APPENDIX B

• PARSONS

Geotechnical Investigation

Type of Document
DRAFT

Project Name
Geotechnical Investigation
Mill Street Class Environmental Assessment
Woodstock, ON

Project Number
KCH-00219274-GE

Prepared By:
exp Services Inc.
405 Maple Grove Road, Unit 6
Cambridge, ON N3E 1B6
Canada

Date Submitted
November, 2014

PARSONS

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Date Submitted:
November, 2014

Legal Notification

This report was prepared by exp Services Inc. for the account of **PARSONS.**

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

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1 Introduction and Background

Exp Services Inc. (**exp**) was retained by PARSONS to conduct a Geotechnical Investigation along Mill Street, from Dundas Street to Highway 401, in Woodstock, Ontario, hereinafter referred to as the 'site'. Authorization for **exp** to proceed with the Geotechnical Investigation was given by Mr. Stanley Pijl, P. Eng. on behalf of PARSONS.

Based on an interpretation of the factual test hole data and a review of soil and groundwater information from test holes advanced at the site, **exp** has provided a pavement condition assessment and pavement design information suitable for the future traffic loading.

1.1 Terms of Reference

The geotechnical investigation was generally done in general accordance with terms in our proposal dated April 15, 2014.

The purpose of the investigation was to determine the thickness of the pavement components along the above noted section of Mill Street and to identify the subgrade soil conditions, and to provide recommendations for rehabilitation strategies for the road section.

This report is provided on the basis of the terms of reference presented above and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning geotechnical aspects of the codes and standards, this office should be contacted to review the design.

The information in this report in no way reflects on the environmental aspects of the soil. Should specific information in this regard be needed, additional testing may be required.

2 Methodology

The drilling fieldwork for this investigation was carried out on October 8, 2014. During this time, eleven (11) sampled boreholes were advanced at the approximate locations shown on the attached Borehole Location Plans (Drawings 1 to 3). At the beginning of the project, eighteen borehole locations were designated as BH1 to BH 18 and were laid out. During the course of the project, boreholes between Athlone and Highway 401 were omitted. Additionally, because of high concentrations of underground utilities, or unknown conditions reported by the utilities, some other boreholes had to be omitted at the time of the drilling fieldwork. For reference, the locations of all the boreholes (drilled or not drilled) are shown on the Borehole Location Plans.

The boreholes were advanced to a depth of about 1.5 m below existing grade using a locally sub-contracted truck-mounted drill rig equipped with solid stem augers, soil sampling and soil testing equipment.

Within the boreholes, auger samples and visual assessment were used to determine the approximate thicknesses of the pavement structure components and the type of subgrade soils. During the drilling, the stratigraphy in the boreholes was examined and logged in the field by exp geotechnical personnel. Short-term groundwater level observations within the open boreholes and the natural moisture contents of recovered soil samples were recorded on the borehole logs.

The fieldwork was supervised by members of the **exp** technical staff who directed the drilling and sampling operations, and logged the samples. All samples recovered were transported to **exp**'s London laboratory for detailed examination and selective testing. Laboratory testing for this investigation consisted of routine moisture content determinations, with results presented on the attached Borehole Logs. Also, grain size analyses were conducted on selected samples to compare the existing material to Ontario Provincial Standard Specification (OPSS) for granular materials.

Samples remaining after the classification testing will be stored for a period of three months following the date of sampling (i.e., until January, 2015). After this time, they will be discarded unless prior arrangements have been made for longer storage.

The ground surface elevations of the boreholes were referenced to topographic plans.

3 Site and Subsurface Conditions

3.1 Site Description

The subject site is the section of Mill Street (Oxford County Road 12) from Dundas Street, to Highway 401. This road section is approximately 3.4 kilometres long and consists of two-lane and four-lane traffic. Development along Mill Street generally consists of commercial properties at the north end, with more new and older residential development to the south. Some vacant land, gravel pit and industrial properties are located along the southern part of the road section. Overall, the grade of Mill Street is increases from north the south, with some relatively flat stretches.

A review of available surficial geology maps indicates that beneath any fill, the predominant native deposits in the vicinity of the Site consist of outwash sand containing some gravel, or a silt to sandy silt till (reference Map 2281, Quaternary Geology, Woodstock, Southern Ontario, Ontario Division of Mines).

3.2 Soil Stratigraphy

The detailed stratigraphy encountered in the boreholes is detailed in the borehole logs found in Appendix B. The stratigraphy is summarized in the following paragraphs. It must be noted that boundaries of soil indicated in the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purposes of geotechnical design and should not be interpreted as exact planes of geological change.

3.2.1 Asphalt

Asphalt was encountered at surface at all borehole locations. The thickness of the asphalt was noted to range from about 100 to 230 mm. The thickest asphalt was noted at Boreholes 4 to 6, with a range in thickness from about 190 to 230 mm. In the remainder of the boreholes, (from Juliana Drive to Dundas Street) the thickness of the asphalt ranged from 100 to 130 mm.

3.2.2 Granular Fill

A layer of granular fill was encountered beneath the asphalt at all borehole locations. In general, the total thickness of this layer was noted to range from approximately 230 to 950 mm. At Borehole 6, this layer was noted to be at least 1800 mm and may be associated with service trench backfill at this location. In general, there was no visual distinctive base or sub-base layers within this granular fill.

The *in situ* moisture content of the granular fill is 2 to 5 percent, indicating damp to moist conditions. Composite samples from the boreholes were submitted for grain size analyses. The results, included in Appendix B, indicate that the overall composition of the granular fill is close to the requirements of OPSS Granular ‘B’ and could be re-used as such material. The samples, as tested, do not meet the gradation requirements for OPSS Granular ‘A’.

3.2.3 Fill

Beneath the granular material at Boreholes 4, 5, 9 to 15, and 18, a layer of fill was encountered to borehole termination depths. In general, the fill was found to consist of brown silty sand or sandy silt, having traces of gravel. The compactness condition of the subgrade fill was noted to generally be in a compact condition, based on visual assessment and augering. The *in situ* moisture content of the fill ranges from 7 to 13 percent, indicating moist conditions.

3.2.4 Peat

A layer of peat was encountered beneath the granular material at Boreholes 16 and 17. The thickness of this layer was noted to be about 400 to 450 mm. The peat was noted to be black, fibrous, and very loose. The *in situ* moisture content of the peat was up to 69 percent, confirming the organic nature of this material.

3.4.5 Silt

All Boreholes 16 and 17, silt was encountered beneath the peat, to borehole termination depths. In general, the silt was noted to be grey, loose, with traces of organic inclusions. The *in situ* moisture content of the silt is in the order of 25 percent.

3.3 Groundwater Conditions

Details of the groundwater conditions observed within the boreholes are provided on the attached Borehole Logs. Moisture contents of selected samples are also recorded on the attached Borehole Logs.

Upon completion of drilling and removing the augers, free water was not noted in any of the boreholes. It is noted that insufficient time was allowed for the measurement of the depth to the stabilized groundwater table prior to backfilling the boreholes.

3.4 Pavement Evaluation

A detailed site evaluation visit was conducted to examine the existing pavement conditions of Mill Street, between Highway 401 and Dundas Street. For the purpose of this evaluation, the road was sub-divided into three sections, and is described below. Photographs of each sub-divided section are included in Appendix D.

3.4.1 Section 1: Highway 401 to 0.7 km North

This section of the road was noted to have been recently paved and the Ride Condition Rating is Excellent. The overall condition of the pavement is noted as Good, with only some minor transverse cracking observed.

3.4.2 Section 2: 0.7 km North of Highway 401 to about 350 m south of Dundas Street

This section of the road has a Ride Condition Rating of Fair. A few surface defects such as severe ravelling and loss of aggregate were observed. Surface deformations such as rippling,

wheel track rutting, and distortion were noted to be slight, but found throughout the section. A few, slight to moderate longitudinal wheel tracking cracking was observed along the section. As well, frequent, single and multiple cracks were noted along the centre line of the road. The centre line also contained intermittent alligator cracks. Cracking along the pavement edges were noted to be frequent for moderated single and multiple cracks and to be intermittent and slight for alligator cracks. Severe transverse cracks were observed throughout the entire section As well, transverse cracks with a slight alligator pattern were frequently observed.

3.4.3 Section 3: Dundas Street, south 350 m

The Ride Condition Rating of this section was noted to be Poor. Surface defects such as ravelling and loss of aggregate were observed to very severe and frequent. Surface deformation in the form of wheel rutting was observed to be very slight throughout the section.

Slight Longitudinal Wheel Track cracking was observed at frequent intervals. Along the road centre line, slight single, multiple, and alligator cracks were observed at an intermittent to extensive frequency. Along the edge of the pavement, severe to very severe cracking was observed along an extensive length of this section. Severe transverse cracks (half, full, and multiple) were noted along an extensive length of this section. As well, severe transverse cracks with an alligator pattern were frequently observed. Intermittent and slight meander and midline cracks were also observed along this section.

4 Discussion and Recommendations

4.1 General

In general, the pavement conditions vary from one end of the road section to the other. The condition of the pavement is Excellent from about Athlone to Highway 401. The majority of the Mill Street section is considered to be in Fair condition, with a wide variety of crack patterns and frequency. The northernmost 350 m of the road section is considered to be in Poor condition, characterized by frequent, severe cracking. The presence of a peat layer beneath the granular base along this northern section is considered to be contributing factor to the condition of the pavement.

4.2 Rehabilitation Options

Pavement rehabilitation options for this study section of Mill Street include:

4.3 Pavement Design

5 General Limitations

The information presented in this report is based on a limited investigation designed to provide information to support an assessment of the current environmental conditions within the subject property. The conclusions and recommendations presented in this report reflect site conditions existing at the time of the investigation. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent. Should this occur, exp Services Inc. should be contacted to assess the situation, and the need for additional testing and reporting. **Exp** has qualified personnel to provide assistance in regards to any future geotechnical and environmental issues related to this property.

Our undertaking at exp, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the engineering profession. It is intended that the outcome of this investigation assist in reducing the client's risk associated with environmental impairment. Our work should not be considered 'risk mitigation'. No other warranty or representation, either expressed or implied, is included or intended in this report.

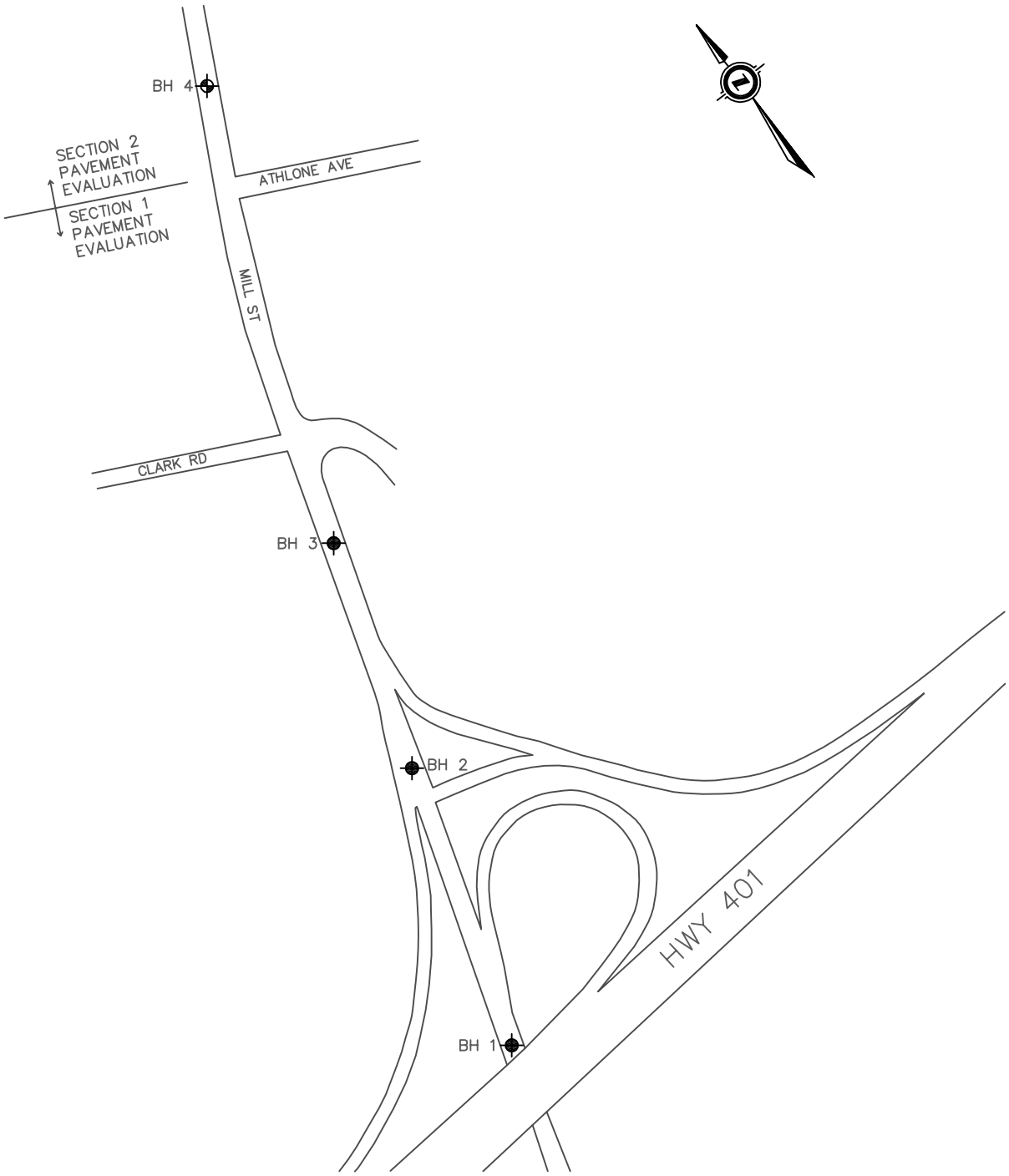
The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

Exp Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not afforded the privilege of making this review, **exp** Services Inc. will assume no responsibility for interpretation of the recommendations in this report

This report was prepared for the exclusive use of PARSONS and may not be reproduced in whole or in part, without the prior written consent of exp, or used or relied upon in whole or in part by other parties for any purposes whatsoever. Any use which a third party makes of this report, or any part thereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Appendix A – Drawings



BOREHOLE LOCATION PLAN

LEGEND

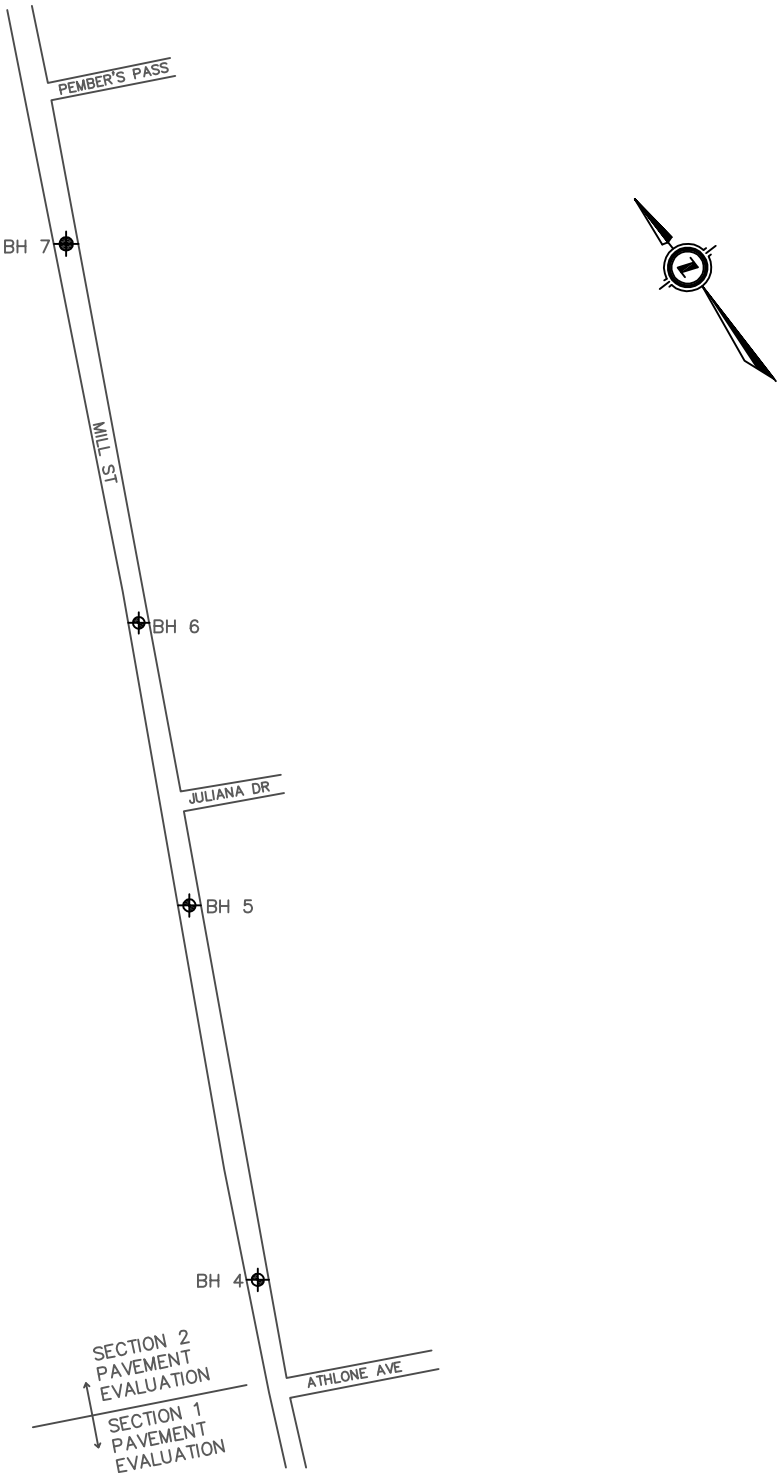
- Approximate Borehole Location (complete)
- Approximate Borehole Location (not drilled)

–NOTES–

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
2. Soil samples will be retained in storage for 3 months and then destroyed unless client advises that an extended time period is required.
3. Topsoil quantities should not be established from the information provided at the test hole locations.

PROJECT:	MILL STREET CLASS EA STUDY
PROJECT#:	KCH–00219274–GE
TITLE:	MILL STREET, WOODSTOCK, ON

DATE	SCALE	PREPARED BY:	DWG.
OCTOBER 2014	NOT TO SCALE	GF/CF	1



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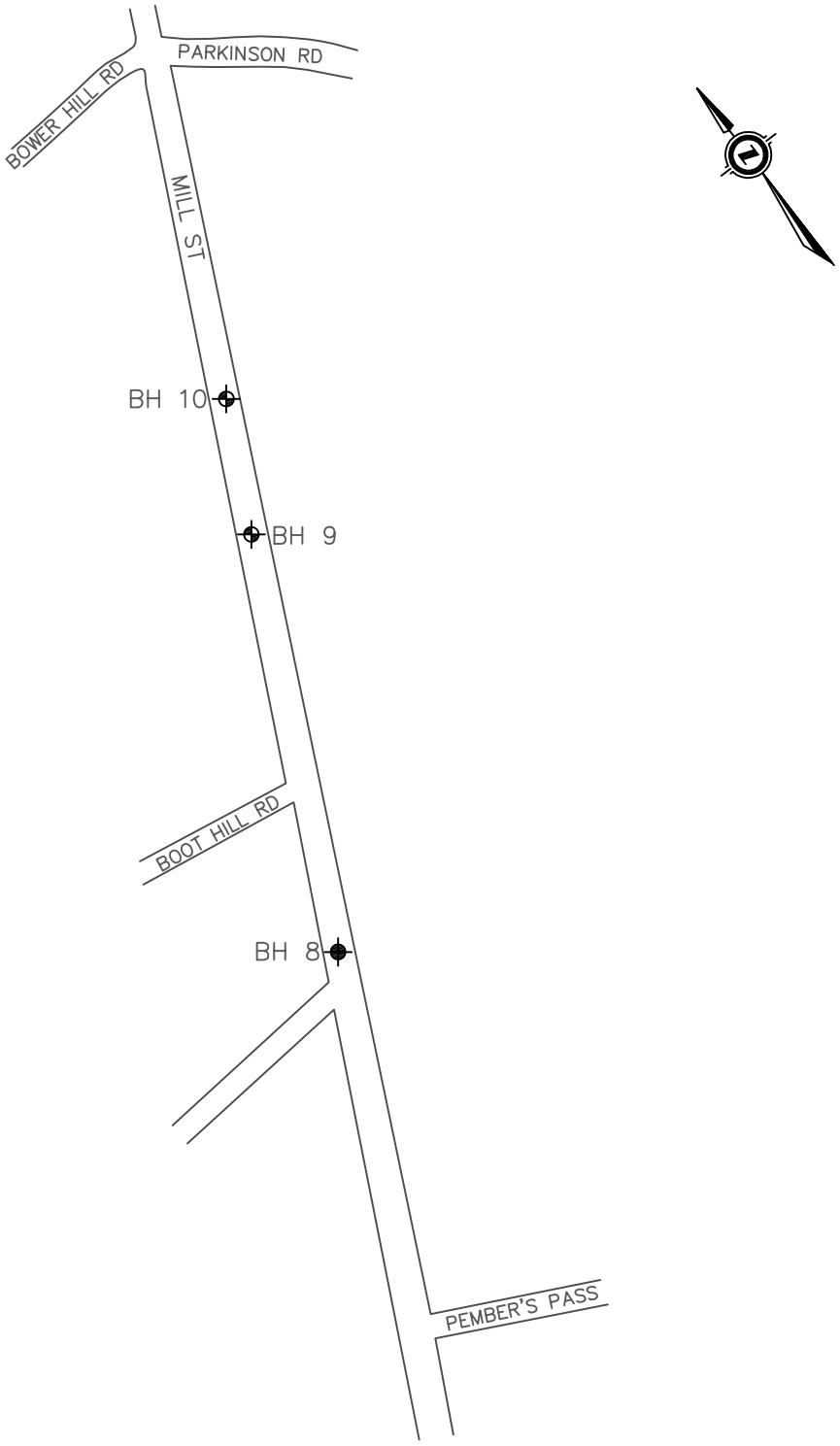
DATE	SCALE	PREPARED BY:	DWG.
OCTOBER 2014	NOT TO SCALE	GF/CF	2



BOREHOLE LOCATION PLAN

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DATE	SCALE	PREPARED BY:	DWG.
OCTOBER 2014	NOT TO SCALE	GF/CF	3

BOREHOLE LOCATION PLAN

LEGEND

- Approximate Borehole Location (complete)
- Approximate Borehole Location (not drilled)

–NOTES–

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
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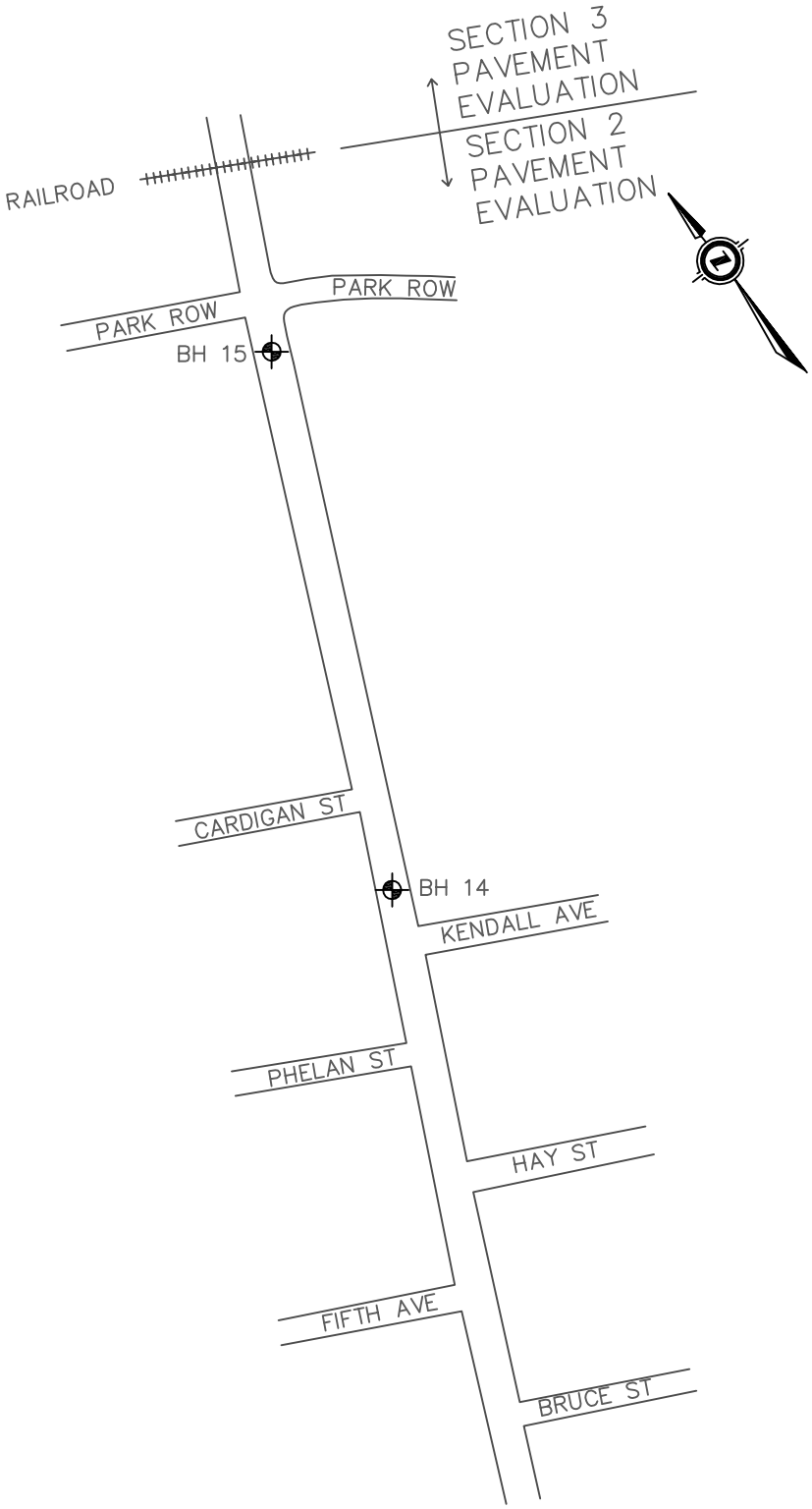
TITLE:	MILL STREET, WOODSTOCK, ON

DATE	SCALE	PREPARED BY:	DWG.
OCTOBER 2014	NOT TO SCALE	GF/CF	4



BOREHOLE LOCATION PLAN

LEGEND

- Approximate Borehole Location (complete)
- Approximate Borehole Location (not drilled)

–NOTES–

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
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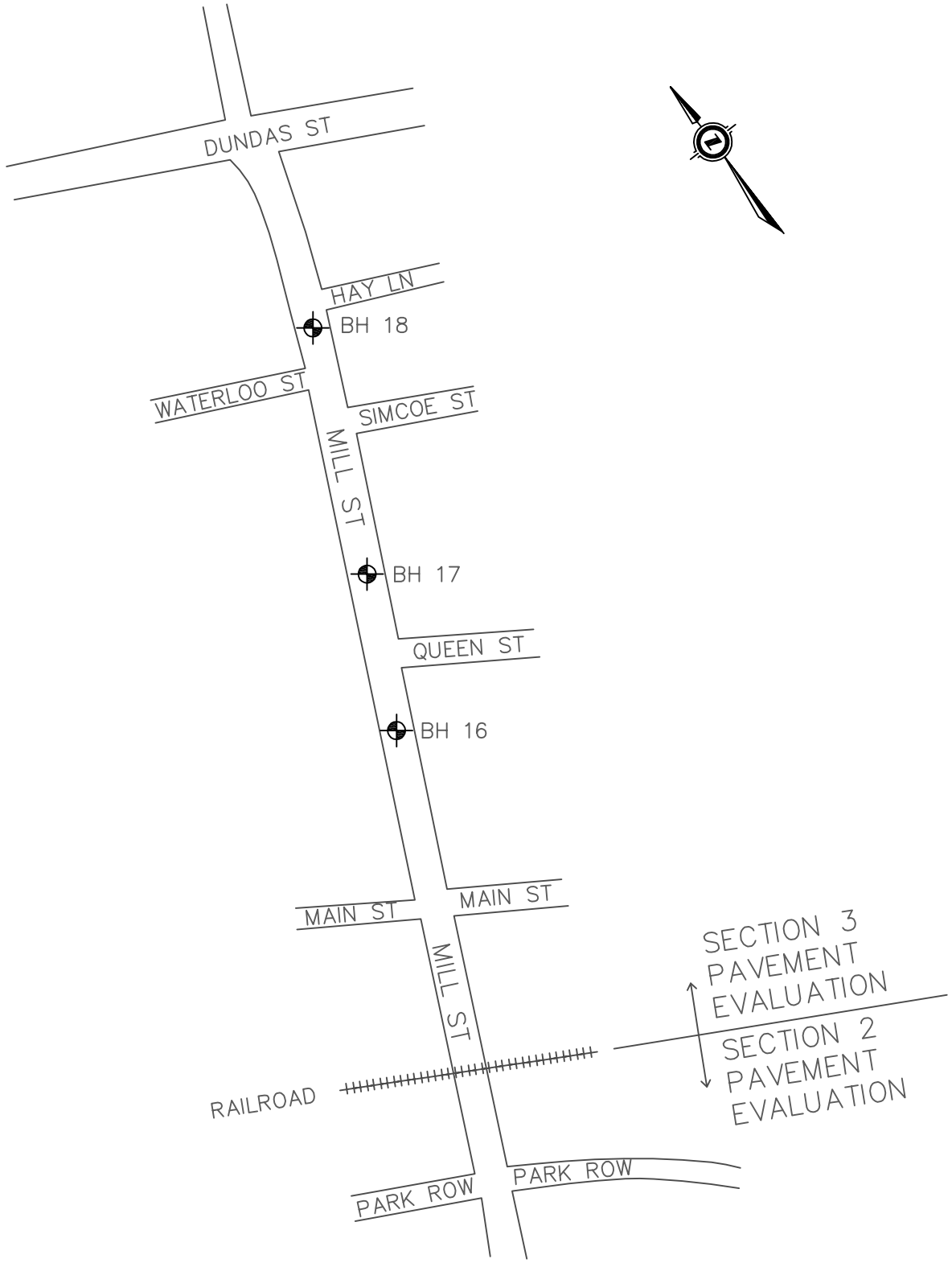
TITLE	MILL STREET, WOODSTOCK, ON

DATE	SCALE	PREPARED BY:	DWG.
OCTOBER 2014	NOT TO SCALE	GF/CF	5



BOREHOLE LOCATION PLAN

LEGEND

- Approximate Borehole Location (complete)
- Approximate Borehole Location (not drilled)

–NOTES–

1. The boundaries and soil types have been established only at borehole locations. Between boreholes they are assumed and may be subject to considerable error.
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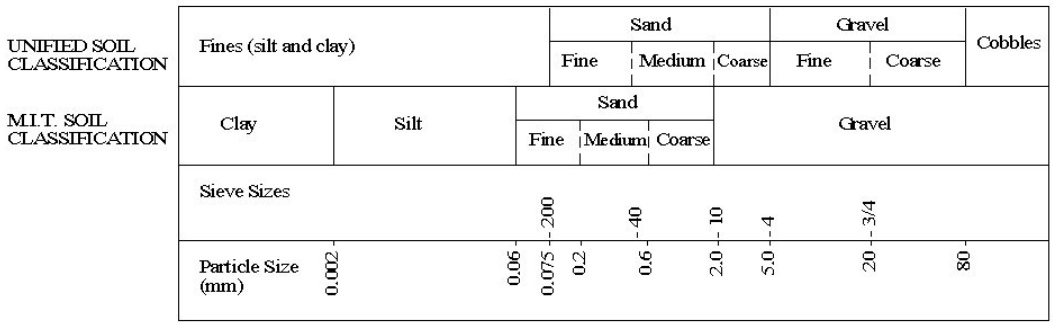
TITLE:	MILL STREET, WOODSTOCK, ON

DATE	SCALE	PREPARED BY:	DWG.
OCTOBER 2014	NOT TO SCALE	GF/CF	6

Appendix B – Borehole Logs

NOTES ON SAMPLE DESCRIPTIONS

1. All descriptions included in this report follow the 'modified' Massachusetts Institute of Technology (M.I.T.) soil classification system. The laboratory grain-size analysis also follows this classification system. Others may designate the Unified Classification System as their source; a comparison of the two is shown for your information. Please note that, with the exception of those samples where the grain size analysis has been carried out, all samples are classified visually and the accuracy of the visual examination is not sufficient to differentiate between the classification systems or exact grain sizing. The M.I.T. system has been modified and the **exp** classification includes a designation for cobbles above the 75 mm size and boulders above the 200 mm size.



2. **Fill**: Where fill is designated on the borehole log, it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description therefore, may not be applicable as a general description of the site fill material. All fills should be expected to contain obstructions such as large concrete pieces or subsurface basements, floors, tanks, even though none of these obstructions may have been encountered in the borehole. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact and correct composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. The fill at this site has been monitored for the presence of methane gas and the results are recorded on the borehole logs. The monitoring process neither indicates the volume of gas that can be potentially generated or pinpoints the source of the gas. These readings are to advise of a potential or existing problem (if they exist) and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic waste that renders the material unacceptable for deposition in any but designated land fill sites; unless specifically stated, the fill on the site has not been tested for contaminants that may be considered hazardous. This testing and a potential hazard study can be carried out if you so request. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common, but not detectable using conventional geotechnical procedures.

3. **Glacial Till**: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process, the till must be considered heterogeneous in composition and as such, may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm in diameter) or boulders (greater than 200 mm diameter) and therefore, contractors may encounter them during excavation, even if they are not indicated on the borehole logs. It should be appreciated that normal sampling equipment can not differentiate the size or type of obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited area; therefore, caution is essential when dealing with sensitive excavations or dewatering programs in till material.

BOREHOLE LOG

BH4
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	333.4									
	333.2	**ASPHALT:** ~ 230 mm thick								
		GRANULAR FILL: ~ 480 mm thick, sand and gravel, moist				S1				
	332.7									
1		**FILL:** Silty Sand, brown, some gravel, compact, moist				S2				
	331.9									
		End of Borehole at 1.52 m depth								
2										
3										
4										
5										

SHEAR STRENGTH
♣ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report KCH-00219274-GE. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH5
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	333.7								
	333.5	**ASPHALT:** ~ 220 mm thick							
		GRANULAR FILL: ~ 770 mm thick				S1			
1	332.7	**FILL:** Silty Sand, brown, some gravel, compact, moist				S2			
	332.2	**End of Borehole at 1.52 m depth**							
2									
3									
4									
5									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report KCH-00219274-GE. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH6
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	330.0									
	329.8	ASPHALT: ~ 190 mm thick								
	329.7	GRANULAR 'A'-TYPE FILL: ~ 140 mm								
		GRANULAR 'B'-TYPE FILL: ~ 1.80 m				S1				
1						S2				
2	327.9									
		End of Borehole at 2.13 m depth								
3										
4										
5										

SHEAR STRENGTH
♣ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report KCH-00219274-GE. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ⧗ Artesian (see Notes)

BOREHOLE LOG

BH9
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) or (%)	SAMPLES: N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	320.0						
	319.9	**ASPHALT:** ~ 115 mm thick					
		GRANULAR: ~ 630 mm thick		S1			
	319.3						
1		**FILL:** Sandy Silt, Some clay, brown, trace gravel, firm, moist		S2			
	318.5						
		End of Borehole at 1.52 m depth					
2							
3							
4							
5							

STRATA PLOT / WELL LOG

SHEAR STRENGTH
✚ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L

● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by exp before use by others. Borehole Logs must be read in conjunction with exp Report KCH-00219274-GE. For definition of terms used on logs, see sheets prior to logs.

2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

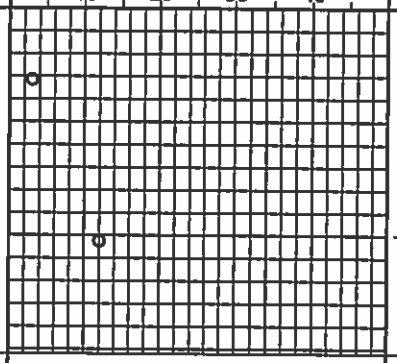
BH10
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	315.4								
	315.3	ASPHALT: ~ 100 mm thick							
		GRANULAR: ~ 430 mm thick				S1			
	314.9								
1		FILL: Sandy Silt, Some clay, brown, stiff, moist				S2			
	313.9								
		End of Borehole at 1.52 m depth							
2									
3									
4									
5									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40



NOTES

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2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ☑ SS Split Spoon ■ ST Shelby Tube
▣ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH11
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)	SHEAR STRENGTH / Atterberg Limits and Moisture
0	304.8									
	304.7	**ASPHALT:** ~ 125 mm thick								
		GRANULAR FILL: ~ 950 mm thick				S1				
1	303.7									
		FILL: Silty Sand, brown, some gravel, compact, moist				S2				
	303.3									
		End of Borehole at 1.52 m depth								
2										
3										
4										
5										

SHEAR STRENGTH
♣ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

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2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH14
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	301.1								
	301.0	**ASPHALT:** ~ 125 mm thick							
		GRANULAR FILL: ~ 680 mm thick				S1			
	300.3								
1		**FILL:** Sandy Silt, brown, some gravel, compact, moist				S2			
	299.6								
		End of Borehole at 1.52 m depth							
2									
3									
4									
5									

SHEAR STRENGTH
♣ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

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2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH15
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	285.6								
	285.5	**ASPHALT:** ~ 130mm thick							
		GRANULAR FILL: ~ 680 mm thick				S1			
	284.8								
1		**FILL:** Silty Sand, brown, some gravel, compact, moist				S2			
	284.1								
		End of Borehole at 1.52 m depth							
2									
3									
4									
5									

SHEAR STRENGTH
● S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

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2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▥ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

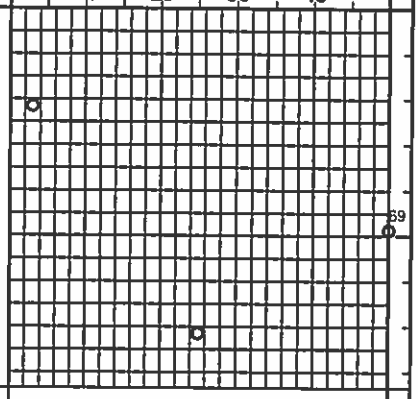
BH16
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) or (%)	SAMPLES: N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	283.5						
	283.4	**ASPHALT:** ~ 100 mm thick					
		GRANULAR FILL: ~ 660 mm thick		S1			
	282.7						
1		**PEAT:** Black, fibrous, very loose, very moist to wet		S2			
	282.3						
		SILT: Grey, trace organic inclusions, loose, very moist		S3			
	281.8						
		End of Borehole at 1.67 m depth					
2							
3							
4							
5							

SHEAR STRENGTH
♣ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 — 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40



NOTES

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2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH17
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLES: TYPE	SAMPLES: NUMBER	SAMPLES: RECOVERY (mm) or (%)	SAMPLES: N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	284.4						
	284.3	**ASPHALT:** ~ 125 mm thick					
		GRANULAR FILL: ~ 780 mm thick		S1			
	283.5						
1		**PEAT:** Black, fibrous, very loose, very moist to wet		S2			
	283.1						
		SILT: Grey, trace organics, loose, very moist		S3			
	282.6						
2		**End of Borehole at 1.82 m depth**					
3							
4							
5							

STRATA PLOT — WELL LOG

SHEAR STRENGTH
♣ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

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2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH18
Sheet 1 of 1

PROJECT Mill Street Class EA Study, Woodstock, ON — PROJECT NO. KCH-00219274-GE
CLIENT Parsons — DATUM Geodetic
DRILL TYPE/METHOD Solid Stem Augers — DATES: Boring October 8, 2014 — Water Level

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	PENETROMETER (kPa)
0	286.5								
	286.4	**ASPHALT**: ~ 125 mm thick							
		GRANULAR FILL: ~ 630 mm thick				S1			
	285.7								
1		**FILL**: Sand, brown, some silt, trace gravel, compact, moist				S2			
	285.0								
		End of Borehole at 1.52 m depth							
2									
3									
4									
5									

SHEAR STRENGTH
♣ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES

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2) Borehole open and dry upon completion.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ▣ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

Appendix C –
Grain Size Analysis

LABORATORY TEST RESULTS

exp Services Inc.

15701 Robin's Hill Road, Unit 2
London, ON N5V 0A5
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fax: 519.963.1152

405 Maple Grove Rd., Unit 6
Cambridge, ON N3E 1B6
tel: 519.650.4918
fax: 519.650.4603

2199 Blackacre Drive, Unit 600
Oldcastle (Windsor), ON N0R 1L0
tel: 519.737.0588
fax: 519.737.0751

265 Front Street North, Suite 411N
Sarnia, ON N7T 7X1
tel: 519.332.1550
fax: 519.332.5662

Project Number: KCH00219274

Project Name: Mill Street, Woodstock, Ontario - Class EA Study

Sampled by: S. Hamilton

Sample Description: Granular A

Sampling Date: Oct 08, 2014

Sample Source: Boreholes 4, 5, 6, 8, 9 and 10

Lab Sample No.: 14141

Sample Location: -

Date Tested: Oct 16, 2014

GRADATION		
Sieve Size	Percent Passing	
	Specification	Sample
26.5 mm	100	98.0 #
19.0 mm	85 - 100 (87 - 100)*	95.6
13.2 mm	65 - 90 (75 - 95)*	90.9 #
9.5 mm	50 - 73 (60 - 83)*	83.5 #
4.75 mm	35 - 55 (40 - 60)*	67.6 #
1.18 mm	15 - 40	44.9 #
300 µm	5 - 22	28.1 #
150 µm	-	23.1
75 µm	2 - 8 (2 - 10)**	19.0 #
Percent Crushed	60% min.	89.1
Asphalt Content (RAP)	30% max.	-

Comments: OPSS Granular 'A'

* where the aggregate is obtained from an iron blast furnace slag source.

** where the aggregate is obtained from a quarry or blast furnace slag or nickel slag source.

The sample gradation is outside of the specified range on the 26.5 mm, 13.2 mm, 9.5 mm, 4.75 mm, 1.18 mm, 0.300 mm and 0.075 mm sieves to meet OPSS Granular A.

Distribution:

Parsons - Stanley Pijl stanley.pijl@parsons.com

G. Fournier

exp Services Inc.
Geotechnical Division

LABORATORY TEST RESULTS

exp Services Inc.

15701 Robin's Hill Road, Unit 2
London, ON N5V 0A5
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fax: 519.963.1152

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tel: 519.737.0588
fax: 519.737.0751

265 Front Street North, Suite 411N
Sarnia, ON N7T 7X1
tel: 519.332.1550
fax: 519.332.5662

Project Number: KCH00219274

Project Name: Mill Street, Woodstock, Ontario - Class EA Study

Sampled by: S. Hamilton

Sample Description: Granular B

Sampling Date: Oct 08, 2014

Sample Source: Boreholes 4, 5, 6, 8, 9 and 10

Lab Sample No.: 14141

Sample Location: -

Date Tested: Oct 16, 2014

GRADATION		
Sieve Size	Percent Passing	
	Specification	Sample
150 mm	100	100.0
53.0 mm	-	100.0
37.5 mm	-	100.0
26.5 mm	50 - 100	98.0
19.0 mm	-	95.6
13.2 mm	-	90.9
9.5 mm	-	83.5
4.75 mm	20 - 100	67.6
1.18 mm	10 - 100	44.9
300 µm	2 - 65	28.1
150 µm	-	23.1
75 µm	0 - 8 (0 - 10)*	19.0 #
Amount of Asphalt Coated Particles in Coarse Aggregate	30% max.	-

Comments: OPSS Granular 'B' Type I * where the aggregate is obtained from a quarry or blast furnace slag or nickel slag source. The sample gradation is outside of the specified range on the 0.075 mm sieves to meet OPSS Granular B.

Distribution:

Parsons - Stanley Pijl stanley.pijl@parsons.com

G. Fournier

exp Services Inc.
Geotechnical Division

LABORATORY TEST RESULTS

exp Services Inc.

15701 Robin's Hill Road, Unit 2
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tel: 519.737.0588
fax: 519.737.0751

265 Front Street North, Suite 411N
Sarnia, ON N7T 7X1
tel: 519.332.1550
fax: 519.332.5662

Project Number: KCH00219274

Project Name: Mill Street, Woodstock, Ontario - Class EA Study

Sampled by: S. Hamilton

Sample Description: Granular B

Sampling Date: Oct 08, 2014

Sample Source: Borehole 6, Sample 2

Lab Sample No.: 14142

Sample Location: -

Date Tested: Oct 16, 2014

GRADATION		
Sieve Size	Percent Passing	
	Specification	Sample
150 mm	100	100.0
53.0 mm	-	97.7
37.5 mm	-	91.6
26.5 mm	50 - 100	87.8
19.0 mm	-	81.4
13.2 mm	-	73.3
9.5 mm	-	65.1
4.75 mm	20 - 100	49.4
1.18 mm	10 - 100	29.0
300 µm	2 - 65	17.7
150 µm	-	14.5
75 µm	0 - 8 (0 - 10)*	12.0 #
Amount of Asphalt Coated Particles in Coarse Aggregate	30% max.	-

Comments: OPSS Granular 'B' Type I * where the aggregate is obtained from a quarry or blast furnace slag or nickel slag source. The sample gradation is outside of the specified range on the 0.075 mm sieve to meet OPSS Granular B.

Distribution:

Parsons - Stanley Pijl stanley.pijl@parsons.com

G. Fournier

exp Services Inc.
Geotechnical Division

Appendix D –
Pavement Evaluation Notes and Photographs

Photograph 1: Looking south, to Highway 401.

Photograph 2: Looking across lanes of Section 1.

Photograph 3: General pavement condition along Section 1.

Photograph 4: Looking north on Section 1.

Photograph 5: Section 2 (near BH 4) transverse cracking.

Photograph 6: Alligator cracking along pavement edge, Section 2.

Photograph 7: Section 2, transverse and longitudinal cracking.

Photograph 8: Conditions along pavement edge, Section 2.

Photograph 9: Section 3, transverse and longitudinal cracking.

Photograph 10: Conditions along pavement edge and transverse crack, Section 3.

Photograph 11: Section 3, general pavement conditions near Queen Street.

Photograph 12: Severe cracking along Section 3.