltd. and referenced to a geodetic datum. It is noted that Peel Street North slopes from west to east approximately 17 to 18 m between the borehole locations.

All of the soil samples collected were submitted for moisture content testing, three soil samples were submitted for particle size distribution analyses and two granular samples were submitted for grain size analyses.. The results of the laboratory tests are provided in **Appendix C**. The remaining soil samples will be stored for a period of 1 month and will be discarded of at that time without prior request from the client to extend storage time.

3.0 SOIL CONDITIONS

Reference is provided to the appended borehole logs for soil stratigraphy details, SPT N-values, results of pocket penetrometer testing, moisture content profiles, and groundwater observations and measurements. Soil conditions encountered at the site typically include road structure and fill overlying glacial till and sand deposits.

3.1 Road Structure

The road structure was made up of surficial granular base soils and underlain by granular subbase soils. The granular base and subbase soils thickness at each borehole location are summarized in the following table;

TABLE 1 - ROAD STRUCTURE BASE AND SUBBASE THICKNESSES

Borehole Number	Base/Subbase Thickness (mm)
BH101-18	760
BH102-18	610
BH103-18	760
BH104-18	610
BH105-18	610

The range, mean and standard deviation of the granular base and subbase soils are summarized in the following table;

TABLE 2 - SUMMARY OF THE GRANULAR BASE AND SUBBASE SOILS

Road Structure	Range	Mean	Standard Deviation
Base/Subbase	610 - 760 mm	670 mm	82

The road structure soils typically range in composition from light brown sand and gravel with trace silt to dark brown gravelly sand with some silt. The results of two grain size distribution analyses conducted on the granular base and subbase soils are provided in **Appendix C** and summarized in the following table;

TABLE 3 - RESULTS OF GRANULAR BASE/SUBBASE SOILS GRAIN SIZE DISTRIBUTION ANALYSES

Borehole Number	Sample Depth (mm)	Gravel (%)	Sand (%)	Fines (%)
BH101-18	0 - 610	37	51	12
BH104-18	0 - 610	24	58	18

The granular base/subbase soils marginally did not pass the OPSS 1010 specification for Granular 'B' Type 1 soils due to high fines content.

SPT N-values in the road structure range from 19 to 39 blows per 300 mm penetration of the split spoon sampler indicating compact to dense conditions.

Insitu moisture contents in the road structure range from 2 to 6% indicating moist to very moist conditions.

3.2 Fill

Fill was encountered beneath the road structure in all of the boreholes and was 0.3 to 1.2 m thick (average thickness = 0.8 m). The fill typically ranges in composition from dark brown sand and gravel with some silt to brown clayey silt with some sand and trace gravel. Organic content was noted within the fill in Borehole BH104-18 at a depth of 0.6 m (Elevation 189.7 m). SPT N-values in the fill range from 15 to 42 blows per 300 mm penetration of the split spoon sampler indicating compact to dense conditions.

Insitu moisture contents in the fill range from 3 to 16% indicating moist to very moist conditions.

3.3 Glacial Till

Glacial till was encountered beneath the road structure and fill in all of the boreholes except Borehole BH102-18 and extends to the termination depth of each borehole it was encountered. The till typically ranges in composition from brown sandy gravelly silt with trace clay to grey clayey silt with trace sand and gravel. The results of two particle size distribution analyses conducted on the till are provided in **Appendix C** and summarized in the following table;

TABLE 4 - RESULTS OF GLACIAL TILL PARTICLE SIZE DISTRIBUTION ANALYSES

Borehole Number	Sample Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH103-18	2.29 - 2.90	12	37	41	10
BH105-18	1.52 - 2.13	28	31	32	9

SPT N-values measured in the till range from 21 to above 50 blows per 300 mm penetration of the split spoon sampler indicating a compact to very dense conditions. Shear strength measured in the cohesive deposits of till was above 200 kPa.

Insitu moisture contents in the till range from 2 to 17% indicating moist to very moist or drier than the plastic limit conditions. A saturated sandy silt layer was contacted in Borehole BH105-18 at a depth of 2.3 m (Elevation 192.8 m) and was 0.2 m thick.

3.4 Sand

A sand deposit was encountered beneath the road structure and fill in Borehole BH102-18 and continued to the termination depth of the borehole. The sand was intercepted by a 150 mm thick clayey silt layer at a depth of 4.6 m (Elevation 173.0 m). The sand typically ranges in composition from brown silty sand with trace gravel to grey sand and gravel with trace silt and clay. The results of a particle size distribution analysis conducted on a sample of the sand are provided in **Appendix C** and summarized in the following table;

TABLE 5 - RESULTS OF SAND PARTICLE SIZE DISTRIBUTION ANALYSIS

Borehole Number	Sample Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH102-18	1.52 - 1.83	37	53	8	2

SPT N-values measured in the sand range from 16 to above 50 blows per 300 mm penetration of the split spoon sampler indicating compact to very dense conditions.

Insitu moisture contents in the sand range from 11 to 20% indicating saturated conditions.

4.0 GROUNDWATER CONDITIONS

Groundwater observations and measurements were carried out in the open boreholes at the time of drilling and are summarized on the borehole logs. Perched groundwater was observed within the sandy silt till in Borehole BH105-18 at a depth of 2.3 m (Elevation 192.8 m).

Upon completion of drilling, free groundwater was measured in Borehole BH102-18 at a depth of 1.5 m (Elevation 176.1 m). No free groundwater was measured in the remaining boreholes. The grey colour of the soil at a depth of 1.5 to 3.1 m below ground surface (Elevation 176.1 to 192.7 m) is indicative of permanent saturated conditions and groundwater is not expected to drop below these levels. It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations and local variations.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

The project involves the full reconstruction of Peel Street North from the Arthur Street West intersection to the west end of the street, and the portion of Bay Street West south of the water treatment facility, from rural gravel roads to a hard surface pavement structure. It is understood that the reconstruction may also include the replacement of storm and sanitary sewers and watermain, and new curbs and sidewalks on both sides of the roadways. The final roadway design was not available at the time of this report.

The subsurface stratigraphy at the site comprises road structure and fill overlying glacial till and sand deposits. Saturated sand was encountered in Borehole BH102-18 at a depth of 0.9 m (Elevation 176.7 m). No free groundwater was encountered in the remaining boreholes.

Based on the results of this geotechnical investigation, reconstruction is a feasible option for Peel Street North and Bay Street West; however, the fill thickness and groundwater table in the vicinity of Borehole BH102-18 will affect design and construction. The following subsections of this report contain geotechnical recommendations pertaining to site preparation, site servicing, excavations and dewatering, pavement structure design, and drainage requirements.

5.2 Site Preparation / Road Widening

The existing base/subbase materials only marginally failed the OPSS 1010 specification for Granular 'B' Type 1 soils due to high fines content, therefore MTE recommends reusing the material as subbase soil. New Granular 'A' base material is recommended The existing base/subbase materials may either be stripped and stockpiled onsite or left in place depending on final grades at the site. If the existing base/subbase materials are stripped and stockpiled onsite then they must be placed back in the roadway in maximum 300 mm thick lifts and compacted to 100% SPMDD.

The existing fill materials are suitable to be left below the road structure depending on final grades at the site. The subgrade soils must be proof rolled and inspected by a geotechnical engineer. If the subgrade is wet and unstable, additional granular subbase will be required.

It is anticipated that Peel Street North and Bay Street West will have to be widened to accommodate the hard surface pavement structure and the possibility of new curbs and sidewalks on both sides of the roadways. Organic fill (topsoil) must be removed from any road widening area. To conduct the widening process, granular material would have to be placed outside of the existing road envelope and then the pavement design constructed above. The existing base/subbase material will have to be benched into the imported granular material used to raise grades. The benching process is outlined on **Figure 3 in Appendix A.**

5.3 Site Servicing

5.3.1 Excavations and Dewatering

Temporary excavations to conventional depths for installation of underground pipes at this site must comply with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects. The road structure, fill and sand encountered at the site are classified as Type 3 soils (O. Reg. 213/91, s. 226 (4)). Temporary side slopes through this material must be cut at an inclination of 1.0 horizontal to 1.0 vertical or less from the base of the excavation, exclusive of groundwater effects. The native glacial till soils encountered at the site are classified as Type 2 soils and temporary side slopes must be cut near vertical at 1.2 m above the base of excavation and at an inclination of 1 horizontal to 1 vertical or less above this level, exclusive of groundwater effects.

Trench side slopes must be continuously inspected especially after periods of heavy rainfall or snow melt to identify areas of instability. Surface water should be directed away from entering the trench.

Moderate groundwater inflow should be expected where the excavations extend into the groundwater encountered in the sand deposit at Borehole BH102-18. It is our opinion that extensive pumping will be required to handle the groundwater infiltration in this area. It will be necessary to flatten the excavation side slopes where groundwater seepage is occurring to ensure stability. Every excavation that a worker may be required to enter shall be kept reasonably free of water (O. Reg. 213/91, s. 230).

It should be noted that an Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW), issued by the Ministry of Environment, Conservation and Parks, will be required if the dewatering system/sumps result in a water taking of more than 50,000 L/day to 400,000 L/day, respectively. The design of the dewatering system should be left to the contractor's discretion to control groundwater at least 0.5 m below the invert level in order to provide stable excavation base. The contractor should notify the prime consultant in the event that he feels that a PTTW will be needed.

5.3.2 Pipe Bedding

It is anticipated invert elevation of the pipes will be at conventional 2 to 3 m depths below ground surface. No bearing problems are anticipated for pipes set on native inorganic subsoil. The bedding material may need to be thickened if subexcavation encounters soft or spongy soil from the base of the service trench.

Pipe bedding for water and sewer services should be conventional Class 'B' pipe bedding comprising a minimum 150 mm thick layer of OPSS Granular 'A' aggregate below the pipe invert. Granular 'A' type aggregate should be provided around the pipe to at least 300 mm above the pipe and the bedding aggregate should be compacted to a minimum 95% standard Proctor maximum dry density (SPMDD), as per the Blue Mountains Engineering Standards Manual, dated April 2009.

A well-graded clear stone such as Coarse Aggregate for HL4 Asphaltic Concrete (OPSS 1003) could be used in the sewer trenches as bedding below the spring line of the pipe to facilitate sump pump dewatering, if necessary. The clear stone should be compacted with a plate tamper.

5.3.3 Groundwater Cutoffs

The proposed alignment of the sewers could create a hydraulic connection between groundwater regimes that are not currently connected. To prevent the movement of water along the pipe bedding, it is recommended that concrete or clay cutoff collars be installed in areas of saturated sand (near Borehole BH102-18). The cutoffs should be 1 m long and in place of regular bedding material.

5.3.4 Trench Backfilling

The trenches above the specified pipe bedding should be backfilled with inorganic on-site soils placed in 300 mm thick lifts and compacted to at least 95% SPMDD. Wet or saturated native mineral soils are not considered suitable for reuse as trench backfill. Any additional material required at the site should comprise imported inorganic soils such as OPSS Select Subgrade Material.

To minimize potential problems, backfilling operations should follow closely after excavation so that only a minimal length of trench is exposed. Care should be taken to protect side slopes of excavations by diverting surface run-off away from the excavations. If construction extends into the winter, then additional steps should be taken to minimize frost and ensure that frozen material is not used as backfill.

5.4 Pavement Design

A full road reconstruction is proposed for Peel Street North and Bay Street West and it would involve removing the existing road structure materials and placement of new Granular ‘B’ subbase soils, Granular ‘A’ base soils and asphaltic concrete. The pavement subgrade soils will comprise compacted subgrade fill or existing granular subbase soils.

The pavement component thicknesses are recommended based on the proposed pavement usage, the frost-susceptibility and strength of the subgrade soils, and the Blue Mountains Engineering Standards Manual, dated April 2009;

TABLE 6 - PAVEMENT DESIGN

Pavement Component	Local Streets
Asphalt Hot Mix	90 mm
OPSS 1010 Granular ‘A’ Base	150 mm
OPSS 1010 Granular ‘B’ Subbase	450 mm

Samples of aggregates should be checked for conformance to OPSS 1010 prior to utilization on site and during construction. The Granular 'B' subbase and Granular 'A' base courses must be compacted to 100% SPMDD, as verified by insitu density testing.

The asphaltic concrete paving materials should conform to the requirements of OPSS 1150. The asphalt should be placed and compacted in accordance with OPSS 310. The Performance Graded Asphalt Cement designation for the asphaltic concrete is 58-28.

The asphaltic concrete should comprise 40 mm of HL3 surface over 50 mm of HL4 binder for local residential streets, as per the Blue Mountains Engineering Standards Manual, dated April 2009.

The pavement design is based on the assumption that construction will be carried out during the drier time of the year and that the subgrade soil is stable as determined by proof-rolling inspected by a Geotechnical Engineer. If the subgrade is wet and unstable, additional granular subbase will be required.

All materials and construction services required for the work should be in accordance with the relevant sections of the Ontario Provincial Standard Specifications.

It is **strongly recommended** to install subdrains beneath the low areas of pavement and connected to catchbasins. The purpose of the subdrains is to remove excess subsurface water in order to improve overall pavement serviceability and increase the pavement life. Consideration should be given to providing continuous subdrains along the perimeter edges of Peel Street North and Bay Street West to promote drainage of the granular materials.

The work of subdrain installation shall be in accordance with OPSS 405 and OPSD 216.021. The subdrain shall be 100 or 150 mm diameter perforated pipe conforming to OPSS 1801 or 1840, and wrapped with geotextile conforming to OPSS 1860.

5.5 Curbs and Gutter and Sidewalks

The concrete for curbs, gutters and sidewalks should be proportioned, mixed, placed and cured in accordance with the requirements of OPSS 353, and OPSS 1350 and shall meet the following specific requirements (OPSS 353.05.01), as per the Blue Mountains Engineering Standards Manual, dated April 2009:

- Minimum compressive strength = 30 MPa at 28 days
- Coarse aggregate = 19.0 mm nominal max. size
- Maximum slump = 60 mm for curb and gutter, 70 mm for sidewalks
- Air entrainment = 7.0 ± 1.5%

During cold weather, any freshly placed concrete must be covered with insulating blankets to protect against freezing as per OPSS 904. Three cylinders from each days pour should be taken for compressive strength testing. Air entrainment, temperature and slump tests should be conducted on the same batch of concrete from the test cylinders made.

5.6 Auxiliary Items

The necessity for continuous repair work and paving supervision as well as quality assurance testing during road reconstruction projects cannot be over emphasized. An annual maintenance program is also recommended to maintain the pavements at a suitable level.

All construction and maintenance work should be conducted during periods of favorable weather. The subgrade and subbase materials can be significantly damaged and loose internal strength if construction is conducted in unfavorable weather. The design recommendations made in this report are based on that all construction and maintenance work will be completed during favorable weather.

6.0 LIMITATIONS OF REPORT

Services performed by **MTE Consultants Inc.** (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Geotechnical Engineering & Consulting profession practicing under similar conditions in the same geographic area were the services are provided. No other warranty or representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of the Client. This report is not intended to be exhaustive in scope or to imply a risk-free site. As such, this report may not deal with all issues potentially applicable to the site and may omit aspects which are or may be of interest to the reader.

In addition, it should be recognized that a soil sample result represents one distinct portion of a site at the time it is collected, and that the findings of this report are based on conditions as they existed during the time period of the investigation. The material in the report reflects our best judgment using the information available at the time the report was written. The soil and groundwater conditions between and beyond the test holes may differ from those encountered in the test holes. Should subsurface conditions arise that are different from those in the test holes MTE should be notified to determine whether or not changes should be made as a result of these conditions.

It should be recognized that the passage of time may affect the views, conclusions and recommendations (if any) provided in this report because groundwater conditions of a property can change, along with regulatory requirements. All design details were not known at the time of submission of this report and it is recommended MTE should be retained to review the final design documents prior to construction to confirm they are consistent with our report recommendations. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may determine whether it affects the contents of this report.

Any use which another party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by another party as a result of decisions made or actions taken, based upon this report. Others with interest in the site should undertake their own investigations and studies to determine how or if the condition affects them or their plans. The contractors bidding on this project or undertaking the construction should make their own interpretation of the factual information and draw their own conclusions as to how subsurface conditions may affect their work.

The benchmark and elevations provided in this report are primarily established to identify differences between the test hole locations and should not be used for other purposes such as, planning, development, grading, and excavation.

Respectfully submitted,

MTE CONSULTANTS INC.

Ben Heinbuch, EIT
Senior Geotechnical Technician

MXW:dld

Montana Wilson, M.Eng. P.Eng. PMP
Civil and Geotechnical Division Manager

APPENDIX A

FIGURES

-ERI-L IM-GE FROM GOOGLE E-RTH

LOCATION PLAN

MTE Engineers | Scientists | Surveyors

Project Name
PEEL STREET NORTH AND BAY STREET WEST RECONSTRUCTION

Site	Client
PEEL STREET NORTH & BAY STREET WEST, BLUE MOUNTAINS, ON	TOWN OF THE BLUE MOUNTAINS

Scale. (8.5x11)	MTE Project No.	Date	Figure No.
N.T.S	44383-100	SEP.26.2018	1

FIGURE 2

LEGEND

BH101-18 BOREHOLE

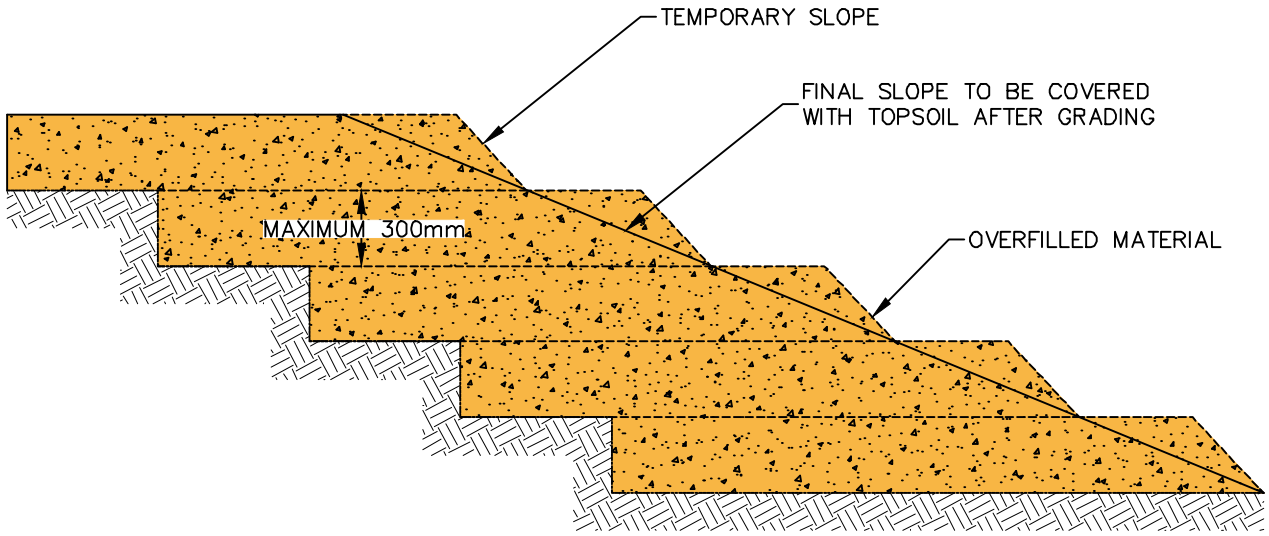
REFERENCES:

- MTE ENGINEERING CONLTANTS INC. DWG #44383-100-CP1. DATED SEPTEMBER 25, 2018.
- AERIAL IMAGE FROM GOOGLE EARTH

SITE PLAN

MTE Engineers | Scientists | Surveyors

Project Name			
PEEL STREET NORTH AND BAY STREET WEST RECONSTRUCTION			
Site		Client	
PEEL STREET NORTH & BAY STREET WEST, BLUE MOUNTAINS, ON		TOWN OF THE BLUE MOUNTAINS	
Scale (11x17)	MTE Project No.	Date	Figure No.
1:750	44383-100	SEP.26.2018	2



GENERAL REQUIREMENTS

1. THE SUBGRADE SHOULD BE INSPECTED AND APPROVED BY A GEOTECHNICAL ENGINEER PRIOR TO FILL CONSTRUCTION. FILL PLACEMENT AND COMPACTION OPERATIONS TO BE CARRIED OUT UNDER ENGINEERING SUPERVISION.

2. POOR SUBGRADE SOIL CONDITIONS OR GROUNDWATER SEEPAGE MAY REQUIRE SPECIAL DRAINAGE PROVISIONS, GEOTEXTILE FABRIC AND/OR GRANULAR FILL.

3 LIFTS SHOULD BE PLACED ONE LEVEL AT A TIME AND THE FILL COMPACTED BEFORE THE NEXT BENCHING LEVEL IS PLACED.

4 THE OVERFILL MATERIAL SHOULD BE EXCAVATED AND REUSED IF POSSIBLE.

5. THE FINISHED SLOPE SHOULD BE GRADED AT MAXIMUM 3H:1V AND COVERED WITH AT LEAST 200mm OF TOPSOIL IMMEDIATELY AFTER GRADING.

PEEL STREET NORTH AND BAY STREET WEST RECONSTRUCTION

FIGURE 3 Date: SEP.26.2018

FILL PLACEMENT FOR ROAD WIDENING

MTE
Engineers | Scientists | Surveyors

Project No.: 44383-100

October 2, 2018 1:08 p.m. Plotted By: cschaerer

APPENDIX B

BOREHOLE LOGS

Boreholes BH101-18 to BH105-18

ID Number: BH101-18

Project: Peel Street North and Bay Street West Reconstruction

Project No: 44383-100

Client: The Corporation of the Town of the Blue Mountains

Site Location: Peel Street North & Bay Street West, Blue Mountains, ON

Drill Date: 9/11/2018

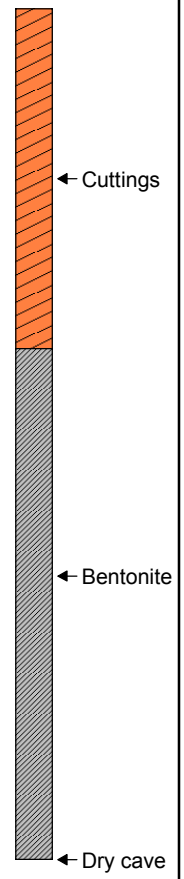
Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T Track

Drill Method: Hollow Stem Augers

Protective Cover: N/A

SUBSURFACE PROFILE				SAMPLE		Dynamic Cone / Standard Penetration	Shear Strength (PP) kPa / Shear Strength (FV) kPa	Water Content %	Groundwater Observations and Standpipe Details
Depth (ft / m)	Symbol	Soil Description	Elevation (masl) / Depth (m)	Number	Type	20 40 60 80	50 100 150 200	10 20 30	
0 / 0		Ground Surface	178.7						
		ROAD STRUCTURE Base: 305 mm, dense light brown sand and gravel, trace silt, moist	0.0 / 178.4	1	SS	38		3	
		Subbase: 455 mm, dense dark brown gravelly sand, some silt, moist	0.3 / 177.9						
2		**FILL** compact dark brown/grey silt, some clay and gravel, trace sand, very moist	0.8 / 177.2	2	SS	29		6	
4		**SILT TILL** dense grey sandy silt, some gravel, trace clay, very moist	1.5 / 176.4	3	SS	35		15	
6 / 2		dense grey gravelly silt, some clay and sand, very moist	2.3 / 175.7	4	SS	31	>200	15	
8		dense grey silt, some gravel and clay, trace sand, very moist	3.0 / 174.1	5	SS	45	>200	7	
10		hard grey clayey silt, trace sand and gravel, DTPL	4.6 / 173.5	6	SS	21	>200	17	
12 / 4		Drilling Terminated	5.2						
14									
16									
18									
20 / 6									



Borehole open and dry upon drilling completion

Field Technician: M. Dalgliesh

Drafted by: B. Heinbuch

Reviewed by: M. Wilson

MTE

Sheet: 1 of 1

ID Number: BH102-18

Project: Peel Street North and Bay Street West Reconstruction

Project No: 44383-100

Client: The Corporation of the Town of the Blue Mountains

Site Location: Peel Street North & Bay Street West, Blue Mountains, ON

Drill Date: 9/11/2018

Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T Track

Drill Method: Hollow Stem Augers

Protective Cover: N/A

Depth (ft / m)	Soil Description	Elevation (masl) / Depth (m)	Sample Number	Sample Type
0 / 0	Ground Surface	177.6		
	ROAD STRUCTURE Base: 305 mm, compact brown gravelly sand, some silt, very moist	0.0 / 177.3 / 0.3	1	SS
2	Subbase: 305 mm, compact light brown gravelly sand, trace silt, moist	177.0 / 0.6		
	FILL compact brown clayey silt, some sand, trace gravel, very moist	176.7 / 0.9	2	SS
4	**SAND** compact brown silty sand, trace gravel, saturated	176.1 / 1.5		
	compact grey sand and gravel, trace silt and clay, saturated	175.7 / 1.8	3	SS
6 / 2	compact grey fine sand, some silt, trace gravel, saturated	175.3 / 2.3		
8	compact grey fine silty sand, trace gravel, saturated		4	SS
10			5	SS
12 / 4				
14		173.0 / 4.6		
	150 mm clayey silt layer		6	SS
16	very dense medium coarse sand, some gravel, trace silt, saturated	172.6 / 5.0		
18	Drilling Terminated			
20 / 6				

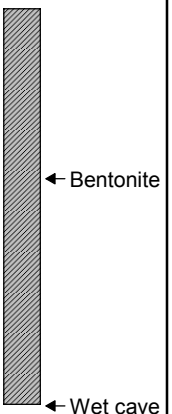
Number	Dynamic Cone / Standard Penetration	Shear Strength (PP) kPa	Shear Strength (FV) kPa	Water Content %
1	19			2
2	16			12
3	16			20
4	21			20
5	16			18
6	50/430mm			11

Standard Penetration: 20 40 60 80

Shear Strength (FV) kPa: 50 100 150 200

Water Content %: 10 20 30

Groundwater Observations and Standpipe Details



Water level at 1.52mbgs upon drilling completion

Field Technician: M. Dalgliesh

Drafted by: B. Heinbuch

Reviewed by: M. Wilson

MTE

Sheet: 1 of 1

ID Number: BH103-18

Project: Peel Street North and Bay Street West Reconstruction

Project No: 44383-100

Client: The Corporation of the Town of the Blue Mountains

Site Location: Peel Street North & Bay Street West, Blue Mountains, ON

Drill Date: 9/11/2018

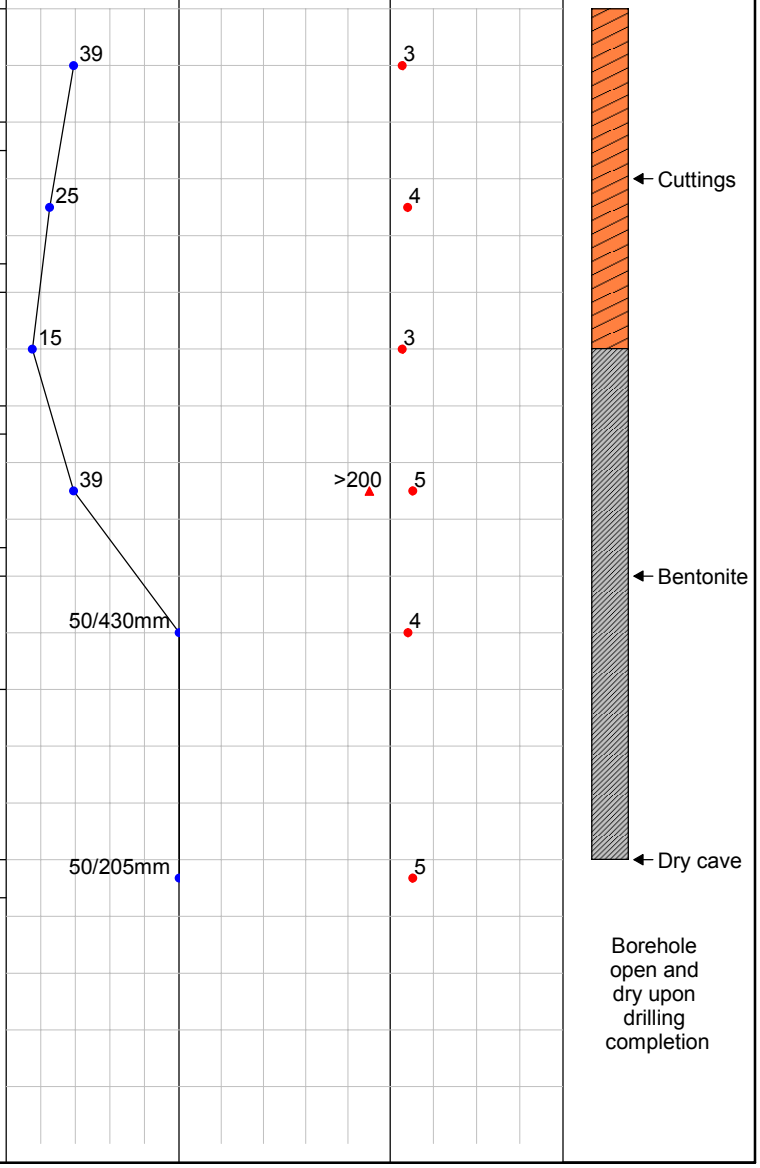
Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T Track

Drill Method: Hollow Stem Augers

Protective Cover: N/A

Depth (ft / m)	Soil Description	Elevation (masl) / Depth (m)	Sample Number	Sample Type
0 / 0	Ground Surface	187.8		
	ROAD STRUCTURE Base: 150 mm, dense light brown sand and gravel, trace silt, moist	0.0	1	SS
2	Subbase: 610 mm, dense dark brown gravelly sand, trace silt, moist	187.0		
	FILL compact dark brown silty sand and gravel, very moist	0.8	2	SS
4				
6 / 2		185.8	3	SS
	SILT TILL compact brown gravelly silt, some sand, very moist	2.0		
8		185.5		
	dense grey silt and sand, some gravel and clay, moist	2.3	4	SS
10		184.8		
	very dense grey sandy silt and gravel, trace clay, moist	3.0	5	SS
12 / 4				
14		183.2		
	very dense grey sandy silt, some gravel, trace clay, moist	4.6	6	SS
16	Drilling Terminated			
18				
20 / 6				



Field Technician: M. Dalgliesh

Drafted by: B. Heinbuch

Reviewed by: M. Wilson

MTE

Sheet: 1 of 1

ID Number: BH104-18

Project: Peel Street North and Bay Street West Reconstruction

Project No: 44383-100

Client: The Corporation of the Town of the Blue Mountains

Site Location: Peel Street North & Bay Street West, Blue Mountains, ON

Drill Date: 9/11/2018

Drilling Contractor: London Soil Test Ltd.

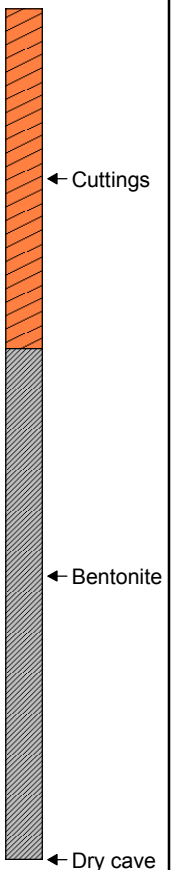
Drill Rig: D50T Track

Drill Method: Hollow Stem Augers

Protective Cover: N/A

Depth (ft / m)	Soil Description	Elevation (masl) / Depth (m)	Sample Number	Sample Type
	Ground Surface	190.3		
0 / 0	**ROAD STRUCTURE** Base: 150 mm, dense brown gravelly sand, some silt, moist	0.0	1	SS
	Subbase: 460 mm, dense light brown gravelly sand, some silt, moist	189.7 / 0.6		
	FILL dense dark brown sand and gravel, some silt, trace organics, moist	189.1 / 1.2	2	SS
4	dense brown gravelly silt, some clay, trace sand, very moist	188.8 / 1.5		
6 / 2	**SILT TILL** very dense light brown silt and gravel, some sand, trace clay, very moist		3	SS
	very dense light brown sandy silt and gravel, some sand, trace clay, very moist	188.0 / 2.3	4	SS
10	grey	187.3 / 3.0	5	SS
12 / 4				
14			6	SS
16	Drilling Terminated	185.5 / 4.8		
18				
20 / 6				

Sample Number	Standard Penetration (Dynamic Cone)	Shear Strength (PP) kPa	Shear Strength (FV) kPa	Water Content %
1	32			2
2	42			10
3	50/205mm		>200	9
4	50/380mm		>200	5
5	50/230mm			5
6	50/255mm			2



Borehole open and dry upon drilling completion

Field Technician: M. Dalgliesh

Drafted by: B. Heinbuch

Reviewed by: M. Wilson

MTE

ID Number: BH105-18

Project: Peel Street North and Bay Street West Reconstruction

Project No: 44383-100

Client: The Corporation of the Town of the Blue Mountains

Site Location: Peel Street North & Bay Street West, Blue Mountains, ON

Drill Date: 9/11/2018

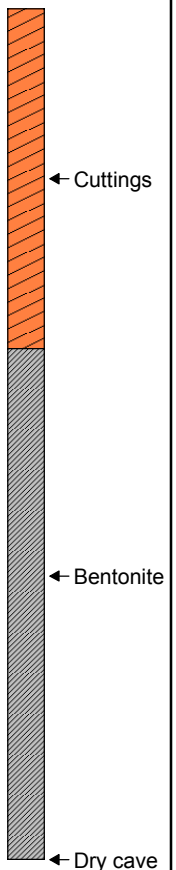
Drilling Contractor: London Soil Test Ltd.

Drill Rig: D50T Track

Drill Method: Hollow Stem Augers

Protective Cover: N/A

Depth (ft / m)	Symbol	Soil Description	Elevation (masl) / Depth (m)	Sample Number	Sample Type	Dynamic Cone / Standard Penetration	Shear Strength (PP) kPa	Shear Strength (FV) kPa	Water Content %
0 / 0		Ground Surface	195.1						
0 / 0		**ROAD STRUCTURE** Base/Subbase: 610 mm, dense brown silty sand and gravel, very moist	0.0 / 194.5	1	SS	34			6
2 / 0		**FILL** compact dark grey sandy silt, some gravel, very moist	0.6 / 193.6	2	SS	17			16
6 / 2		**SILT TILL** dense brown sandy gravelly silt, trace clay, very moist	1.5 / 192.8	3	SS	49			8
8 / 2		very dense brown sandy silt, some gravel, saturated	2.3	4	SS	77		>200	12
8 / 2		very dense grey gravelly silt, some sand, trace clay, very moist							9
10 / 2				5	SS	50/455mm		>200	6
14 / 4		moist	4.6 / 190.5	6	SS	50			9
16 / 4			189.9						
18 / 6		Drilling Terminated	5.2						
20 / 6									



Borehole open and dry upon drilling completion

Field Technician: M. Dalgliesh

Drafted by: B. Heinbuch

Reviewed by: M. Wilson

MTE

Sheet: 1 of 1

APPENDIX C

LABORATORY TEST RESULTS

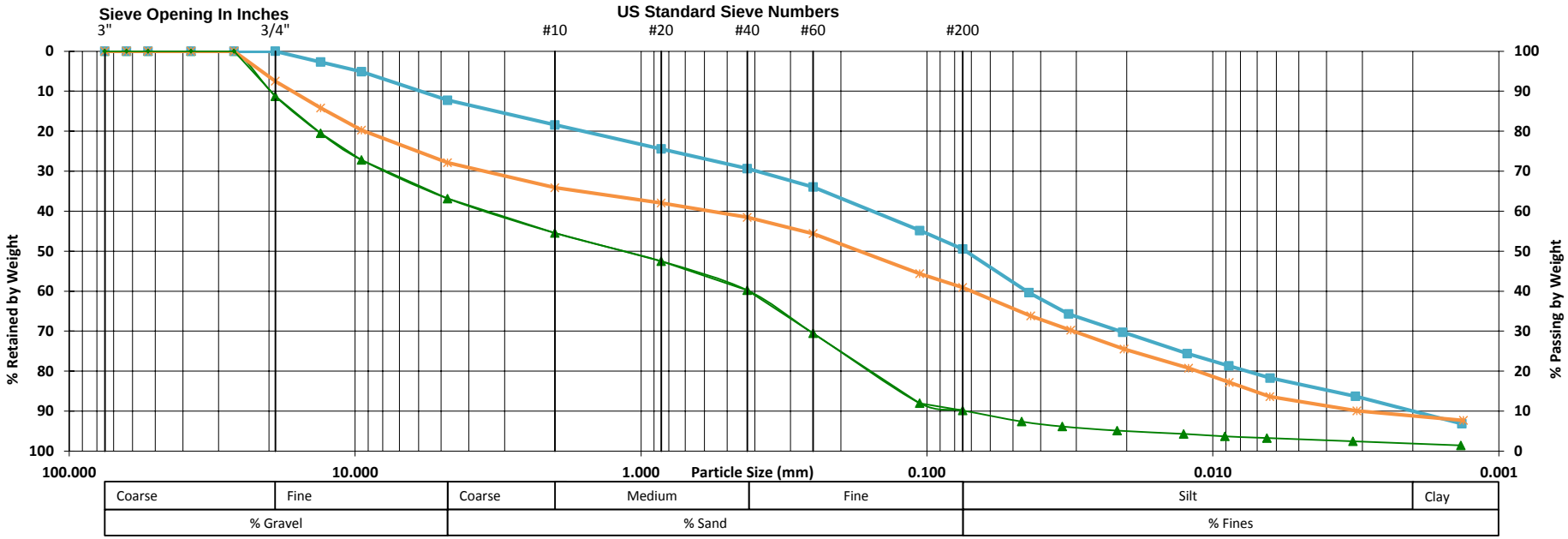
Tables 1 & 2

Particle Size Distribution Analysis Test Results

PROJECT NAME: Proposed Peel Street North Reconstruction **DATE SAMPLED:** September 11, 2018 **FILE No.:** 44383-100

CLIENT: The Town of the Blue Mountains **DATE TESTED:** September 24-26, 2018 **TABLE #:** 1

Unified Soil Classification



Symbol	Borehole ID	Sample #	*Sample Depth*	Description
▲	BH102-18	SS-3	1.52-1.83 mbgs	SAND and GRAVEL, trace Silt and Clay
■	BH103-18	SS-4	2.29-2.90 mbgs	SAND and SILT TILL, some Gravel and Clay
✳	BH105-18	SS-3	1.52-2.13 mbgs	Sandy Gravelly SILT TILL, trace Clay

CERTIFIED BY CCIL Canadian Council of Independent Laboratories
For specific tests as listed on www.ccil.com

NOTES:

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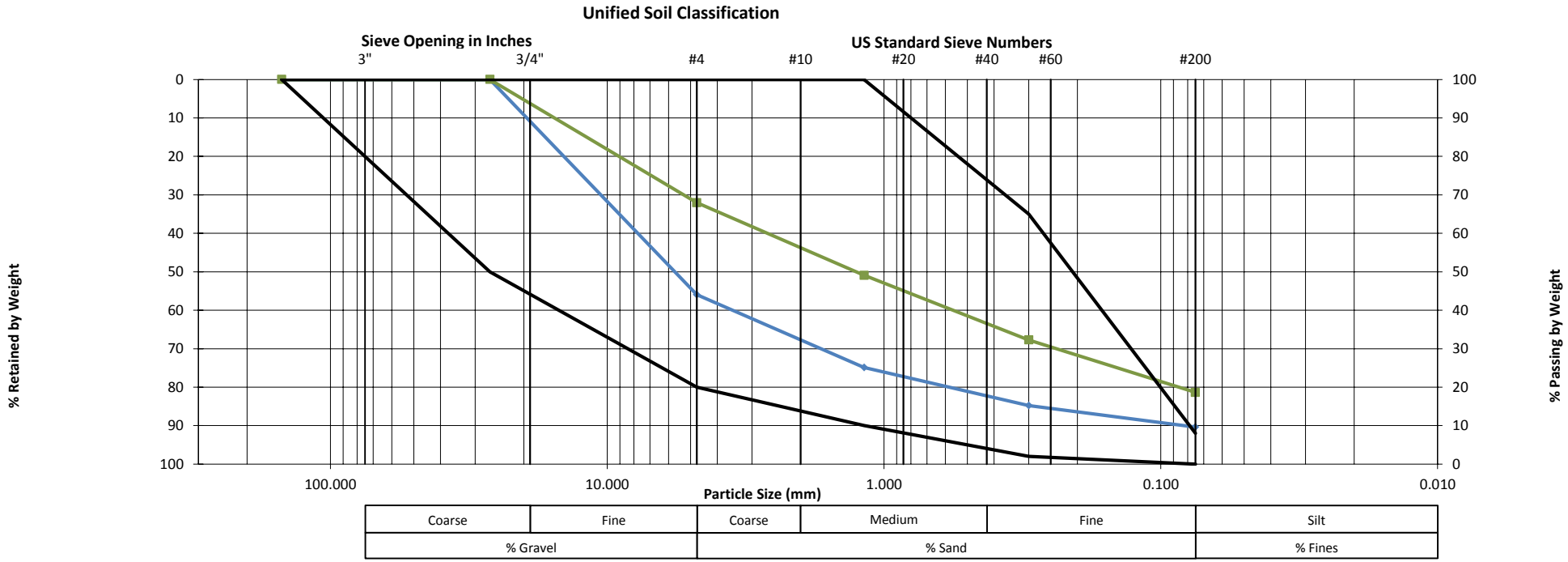
365 Home Street
Stratford, Ontario N5A 2A5
Phone: 519-271-7952
Fax: 519-271-3545
www.mte85.com

Particle Size Distribution Analysis Test Results

PROJECT NAME: Proposed Peel Street North Reconstruction
CLIENT: The Town of the Blue Mountains
DATE SAMPLED: September 11, 2018
DATE TESTED: October 1-2, 2018
FILE No.: 44383-100
TABLE #: 2



Black lines represent the acceptable ranges for % Passing by mass as per OPSS 1010 specifications for a Granular 'B' Type 1

Symbol	Borehole ID	Sample #	*Sample Depth*	Description
	BH101-18	SS-1	0.00-0.61 mbgs	SAND and GRAVEL, trace Silt
	BH104-18	SS-1	0.00-0.61 mbgs	Gravelly SAND, some Silt

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For specific tests as listed on www.ccil.com

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