APPENDIX E
Geotechnical Study

THURBER ENGINEERING LTD.

August 10, 2023 File No.: 25025

Matrix Solutions Inc.
Unit 7B, 650 Woodlawn Rd W
Guelph, ON N1K 1B8

Attention: Amanda McKay, P.Eng., PMP

EXPANDED GEOTECHNICAL DESKTOP STUDY
DIXIE-DUNDAS FLOOD MITIGATION
MISSISSAUGA, ONTARIO

Dear Ms. McKay:

Thurber Engineering Ltd. (Thurber) has been retained by Matrix Solutions Inc. (Matrix) to undertake an expanded geotechnical desktop study of the Little Etobicoke Creek as part of the overall Dixie-Dundas Flood Mitigation project in Mississauga, Ontario. Authorization to proceed with the desktop study was received via email on June 15, 2021 from Mr. Andrew Doherty of Matrix.

Activities carried out in association with this geotechnical desktop study consisted of the following:

- A review of available information from the Ontario Ministry of Transportation (MTO) Foundation Library service (i.e. Geocres) as well as available geologic mapping;
- Site visits in order to assess the site conditions within the study area, including existing slopes, creekbanks and pavements; and
- Preparation of a geotechnical desktop study report providing preliminary geotechnical recommendations for slope/creek stabilization and bridge design as well as recommendations for further work during detailed design.

Use of this letter is subject to the Statement of Limitations and Conditions, which is included at the end of this document.

1. BACKGROUND

The project site encompasses Little Etobicoke Creek and originally included 500 m upstream of the Dixie Road bridge to the north edge of the Dundas Street East bridge. We understand that the project limits have been expanded to include the Dundas Street East bridge and up to 300 m downstream of the Dundas Street East bridge.

The existing Dixie Road Bridge structure is located about 375 m north of Dundas Street East. The existing structure is a single span bridge that carries Dixie Road over Little Etobicoke Creek. The creek flows in a southerly direction towards Lake Ontario. The Dundas Street East Bridge is located approximately 550 m east of Dixie Road.

The purpose of the flood mitigation study is to provide a comprehensive flood remediation plan for the site. The first stage will be a feasibility investigation to narrow down viable technical solutions that could be implemented to remove the flood spill. The second stage will be to undertake the Municipal Class Environmental Assessment (EA) process culminating in a preferred solution. The third stage will be to complete the detailed design and permitting for the preferred solution. Our geotechnical desktop study was carried out as part of the work for the first stage.

It is understood that the preferred conceptual flood mitigation solution will include the following:

- Replacement of the existing Dixie Road bridge
- Replacement of the existing Dundas Street East bridge
- Potential lowering of the Little Etobicoke Creek bottom between 0 and 1 m at the Dixie Road bridge area
- Channel stabilization works

2. SITE DESCRIPTION

The project site encompasses Little Etobicoke Creek and extends 500 m upstream of the Dixie Road bridge to 300 m downstream of the Dundas Street East bridge (see Site Plan Sketch following the text of this letter). The existing Dixie Road bridge is located approximately 350 m north of Dundas Street East. The existing Dundas Street East bridge is located approximately 550 m east of Dixie Road. For project purposes, Dundas Street East will be considered to be oriented east-west and Dixie Road will be considered to be oriented north-south.

Existing land use adjacent to the Little Etobicoke Creek within the project site consists of residential, commercial and industrial buildings as well as parking lots.

3. BACKGROUND STUDY AND SITE RECONNAISSANCE

3.1 Existing Information

Thurber reviewed the following historical foundation report that is available within the online Geocres Library:

1. Foundation Investigation for Dixie Creek Culvert Extension, Highway No. 5, Ontario, dated February 4, 1957, Racey, Maccallum and Associates Limited [Geocres 30M11-169]

Based on the 1957 report, bedrock consisting of grey shale with limestone interbeds was encountered at a depth of approximately 3.0 m below the creek level.

3.2 Site Geology

The project site is situated within the physiographic region known as the Iroquois Plain (Chapman and Putnam, 1984). The Iroquois Plain extends south to Lake Ontario and the area is a complex mix of till plains, drumlins and areas of glaciolacustrine sediments deposited in Lake Iroquois.

Based on the Ontario Geological Survey Map 2544 “Bedrock Geology of Ontario, Southern Sheet” (Ontario Geological Survey, 1991), the bedrock in the area of the project site is reported to consist of shale belonging to the Georgian Bay Formation.

3.3 Site Reconnaissance

An initial site visit was carried out by Thurber on June 6, 2019, and a supplemental site visit was carried out on June 24, 2021 for the expanded project limits south of Dundas Street East. Observations of the general slope inclinations, vegetation, soil types, seepage and general stability conditions at the project site were noted. Select site photographs taken during the site visits are included at the end of this letter. Our observations are summarized below:

- The existing Dixie Road bridge is a single span structure with an approximate length of 55 m and a width of 30 m. The bridge structure carries six lanes of Dixie Road as well as an additional southbound left-turn lane over Little Etobicoke Creek. Sidewalks are present on both sides of the bridge. Steel beam guiderails are present at three of the quadrants of the bridge.
- The pavement condition over the Dixie Road bridge and along the north approach is considered to be in good condition with few areas of visible distress. The pavement condition along the south approach is considered to be in fair to poor condition with frequent wheelpath, transverse and construction joint cracking of slight to moderate severity.
- The existing Dundas Street East bridge is a single span structure with an approximate length of 32 m and a width of 28 m. The bridge structure carries six lanes of Dundas Street East over Little Etobicoke Creek. Sidewalks are present on both sides of the bridge. Steel beam guiderails are present at all four quadrants of the bridge.
- The pavement condition over the Dundas Street East bridge is considered to be in good condition with few areas of visible distress. The pavement condition along the east and west approaches is considered to be in fair condition with frequent wheelpath, transverse and construction joint cracking of slight to moderate severity.
- Two concrete stormwater outfall structures with armourstone drop-spillways were observed, one approximately 7 m and another about 390 m downstream (east) of the existing Dixie Road Bridge.
- Two pedestrian bridges crossing the creek were observed, one approximately 185 m and one approximately 385 m upstream (west) of the existing Dixie Road bridge.
- The existing slopes adjacent to the creek have overall inclinations of about 2 horizontal to 1 vertical (2H:1V) from approximately 500 m upstream to 50 m downstream of the existing Dixie Road bridge. Steeper slopes were observed along the west bank opposite Willowcreek Park and near vertical slopes were noted along the east bank behind Eddies Meat Market or approximately 40 m upstream (north) of the existing Dundas Street East bridge. Near vertical slopes were also noted along the east bank approximately 300 m downstream of the existing Dundas Street East bridge.
- Three to four rows of armourstone with near vertical slopes were observed on both sides of the creek) from approximately 500 m upstream to 50 m downstream of the existing Dixie Road bridge. Armourstone was not observed along portions of the creek approximately 390 m downstream (east) of the existing Dixie Road Bridge, along

Willowcreek Park and behind Eddies Meat Market. Significant toe erosion was noted at these locations.

- Localized toe erosion/undermining along the west bank was observed approximately 300 m downstream of the existing Dundas Street East bridge.
- The existing slopes adjacent to the creek within the project site are predominantly heavily vegetated with mature trees and brush, except at areas of toe erosion as noted above.
- Multiple downed trees were observed within the project site.
- The creek flows in a southerly direction towards Lake Ontario.
- The creek bed generally consists of fluvial deposits consisting of sand and gravel with cobbles and boulders with potential slabs of shale bedrock.

4. DISCUSSION AND RECOMMENDATIONS

4.1 Preliminary Recommendations for Slope/Creek Stabilization

It is anticipated that the existing slopes on either side of the creek within the project site consist of native soil and/or earth fill overburden. A site investigation and field testing program should be carried out during the design process to establish the soil stratigraphy. The existing slopes adjacent to the creek within the project site appear to be stable except at areas with steeper slopes and/or toe erosion near Goldmar Drive, along Willowcreek Park and behind Eddies Meat Market. The existing slopes are predominantly heavily vegetated except at areas of toe erosion as noted previously.

Design for creek widening will result in cutting back the slopes into the existing overburden. Similar erosion protection measures will be required for new slopes if the existing creek is widened (i.e. armourstone walls, vegetation, etc.).

On a preliminary basis, new cut or fill slopes can be designed with an inclination of 3H:1V, or flatter. Where earth fill is to be placed, it should be placed in maximum 200 mm thick lifts and should be compacted to at least 95 percent of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

All excavation must be carried out in accordance with the requirements of the Occupational Health & Safety Act & Regulations (OHSA) for Construction Projects. At locations where there are space restrictions or where a slope has to be retained, the excavations will need to be carried out within a temporary protection system.

Excavated soils should be properly managed and disposed in accordance with applicable regulations. Assessment of the quality of soils to remain on site or to be used as clean fill off site should be conducted in accordance with Ontario Regulations, including the generic soil quality standards presented in new Ontario Regulation (O. Reg.) 406/19, as amended, "On-Site and Excess Soil Management". Where impacted soils are encountered, they must be handled as waste under the requirements of O. Reg. 347.

Assessment of the dewatering requirements and the need for a Permit to Take Water (PTTW) should be carried out in support of detailed design.

4.2 Preliminary Structure Foundation Alternatives

It is anticipated that the most likely foundation options to support the new Dixie Road and Dundas Street East bridges are:

- Spread footings
- Driven piles
- Caissons

Once load demands are provided and the site investigation and field testing program is carried out, viable foundation options can be assessed.

5. RECOMMENDATIONS FOR FURTHER WORK

A site investigation and field testing program should be carried out during the design process to establish the soil stratigraphy. At a minimum, the borehole program should consist of the following:

- 2 BHs at each foundation element advancing to a minimum of 3 m below refusal (if bedrock is encountered, a minimum of 50% of boreholes should be cored for a minimum depth of 3 m)
- 1 BH at each bridge approach embankment within 20 m of the abutment, advancing to 3 m into a competent stratum or 10 m below the base of the fill, whichever is less
- BHs along the creek banks at an approximate spacing of 50 m, advancing to 3 m into a competent stratum
- 6 BHs (1.5 m deep) for pavement design at each bridge

6. CLOSURE

We trust this information meets your present needs. If you have any questions, please contact the undersigned at your convenience.

Yours truly,
Thurber Engineering Ltd.

Michael Eastman, P.Eng.
Geotechnical Engineer

Renato Pasqualoni, P.Eng.
Review Principal

Attachments

- Statement of Limitations and Conditions
- Site Plan Sketch
- Site Photographs
- Existing Information (Geocres 30M11-169)

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

2. COMPLETE REPORT

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

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

3. BASIS OF REPORT

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

4. USE OF THE REPORT

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

5. INTERPRETATION OF THE REPORT

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

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

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

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

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

7. INDEPENDENT JUDGEMENTS OF CLIENT

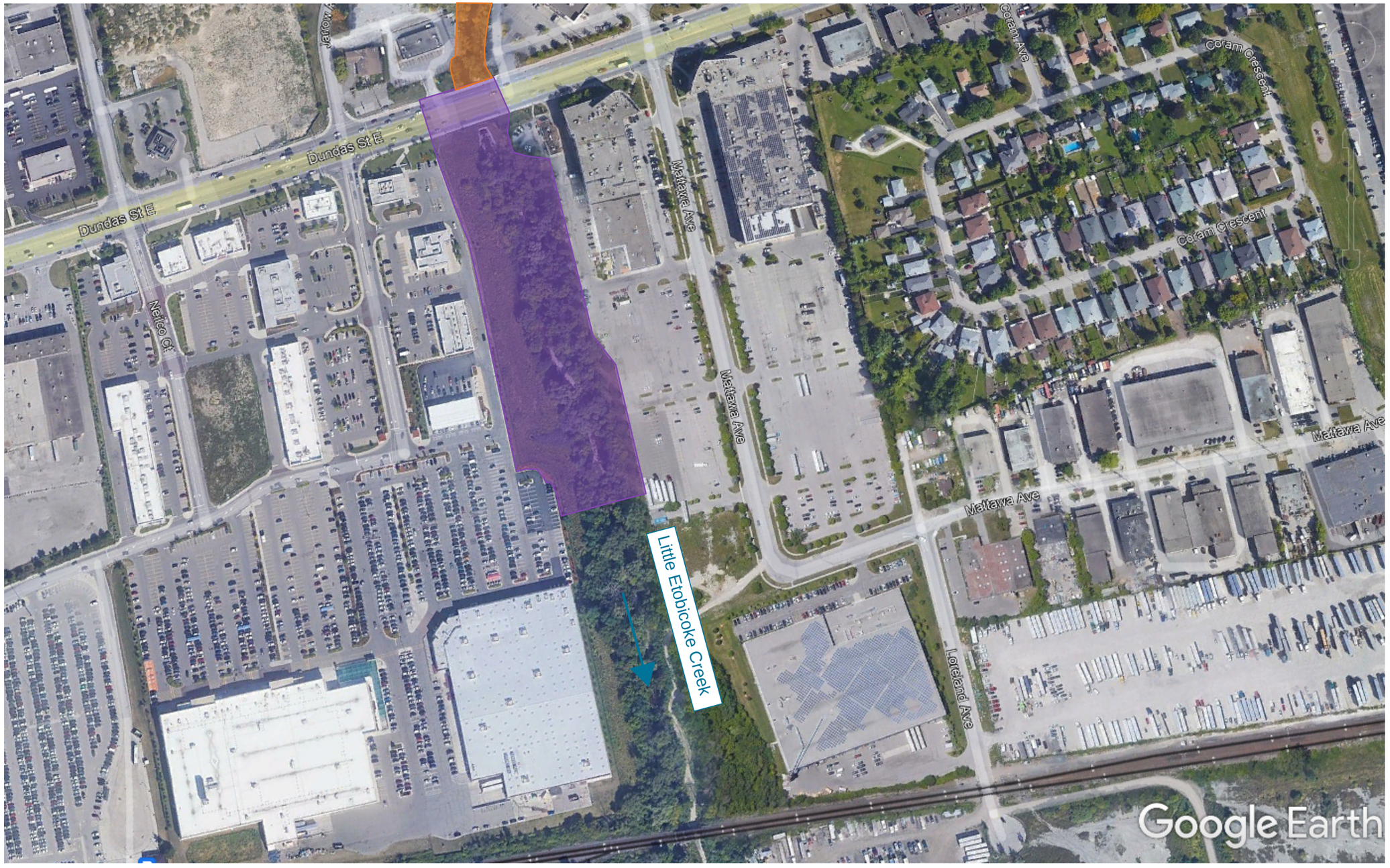
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or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

Anticipated extents of flood mitigation work -- 500 m upstream to 50 m downstream of Dixie Road Bridge (Matrix 2018)

Site Plan Sketch

Dixie-Dundas Flood Mitigation
May 22, 2019

Matrix Solutions. 2018. *Consulting Services for the Dixie-Dundas Flood Mitigation*. Proposal for The City of Mississauga.



2019 Study Area - Geotechnical Assessment

2021 Expanded Study Area - Geotechnical Assessment

Expanded Study Area Site Plan Sketch

Dixie-Dundas Flood Mitigation Project

September 22, 2021

Photo 1. Looking north towards Dixie Road bridge from east sidewalk. [taken June 2019]

Photo 2: Looking north towards Dixie Road bridge from west sidewalk. [taken June 2019]

Photo 3: Looking upstream from east side of Dixie Road bridge. [taken June 2019]

Photo 4: Looking north at stormwater outfall structure located approximately 7 m downstream of Dixie Road bridge. [taken June 2019]

Photo 5: Looking upstream from underneath Dixie Road bridge. [taken June 2019]

Photo 6: Looking at creek bed from underneath Dixie Road bridge. [taken June 2019]

Photog 7: Looking south from west side of Dixie Road bridge. [taken June 2019]

Photo 8: Looking upstream from underneath Dixie Road bridge. [taken June 2019]

Photo 9: Looking downstream from approximately 50 m west of Dixie Road bridge. [taken June 2019]

Photo 10: Looking upstream at a fallen tree located approximately 50 m west of Dixie Road bridge. [taken June 2019]

Photo 11: Looking downstream from a pedestrian bridge located approximately 185 m west of Dixie Road bridge. [taken June 2019]

Photo 12: Looking upstream from a pedestrian bridge located approximately 185 m west of Dixie Road bridge. [taken June 2019]

Photo 13: Looking downstream from a pedestrian bridge located approximately 385 m west of Dixie Road bridge. [taken June 2019]

Photo 14: Looking upstream from a pedestrian bridge located approximately 385 m west of Dixie Road bridge. [taken June 2019]

Photo 15: Looking downstream from a walking trail approximately parallel with Goldmar Drive. [taken June 2019]

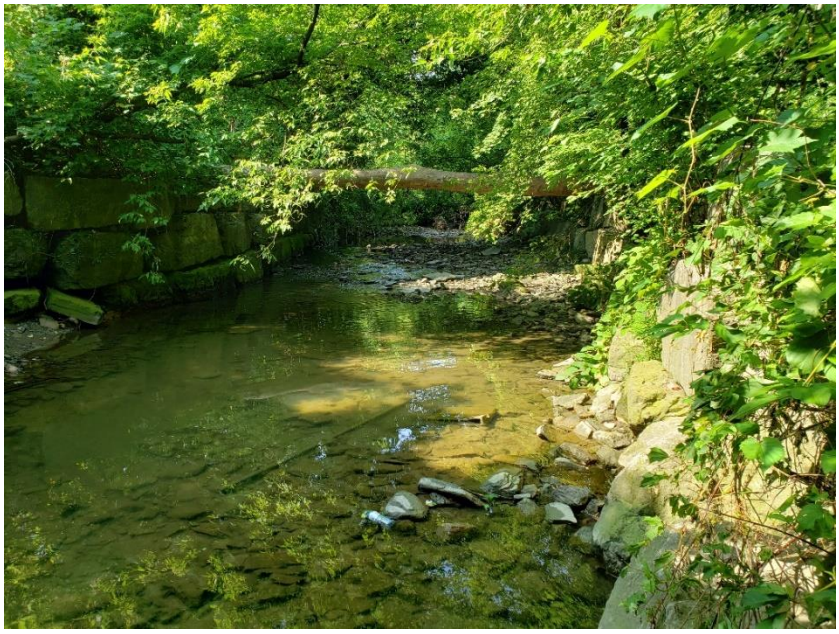


Photo 16: Looking upstream from a walking trail approximately parallel with Goldmar Drive. [taken June 2019]

Photo 17: Looking downstream from Willowcreek Park. [taken June 2019]

Photo 18: Looking upstream from Willowcreek Park. [taken June 2019]

Photo 19: Looking west towards steep slope along west bank opposite Willowcreek Park. [taken June 2019]

Photo 20: Looking at gabion baskets along east bank at Willowcreek Park. [taken June 2019]

Photo 21: Looking downstream from behind Eddie’s Meat Market. [taken June 2019]

Photo 22: Looking upstream from behind Eddie’s Meat Market. [taken June 2019]

Photo 23: Looking at near vertical slope along east bank opposite Eddie's Meat Market. [taken June 2019]

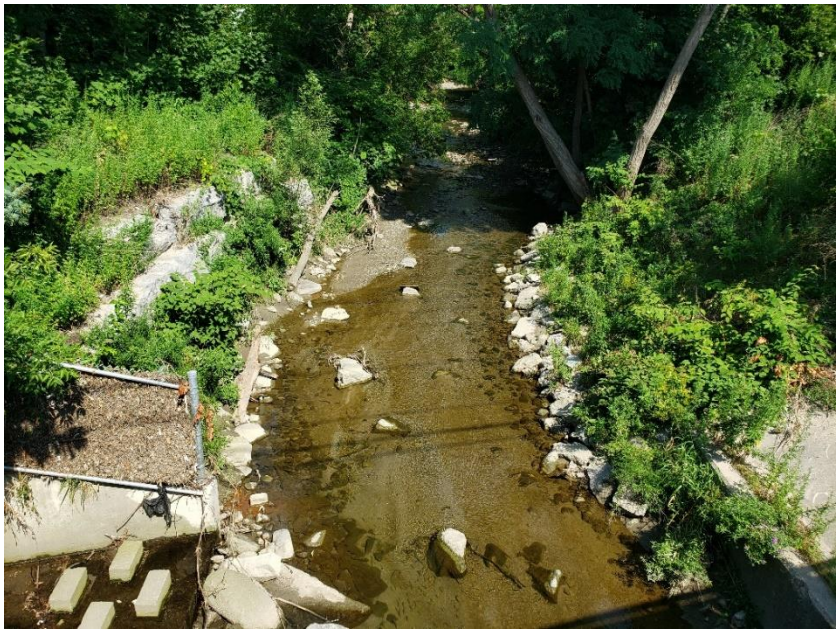


Photo 24: Looking upstream from Dundas Street East Bridge. [taken June 2019]

Photo 25. Looking north towards Dundas Street East bridge from south sidewalk. [taken June 2021]

Photo 26: Looking upstream towards Dundas Street East bridge. [taken June 2021]

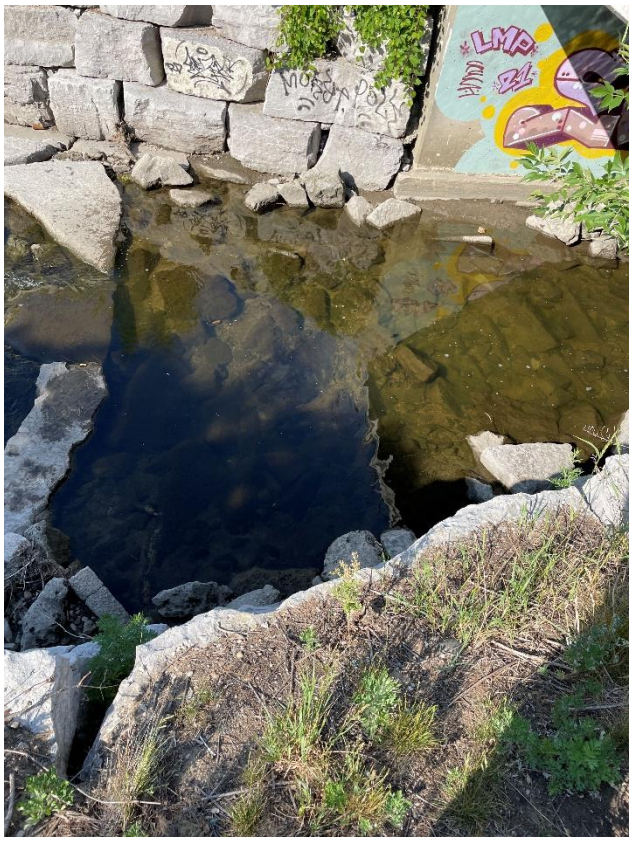


Photo 27: Looking at creek bed from south-east corner of Dundas Street East bridge. [taken June 2021]

Photo 28: Looking east towards steep slope along east bank 300 m downstream from Dundas Street East bridge. [taken June 2021]

Photo 29: Looking west towards undermining along west bank 300 m downstream from Dundas Street East bridge. [taken June 2021]

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M11-169

W.P. No.

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 5

LOCATION DIKE CREEK CULVERT

SYDENHAM

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. NONE

REMARKS:

GI-30 SEPT. 1975

B 9539

RACEY, MacCALLUM AND ASSOCIATES

LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers

AND ASSOCIATED STAFF

MONTREAL VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.E.M., M.E.I.C., A.M.C.S.E.
P. JOHN RACEY, B.Sc. (M.E.), M.E.I.C., P.Eng.
A. ERIC RAMSAY, B.A., B.Sc. (M.E.), M.E.I.C., A.M.I.E.E., P.Eng.

TORONTO DIVISION
20 CARLTON STREET

30 M11 - 169

RECORDS No.

Reference: S-500-663/T-597

4 February 1957

Department of Highways of Ontario,
c/o Harris, Giffels and Vallet,
9 Richmond Street East,
TORONTO, Ontario.

Attention: Mr. L.C. Amadio.

RE: FOUNDATION INVESTIGATION FOR
DIXIE CREEK CULVERT EXTENSION,
HIGHWAY 10.5, ONTARIO.

Dear Sirs:

Herewith are the boring logs for an investigation performed at the above noted site on 25 and 26 January 1957. We are presenting our comments by letter, because the magnitude of the work does not appear to justify the extra cost of a formal report.

Reference to the attached engineering data sheets indicates that firm bedrock, consisting of grey shale with interbeds of limestone, will be encountered at a depth of approximately nine feet below the present river level, or nineteen to twenty feet below the top surface of the existing culvert. On the west side of the bank, in the vicinity of hole no.1, a weathered shale was encountered five feet above bedrock, and this material was partially softened back to a clay state. This weathered rock was not noted in the east boring under the old embankment, which exists just south and parallel to the present highway. In its place was an extremely dense dry stratum of silty sand with gravel, which extends from river level down to rock. The upper five feet of soil at hole no1 consisted of loose brown medium sand, having a water table coincident with river level. This upper material will not necessarily be representative of surface conditions at all points along the culvert extension line, because the area has been altered by the addition of fill and very probably also by flood water.

4 February 1957

During periods of heavy run-off, relatively high water velocities should be anticipated through this extended culvert, and this fact will probably dictate the depth for the establishment of the footings. In view of the proximity of bedrock and the uncertainties regarding the maximum depth to which scouring effects will extend, it would appear that the support of the footings on bedrock is a reasonable, although somewhat conservative, foundation proposal. The installation of braced sheeting and pumping facilities during excavation must be anticipated, but this work will be required regardless of the foundation depth proposed.

We thank you for this opportunity to be of service to you in this regard, and shall be pleased to discuss the soil conditions in greater detail, if culvert support above bedrock is contemplated.

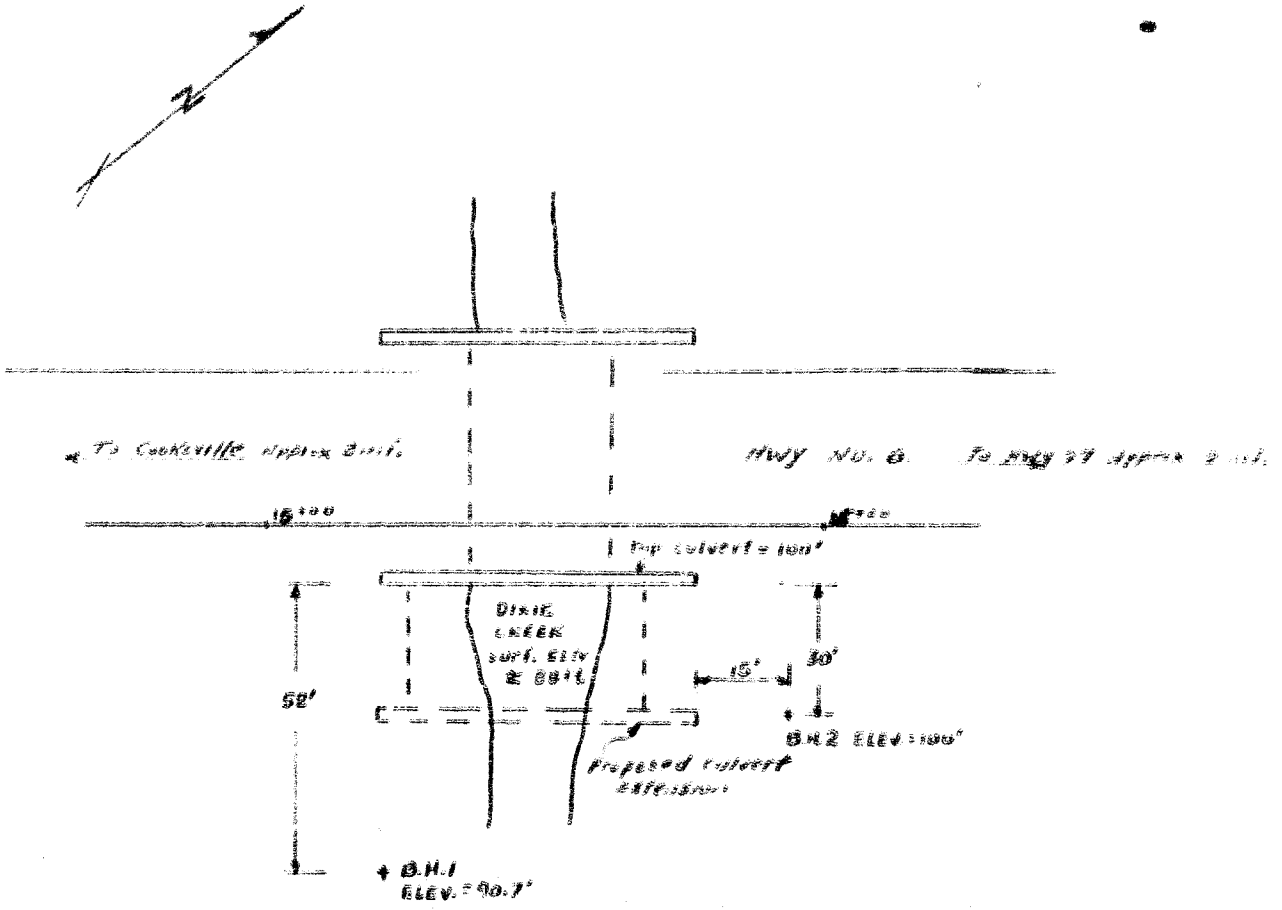
Yours very truly,
RACEY, MacCALLUM AND ASSOCIATES LIMITED

W.A.Trow, P.Eng.,
Divisional Soils Engineer.

WAT/MD
Encls.

Order No. Survey
Prep. By

Enclosure No. 1



30 HILL - 169

SKETCH SHOWING LOCATION OF BORINGS

Rocsy, MacCallum & Associates Ltd.

Cont. No. 2

2500-613(T)97 ... AND ASSOCIATES — Driller: Lush

Engineering Data Sheet for Borehole 1

Job Name: DIXIE CREEK CULVERT EXTENSION

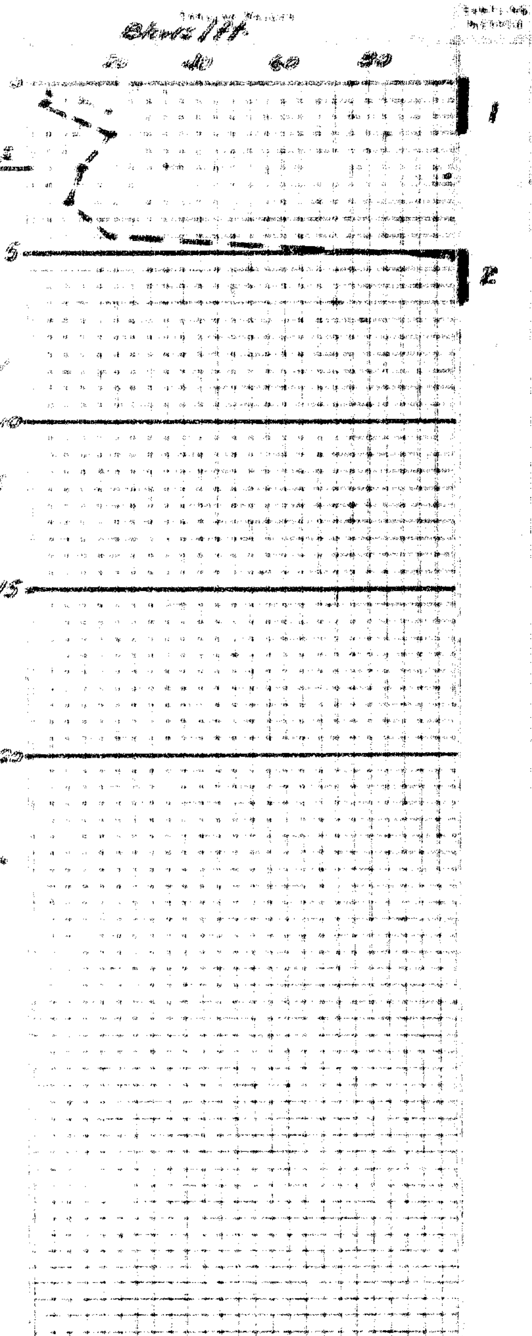
Job Location: HWY 5 ± 3 mi. East Clarksville, Cal.

Hole Location: See Card No 1

Hole Elevation: 90.7 Datum Top South End Culvert "100"

Depth	Blows	Description
0	40	Ground Surface
		Black organic topsoil
		med. dense brown silty sand
5'	25	Weathered ... partly ... (Refusal to 5" Pennell at ...)
	50	Bedrock — gray shale with ... of ... (...% recovery)

— End of Bore



Legend

——— Pent. Cust 2" ... Energy ... ft-lbs.

▮ 2in. O.D. Shelby tube

* Such Continuous Flite Pennell used to core

Encl. No. 3

Order No. S-Sainsbury RAMSAY [illegible] AND ASSOCIATES

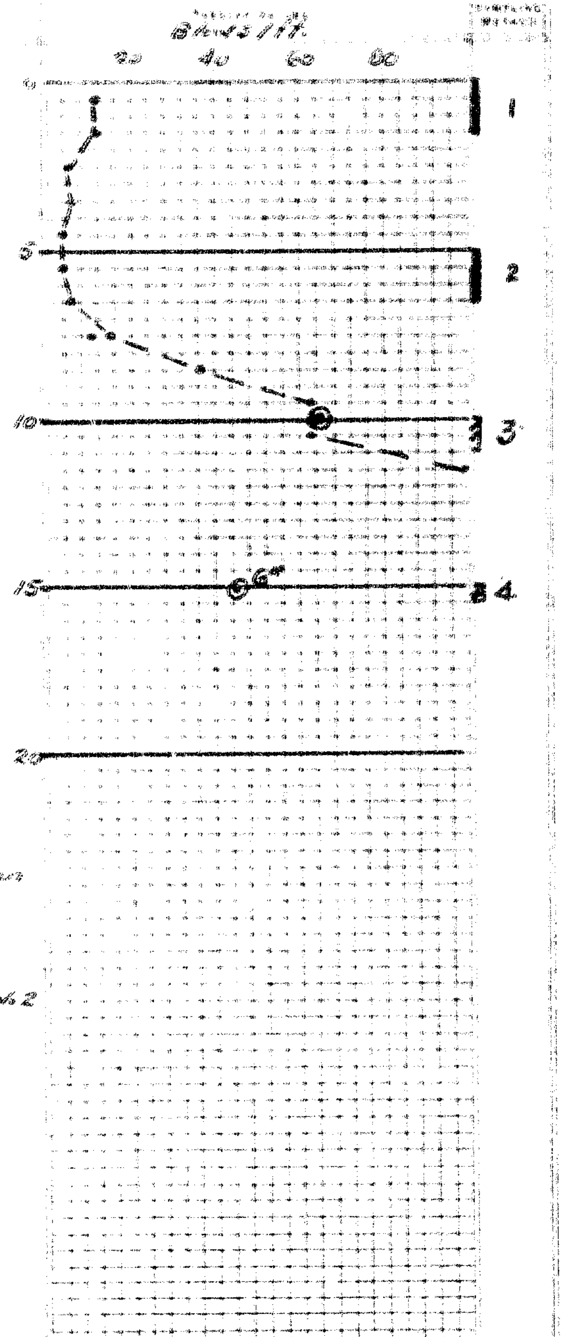
Lusk

Hole Drilled: [illegible]

Engineering Data Sheet for Borehole: 2

Job Name: DIXIE CREEK CULVERT EXTENSION
Job Located: Hwy 5 ≈ 3 mi. East Cooksville Ont.
Hole Located: See encl. No. 1
Hole Elevation: 100. Datum: Top south rail Culvert = 100'

Depth	Elev.	Description
0	100	Top earth embankment, [illegible] to Hwy No. 5
		Dry brown sandy silt with gravel, [illegible]
10	90	Very dry silty sand with gravel. Very dense
19''	81	Refusal on dry shale



Legend
⊙ Blows/ft 2" O.D. split spoon

▯ Split Spoon

Other symbols as on encl. No. 2

THURBER ENGINEERING LTD.

FINAL
PRELIMINARY GEOTECHNICAL INVESTIGATION
REPORT
DIXIE-DUNDAS FLOOD MITIGATION
MISSISSUAGA, ONTARIO

Report

to

Matrix Solutions Inc.

Joshua Alexander, EIT
Geotechnical EIT

Michael Eastman, P.Eng.
Geotechnical Engineer

Date: August 10, 2023
File: 25025

Renato Pasqualoni, P.Eng.
Review Principal

THURBER

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THURBER

APPENDICES

THURBER

1. INTRODUCTION

Thurber Engineering Ltd. (Thurber) has been retained by Matrix Solutions Inc. (Matrix) to conduct a preliminary geotechnical investigation for the potential replacement of the Dixie Road and Dundas Street East bridges over Little Etobicoke Creek as part of the overall Dixie-Dundas Flood Mitigation project in Mississauga, Ontario. Authorization to proceed with the investigation was received via email on June 15, 2021 from Mr. Andrew Doherty of Matrix.

The purpose of this investigation was to explore the subsurface conditions at the site and based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results and a written description of the subsurface conditions. Based on the encountered subsurface conditions, preliminary discussion and recommendations are provided to assist the project team in the design of the Dixie Road and Dundas Street East bridge replacements.

Use of this report is subject to the Statement of Limitations and Conditions, which is included at the end of this document.

2. SITE DESCRIPTION

The project site encompasses Little Etobicoke Creek and extends 500 m upstream of the Dixie Road bridge to 300 m downstream of the Dundas Street East bridge. The existing Dixie Road bridge is located approximately 350 m north of Dundas Street East. The existing Dundas Street East bridge is located approximately 550 m east of Dixie Road. For project purposes, Dundas Street East will be considered to be oriented east-west and Dixie Road will be considered to be oriented north-south.

Existing land use adjacent to the Little Etobicoke Creek within the project site consists of residential, commercial and industrial buildings as well as parking lots.

Photographs showing the existing conditions at the project site at the time of the field investigation are included in Appendix D for reference.

3. INVESTIGATION PROCEDURES

The field investigation was carried out between July 30 and August 4, 2021. Two boreholes were advanced to depths ranging from 10.2 and 11.1 m below ground surface.

The boreholes were drilled using a track-mounted B-57 drill rig supplied and operated by Landshark Drilling Inc. of Brantford, Ontario. Soil samples were obtained at selected intervals

using a split spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586).

Prior to commencement of the field investigation, utility clearances were obtained in the vicinity of the borehole locations.

The approximate locations of the boreholes are shown on the Borehole Location Plan included in Appendix A. The as-drilled borehole locations were surveyed by Thurber using a Trimble R10 GPS unit. The surveyed borehole locations are provided in Modified Transverse Mercator (MTM) North American Datum 1983 (NAD83) Zone 10 northing and easting coordinates and ground surface elevations referenced to the Canadian Geodetic Vertical Datum 1928 (CGVD28). The borehole locations, ground surface elevations and termination depths/elevations are summarized in the table below.

Table 3-1: Borehole Summary

Borehole	Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth / Elevation (m)
DIX-01	Dixie Road	4,830,180.0	297,748.8	124.4	11.1 / 113.3
DUN-01	Dundas Street East	4,830,353.9	298,396.8	116.0	10.2 / 105.8

Soil samples were obtained at selected intervals using a split spoon sampler in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). Bedrock core samples were obtained using an HQ-size triple tube rock core barrel.

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. The drilling supervisor logged the boreholes and processed the recovered soil and rock samples for transport to the laboratory for further examination and testing.

Monitoring wells, each consisting of 51 mm diameter PVC pipe with a 1.5 or 3.0 m long slotted screen, were installed in both boreholes to allow for longer term measurements of the groundwater levels. The monitoring well details are illustrated in the corresponding Record of Borehole sheets provided in Appendix B. The monitoring wells are still operational.

4. LABORATORY TESTING

The recovered soil samples were subjected to visual identification and to natural moisture content determination. Selected samples were subjected to gradation analyses (hydrometer and/or sieve). Two soil samples were selected and submitted for analytical testing of corrosivity parameters and sulphate content. All laboratory test results from the field investigation are provided in Appendix C.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil, bedrock and groundwater conditions will vary between and beyond the borehole locations.

In general terms, the encountered stratigraphy consisted of fill overlying loose to very dense sands and silts underlain by shale bedrock.

5.1 Topsoil

Both boreholes encountered topsoil at the ground surface with a thickness of 100 mm.

5.2 Fill

A fill layer consisting of sand to sand and gravel was encountered below the topsoil in both boreholes. The sand fill had a thickness of 1.3 m and extended to a depth of 1.4 m.

SPT N-values in the sand fill ranged from 27 to 42 blows indicating a compact to dense relative density. The recorded moisture contents ranged from 2 to 7%.

The result of grain size distribution testing completed on a sample of the sand fill are illustrated in Figure C1 in Appendix C. The results are presented on the Record of Borehole sheets in Appendix B.

5.3 Silty Sand to Sand and Silt

A layer of silty sand to sand and silt was encountered below the fill in both boreholes. The sand layer varied in thickness from 3.5 to 6.7 m and extended to depths ranging from 4.9 to 8.1 m.

SPT N-values in the sand layer ranged from 4 to 75 blows, indicating a loose to very dense relative density. Recorded moisture contents ranged from 4 to 25%.

The results of grain size distribution testing completed on three samples of the sand layer are illustrated in Figures C2 and C3 in Appendix C. The results are presented on the Record of Borehole sheets in Appendix B.

5.4 Cobbles

A layer of cobbles with shale fragments was encountered below the sand and silt layer in Borehole DUN-01. The cobble layer had a thickness of 0.6 m and extended to a depth of 5.5 m.

5.5 Bedrock

Both boreholes were cored and terminated within bedrock. A summary of the bedrock information is presented in the table below.

Table 5-1: Summary of Bedrock Surface

Borehole	Ground Surface Elevation (m)	Depth to Top of Bedrock (mbgs)	Top of Bedrock Elevation (m)
DIX-01	124.4	8.1	116.3
DUN-01	115.9	5.5	110.5

The bedrock cored in the boreholes can generally be described as highly to moderately weathered, thinly laminated, grey, typically weak shale (Georgian Bay Formation).

The total core recovery (TCR) measured on the recovered bedrock cores ranged from 97 to 100%, the solid core recovery (SCR) ranged from 67 to 97% and the rock quality designation (RQD) ranged from 17 to 53%. Based on the RQD values, the bedrock is classified as very poor to fair quality in accordance with CFEM (2006).

Photographs of the bedrock cores are provided in Appendix C.

5.6 Groundwater

Monitoring wells were installed in both boreholes. The groundwater level measurements are summarized in the table below.

Table 5-2: Groundwater Level Observations

Borehole	Groundwater Level		Date of Measurement
	Depth (mbgs*)	Elevation (m)	
DIX-01	4.1	120.3	August 13, 2021
DUN-01	3.4	112.5	August 13, 2021

**mbgs = metres below ground surface*

These groundwater level observations are considered short term and it should be noted that the groundwater level at the time of any construction may be different and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation.

5.7 Analytical Testing

Two soil samples were submitted for analysis of pH, water soluble sulphate, sulphide and chloride concentrations, resistivity and conductivity, for assessment of sulphate impacts to concrete and metal corrosion. The analytical results are included in **Error! Reference source not found.** and a re summarized in the following table.

Table 5-3: Summary of Analytical Test Results

Borehole	Sample	Depth (m)	Conductivity (µmho/cm)	pH	Resistivity (ohm-cm)	Chloride (µg/g)	Sulphate (µg/g)	Sulphide (mg/kg)
DIX-01	SS2	0.8-1.4	157	7.90	6,400	29	<20	1.4
DUN-01	SS3	1.5-2.1	1,070	9.44	930	550	320	17.3

6. PRELIMINARY DISCUSSION AND RECOMMENDATIONS

6.1 General

This section of the report presents preliminary discussion and recommendations to assist the project team in the design of the Dixie Road and Dundas Street East bridge replacements. The preliminary discussion and recommendations presented in this report are based on the information provided by Matrix and the factual data obtained during the course of the preliminary geotechnical investigation.

In general terms, the encountered stratigraphy consisted of fill overlying loose to very dense sands and silts underlain by shale bedrock. Borehole DUN-01 at the existing Dundas Street East

bridge encountered a layer of cobbles with shale fragments below the sand and silt layer. The groundwater elevation was measured at Elevation 120.3 and 112.5 m in Boreholes DIX-01 and DUN-01, respectively.

The existing Dixie Road bridge is located approximately 350 m north of Dundas Street East. The existing Dundas Street East bridge is located approximately 550 m east of Dixie Road.

6.2 Bridge Foundation Alternatives

Given the soil stratigraphy and groundwater conditions encountered during the current preliminary field investigation, the following options have been considered from a foundation's perspective for the support of the new bridges constructed along the existing alignments:

- Spread footings
- Driven steel piles
- Caissons (drilled shafts)

Depending on the load demands, spread footings may be a feasible option for both bridge replacements. The soils expected to be encountered at the founding elevation for spread footings would consist of dense to very dense sands and silts. For higher load demands, the structures should be supported with deep foundations. Piles driven to practical refusal in bedrock or caissons socketed into bedrock are considered to be feasible foundation options.

6.3 Excavations and Groundwater Control

Excavations for foundations and bridge abutments will generally extend through the loose to very dense sand and silt overburden down to bedrock. All excavations should be carried out in accordance with the requirements of the Occupational Health and Safety Act (OHSA) and local regulations. For the purposes of the OHSA, the soils within the likely depth of excavation at these sites may be classed as Type 3 soils above the water table and Type 4 for soils below the water table.

Slopes of temporarily unsupported cuts should conform with the requirements of OHSA, but should not be steeper than 1H:1V. Flatter slopes may be required at locations where water seepage or sloughing occurs during excavation. Where space restrictions preclude excavation of inclined slopes, service installation may be carried out using shoring. Engineering support systems should be designed by a licensed Professional Engineer experienced in such designs. The design of shoring systems should include the effects of surcharge loads such as those

imposed by adjacent utilities and construction equipment. Soil should not be stockpiled in the vicinity of the excavation.

Excavations in overburden can be completed using conventional hydraulic excavating equipment. Excavation of the highly to moderately weathered shale should be possible using heavy excavation equipment and rippers, supplemented by pneumatic rock breakers where thick layers of hard material are encountered. The shale typically becomes stronger and less weathered with depth, and intensive use of pneumatic/hydraulic breakers, line drilling or other methods of loosening the bedrock may be required with increasing depth.

Excavations extended through overburden below the water table will not be stable. Such excavations will require pre-dewatering using either a series of groundwater extraction wells or well points. Alternatively, it may be possible to install a watertight groundwater control barrier extended and keyed into bedrock.

A hydrogeological assessment to provide recommendations for groundwater control during construction and determine the need for EASR registration or PTTW application should be completed concurrently with the final design.

7. CLOSURE

We trust this report meets your requirements. If you have any questions or require further information, please do not hesitate to contact us.

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

2. COMPLETE REPORT

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

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

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5. INTERPRETATION OF THE REPORT

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

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

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

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

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

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

Appendix A Drawings

Borehole Location Plan

DIX–01

DIXIE ROAD

SEDLESCOMB DRIVE

ARROW AVENUE

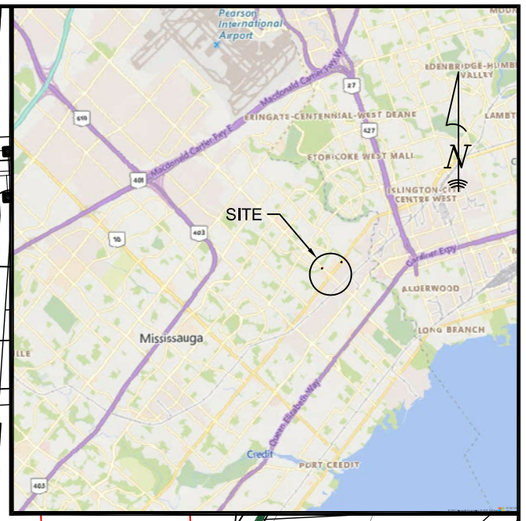
EASEMENT

NEILCO COURT

DUNDAS STREET EAST

CONSUMERS GAS EASEMENT

DUN–01



LEGEND

BOREHOLE LOCATION

40 0 40 80m

SCALE 1:2000

MATRIX SOLUTIONS

DIXIE-DUNDAS
FLOOD MITIGATION INVESTIGATION
MISSISSAUGA, ON

BOREHOLE LOCATION PLAN

JOB# 25025

THURBER ENGINEERING LTD.

ENGINEER:	DRAWN:	APPROVED:
MKE	MFA	RP
DATE:	SCALE:	DRAWING No.
AUGUST 2021	1:2000	FIGURE A1

FILENAME: H:\Drafting\25000\25025\TED-25025-BHPL.dwg
PLOTDATE: Aug 22, 2021 - 1:09 PM

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Appendix B Record of Borehole Sheets

RECORD OF BOREHOLE DIX-01

PROJECT : Dixie-Dundas Flood Mitigation
LOCATION : Mississauga, Ontario
STARTED : July 30, 2021
COMPLETED : July 30, 2021
N 4 830 180.0 E 297 748.8

Project No. 25025
SHEET 1 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		124.38				DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100			
		TOPSOIL (100mm)									
		SAND, some gravel, some silt, compact to dense, brown, moist: (FILL)		0.10	1	SS	27		○		
1					2	SS	31	Grain Size Analysis: Gr 18%/ Sa 69%/ Si & Cl 13%	○		
				122.93							
		SAND, silty, trace clay, loose to very dense, brown, moist to wet		1.45							
2					3	SS	4		○		
					4	SS	9		○		Bentonite
3					5	SS	33		○		
4	200 mm O.D. Hollow Stem Augers / Power Auger Boring										▼
		Becoming Grey at 4.9m			6	SS	41		○		Filter Sand
5									○		
6					7	SS	45		○		Slotted Screen
7											
8					8	SS	75	Grain Size Analysis: Gr 0%/ Sa 62%/ Si 33%/ Cl 5%	○	FI	
				116.30							
	HQ Coring	**SHALE**, highly to moderately weathered, thinly laminated, very poor to poor quality, weak, grey (GEORGIAN BAY FORMATION) rubble zone (150mm) at 8.1m, (25mm) at 8.3m, (25mm) at 8.4m, (100mm) at 8.6m, and (50mm) at 9.3m horizontal fractures at 8.3m, 8.5m, 8.7m, 8.8m, 8.9m, 9.1m, 9.2m, 9.4m, and 9.5m clay seam (75mm) at 8.9m		8.08						>10	
					1	RUN		TCR=97% SCR=67% RQD=17%		>10	
9										>10	
										6	
										4	
		horizontal fractures at 9.7m, 9.8m, 10.0m, 10.1m, 10.2m, 10.3m, 10.4m, 10.5m, 10.6m, 10.7m, 10.8m, 10.9m, and 11.0m								4	

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

August 13, 2021

LOGGED : MP
CHECKED : MKE

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THURBER2S TEL-25025.GPJ 8/19/21

RECORD OF BOREHOLE DIX-01

PROJECT : Dixie-Dundas Flood Mitigation
LOCATION : Mississauga, Ontario
STARTED : July 30, 2021
COMPLETED : July 30, 2021

Project No. 25025
SHEET 2 OF 2
N 4 830 180.0 E 297 748.8
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚ rem V - ● Q - ✖ Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp w wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
11	HQ Coring	vertical fractures (50mm) at 10.8m and (100mm) at 10.9m		113.26	2	RUN		TCR=100% SCR=95% RQD=23%		2 8 7 5	
		END OF BOREHOLE AT 11.13m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Aug 13/21 4.06 120.32		11.13							
12											
13											
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
August 13, 2021

LOGGED : MP
CHECKED : MKE

THURBER

THURBER2S TEL-25025.GPJ 8/19/21

RECORD OF BOREHOLE DUN-01

PROJECT : Dixie-Dundas Flood Mitigation
LOCATION : Mississauga, Ontario
STARTED : August 4, 2021
COMPLETED : August 4, 2021
N 4 830 353.9 E 298 396.8

Project No. 25025
SHEET 1 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		115.95						
		TOPSOIL (100mm)								
		SAND and **GRAVEL**, some silt, dense, grey, moist: (FILL)		0.10	1	SS	42			
1					2	SS	31			
		SAND and **SILT**, some clay, trace to some gravel, loose to very dense, grey, moist		114.58 1.37						
					3	SS	17	Grain Size Analysis: Gr 1%/ Sa 50%/ Si 37%/ Cl 12%		Bentonite
2					4	SS	7			
3	200 mm O.D.Hollow Stem Augers Power Auger Boring				5	SS	6	Grain Size Analysis: Gr 0%/ Sa 42%/ Si 46%/ Cl 12%		Filter Sand
4										Slotted Screen
				111.07	6	SS	61			
5		**COBBLES**, shale fragments		4.88						
				110.46						
		SHALE, highly weathered, thinly laminated, very poor to poor quality, weak, grey (GEORGIAN BAY FORMATION) rubble zone (175mm) at 5.6m clay zone (100mm) at 5.7m, (100mm) at 5.8m, (25mm) at 6.1m, and (25mm) at 6.2m horizontal fractures at 6.1m, 6.2m, 6.3m, 6.5m, 6.7m, 6.8m, 6.9m, and 7.0m		5.49					FI	
6	HQ Coring				1	RUN		TCR=97% SCR=80% RQD=20%	>10 >10 4 4	
7		horizontal fractures at 7.2m, 7.3m, 7.4m, 7.5 m, 7.8m, 7.9m, 8.0m, 8.1m, 8.4m, 8.5m rubble zone (25mm) at 7.2m							5 >10 1	
8					2	RUN		TCR=100% SCR=97% RQD=48%	6 4 3	
9		horizontal fractures at 8.8m, 8.9m, 9.0m, 9.2m, 9.3m, 9.4m, 9.5m, 9.6m, and 9.9m			3	RUN		TCR=100% SCR=93% RQD=53%	4 3 8 2	

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
August 13, 2021

LOGGED : MP
CHECKED : MKE

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THURBER2S TEL-25025.GPJ 8/19/21

RECORD OF BOREHOLE DUN-01

PROJECT : Dixie-Dundas Flood Mitigation
LOCATION : Mississauga, Ontario
STARTED : August 4, 2021
COMPLETED : August 4, 2021
N 4 830 353.9 E 298 396.8

Project No. 25025
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
				105.76						3	
		END OF BOREHOLE AT 10.19m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.54m slotted screen.		10.19							
		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m) — Aug 13/21 / 3.44 / 112.51									
11											
12											
13											
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
August 13, 2021

LOGGED : MP
CHECKED : MKE

THURBER

THURBER2S TEL-25025.GPJ 8/19/21

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Appendix C Laboratory Testing Results

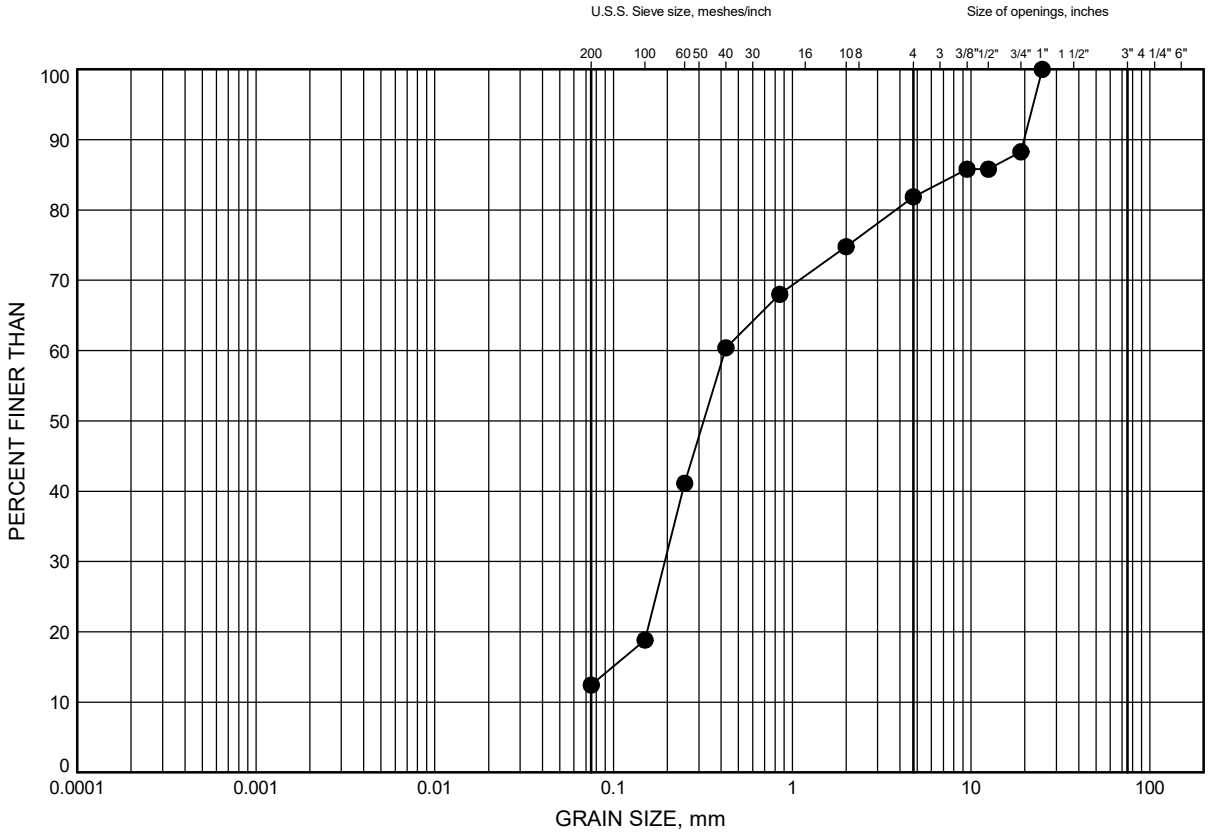
Particle Size Analysis Figures
Rock Core Photographs
Analytical Testing Results

Dixie-Dundas Flood Mitigation

GRAIN SIZE DISTRIBUTION

FIGURE C1

Granular Fill



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DIX-01	1.07	123.32

Date August 2021

Project 25025

THURBER

Prep'd BH

Chkd. JA

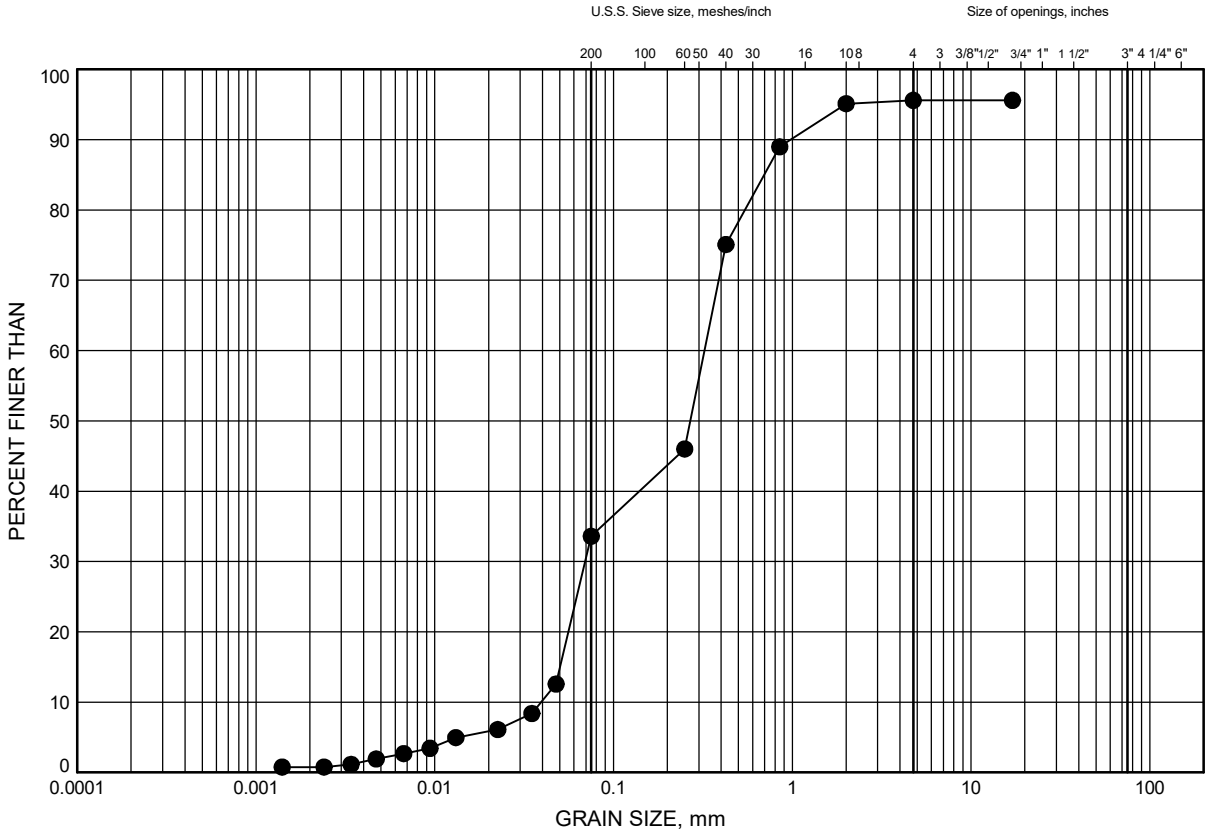
GRAIN SIZE DISTRIBUTION - THURBER TEL-25025.GPJ 8/17/21

Dixie-Dundas Flood Mitigation

GRAIN SIZE DISTRIBUTION

FIGURE C2

Silty SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DIX-01	7.92	116.46

Date August 2021

Project 25025

THURBER

Prep'd BH

Chkd. JA

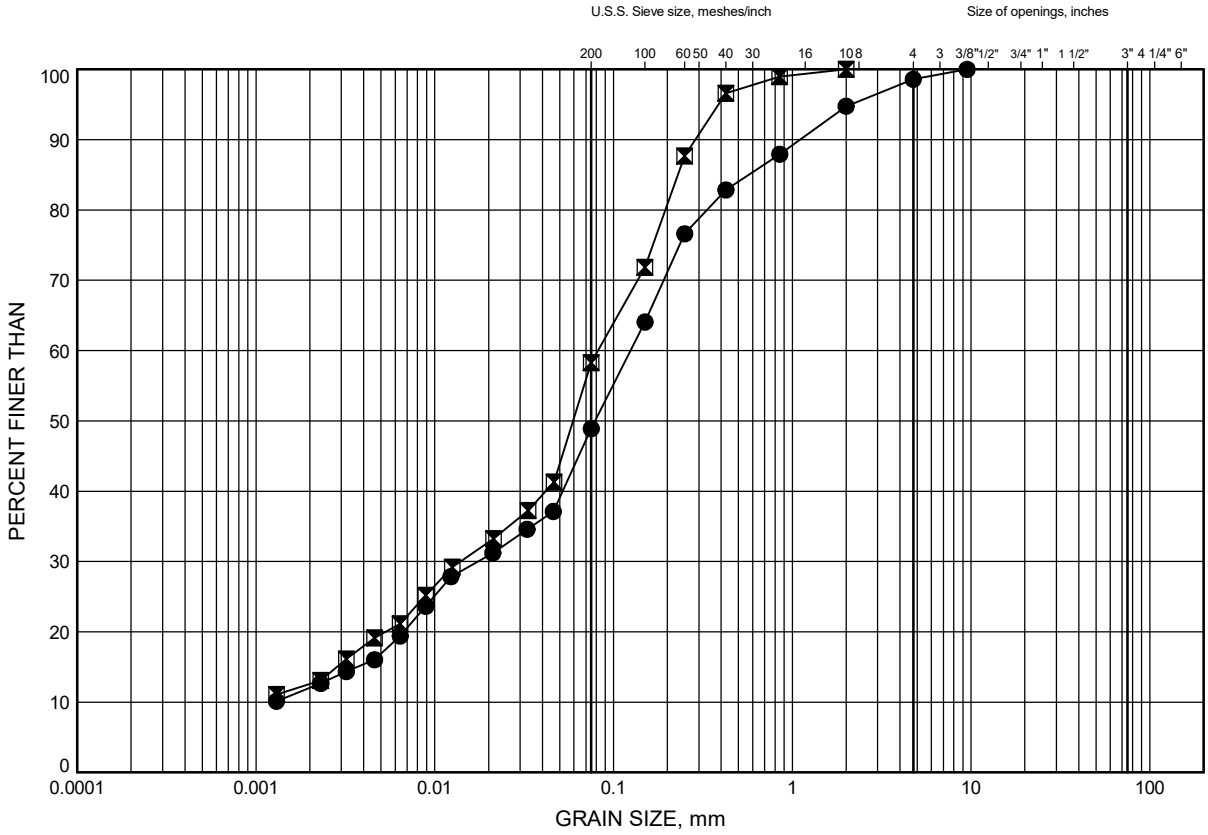
GRAIN SIZE DISTRIBUTION - THURBER TEL-25025.GPJ 8/17/21

Dixie-Dundas Flood Mitigation

GRAIN SIZE DISTRIBUTION

FIGURE C3

SILT and SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DUN-01	1.83	114.12
⊠	DUN-01	3.35	112.60

Date August 2021

Project 25025

THURBER

Prep'd BH

Chkd. JA

GRAIN SIZE DISTRIBUTION - THURBER TEL-25025.GPJ 8/17/21

THURBER

DIX-01
Run 1-2
8.1 to 11.1 m

Date: September 2021
Project: 25025

THURBER

DUN-01
Run 1-3
5.5 to 10.2 m

Date: September 2021
Project: 25025

Your Project #: 25025
Site#: Dixie-Dundas Flood Mitigation
Your C.O.C. #: 838995-01-01

Attention: Michael Eastman

Thurber Engineering Ltd
2010 Winston Park Dr
Suite 103
Oakville, ON
CANADA L6H 5R7

Report Date: 2021/08/16
Report #: R6767594
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1M0105
Received: 2021/08/05, 11:30

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	2	2021/08/09	2021/08/10	CAM SOP-00463	SM 23 4500-Cl E m
Cyanide (WAD) in Leachates	2	N/A	2021/08/11	CAM SOP-00457	OMOE 3015 m
Conductivity	2	2021/08/09	2021/08/09	CAM SOP-00414	OMOE E3530 v1 m
Fluoride by ISE in Leachates	2	2021/08/11	2021/08/12	CAM SOP-00449	SM 23 4500-F- C m
Total Metals in TCLP Leachate by ICPMS	2	2021/08/11	2021/08/12	CAM SOP-00447	EPA 6020B m
Moisture (Subcontracted) (1, 3)	2	N/A	2021/08/11	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	2	N/A	2021/08/13	AB SOP-00080	EPA9030B/SM4500S2-DF
Nitrate(NO3) + Nitrite(NO2) in Leachate	2	N/A	2021/08/11	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH CaCl2 EXTRACT	2	2021/08/10	2021/08/10	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	2	2021/08/05	2021/08/09	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	2	2021/08/09	2021/08/10	CAM SOP-00464	EPA 375.4 m
Redox Potential (2, 4)	2	N/A	N/A		
TCLP - % Solids	2	2021/08/10	2021/08/11	CAM SOP-00401	EPA 1311 Update I m
TCLP - Extraction Fluid	2	N/A	2021/08/11	CAM SOP-00401	EPA 1311 Update I m
TCLP - Initial and final pH	2	N/A	2021/08/11	CAM SOP-00401	EPA 1311 Update I m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Your Project #: 25025
Site#: Dixie-Dundas Flood Mitigation
Your C.O.C. #: 838995-01-01

Attention: Michael Eastman

Thurber Engineering Ltd
2010 Winston Park Dr
Suite 103
Oakville, ON
CANADA L6H 5R7

Report Date: 2021/08/16
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CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1M0105

Received: 2021/08/05, 11:30

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Calgary via Mississauga
(2) This test was performed by Sub from Campo to Env. Testing Canada (Eurofins)
(3) Offsite analysis requires that subcontracted moisture be reported.
(4) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Keino Widjanarko, Project Manager Assistant
Email: christopher-keino.widjanarko@bureauveritas.com
Phone# (905) 817-5700

==========

This report has been generated and distributed using a secure automated process.
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BV Labs Job #: C1M0105
Report Date: 2021/08/16

Thurber Engineering Ltd
Client Project #: 25025

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		QHH878		QHH879		
Sampling Date		2021/07/30 10:00		2021/08/03 10:30		
COC Number		838995-01-01		838995-01-01		
	UNITS	DIX-01 SS # 2 2.5' - 4.5'	QC Batch	DUN-01 SS # 3 5' - 7'	RDL	QC Batch
Calculated Parameters						
Resistivity	ohm-cm	6400	7502853	930	N/A	7502853
Inorganics						
Soluble (20:1) Chloride (Cl-)	ug/g	29	7508226	550	20	7508226
Conductivity	umho/cm	157	7508251	1070	2	7508251
Available (CaCl2) pH	pH	7.90	7510549	9.44	N/A	7510407
Soluble (20:1) Sulphate (SO4)	ug/g	<20	7508236	320	20	7508236
Sulphide	mg/kg	1.4 (1)	7519867	17.3	0.5	7519867
Physical Testing						
Moisture-Subcontracted	%	12	7519890	17	0.30	7519890

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
(1) Analyzed past method specified hold time

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O.REG 558 TCLP INORGANICS PACKAGE (SOIL)

BV Labs ID		QHH878	QHH879		
Sampling Date		2021/07/30 10:00	2021/08/03 10:30		
COC Number		838995-01-01	838995-01-01		
	UNITS	DIX-01 SS # 2 2.5' - 4.5'	DUN-01 SS # 3 5' - 7'	RDL	QC Batch
Inorganics					
Leachable Fluoride (F-)	mg/L	0.24	0.23	0.10	7513235
Leachable WAD Cyanide (Free)	mg/L	<0.010	<0.010	0.010	7513238
Leachable Nitrite (N)	mg/L	<0.10	<0.10	0.10	7513237
Leachable Nitrate (N)	mg/L	<1.0	<1.0	1.0	7513237
Leachable Nitrate + Nitrite (N)	mg/L	<1.0	<1.0	1.0	7513237
Metals					
Leachable Arsenic (As)	mg/L	<0.2	<0.2	0.2	7513346
Leachable Barium (Ba)	mg/L	<0.2	0.5	0.2	7513346
Leachable Boron (B)	mg/L	0.2	0.3	0.1	7513346
Leachable Cadmium (Cd)	mg/L	<0.05	<0.05	0.05	7513346
Leachable Chromium (Cr)	mg/L	<0.1	<0.1	0.1	7513346
Leachable Lead (Pb)	mg/L	<0.1	<0.1	0.1	7513346
Leachable Mercury (Hg)	mg/L	<0.001	<0.001	0.001	7513346
Leachable Selenium (Se)	mg/L	<0.1	<0.1	0.1	7513346
Leachable Silver (Ag)	mg/L	<0.01	<0.01	0.01	7513346
Leachable Uranium (U)	mg/L	<0.01	<0.01	0.01	7513346

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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TCLP LEACHATE PREPARATION (SOIL)

BV Labs ID		QHH878	QHH879		
Sampling Date		2021/07/30 10:00	2021/08/03 10:30		
COC Number		838995-01-01	838995-01-01		
	UNITS	DIX-01 SS # 2 2.5' - 4.5'	DUN-01 SS # 3 5' - 7'	RDL	QC Batch
Inorganics					
Final pH	pH	6.61	6.32	N/A	7512861
Initial pH	pH	9.20	9.78	N/A	7512861
TCLP - % Solids	%	100	100	0.2	7512838
TCLP Extraction Fluid	N/A	FLUID 1	FLUID 1	N/A	7512860

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	13.0°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
7508226	ADB	Matrix Spike	Soluble (20:1) Chloride (Cl-)	2021/08/10		NC	%	70 - 130
7508226	ADB	Spiked Blank	Soluble (20:1) Chloride (Cl-)	2021/08/10		103	%	70 - 130
7508226	ADB	Method Blank	Soluble (20:1) Chloride (Cl-)	2021/08/10	<20		ug/g	
7508226	ADB	RPD	Soluble (20:1) Chloride (Cl-)	2021/08/10	7.0		%	35
7508236	ADB	Matrix Spike	Soluble (20:1) Sulphate (SO4)	2021/08/10		NC	%	70 - 130
7508236	ADB	Spiked Blank	Soluble (20:1) Sulphate (SO4)	2021/08/10		104	%	70 - 130
7508236	ADB	Method Blank	Soluble (20:1) Sulphate (SO4)	2021/08/10	<20		ug/g	
7508236	ADB	RPD	Soluble (20:1) Sulphate (SO4)	2021/08/10	3.2		%	35
7508251	NYS	Spiked Blank	Conductivity	2021/08/09		98	%	90 - 110
7508251	NYS	Method Blank	Conductivity	2021/08/09	<2		umho/cm	
7508251	NYS	RPD	Conductivity	2021/08/09	0.79		%	10
7510407	NYS	Spiked Blank	Available (CaCl2) pH	2021/08/10		100	%	97 - 103
7510407	NYS	RPD	Available (CaCl2) pH	2021/08/10	0.58		%	N/A
7510549	NYS	Spiked Blank	Available (CaCl2) pH	2021/08/10		100	%	97 - 103
7510549	NYS	RPD	Available (CaCl2) pH	2021/08/10	0.21		%	N/A
7513235	SAU	Matrix Spike	Leachable Fluoride (F-)	2021/08/12		110	%	80 - 120
7513235	SAU	Leachate Blank	Leachable Fluoride (F-)	2021/08/12	<0.10		mg/L	
7513235	SAU	Spiked Blank	Leachable Fluoride (F-)	2021/08/12		94	%	80 - 120
7513235	SAU	Method Blank	Leachable Fluoride (F-)	2021/08/12	<0.10		mg/L	
7513235	SAU	RPD	Leachable Fluoride (F-)	2021/08/12	11		%	25
7513237	C_N	Matrix Spike	Leachable Nitrite (N)	2021/08/11		112	%	80 - 120
			Leachable Nitrate (N)	2021/08/11		75 (1)	%	80 - 120
			Leachable Nitrate + Nitrite (N)	2021/08/11		82	%	80 - 120
7513237	C_N	Leachate Blank	Leachable Nitrite (N)	2021/08/11	<0.10		mg/L	
			Leachable Nitrate (N)	2021/08/11	<1.0		mg/L	
			Leachable Nitrate + Nitrite (N)	2021/08/11	<1.0		mg/L	
7513237	C_N	Spiked Blank	Leachable Nitrite (N)	2021/08/11		109	%	80 - 120
			Leachable Nitrate (N)	2021/08/11		92	%	80 - 120
			Leachable Nitrate + Nitrite (N)	2021/08/11		95	%	80 - 120
7513237	C_N	Method Blank	Leachable Nitrite (N)	2021/08/11	<0.10		mg/L	
			Leachable Nitrate (N)	2021/08/11	<1.0		mg/L	
			Leachable Nitrate + Nitrite (N)	2021/08/11	<1.0		mg/L	
7513237	C_N	RPD	Leachable Nitrite (N)	2021/08/11	NC		%	25
			Leachable Nitrate (N)	2021/08/11	NC		%	25
			Leachable Nitrate + Nitrite (N)	2021/08/11	NC		%	25
7513238	ABP	Matrix Spike	Leachable WAD Cyanide (Free)	2021/08/11		84	%	80 - 120
7513238	ABP	Leachate Blank	Leachable WAD Cyanide (Free)	2021/08/11	<0.010		mg/L	
7513238	ABP	Spiked Blank	Leachable WAD Cyanide (Free)	2021/08/11		95	%	80 - 120
7513238	ABP	Method Blank	Leachable WAD Cyanide (Free)	2021/08/11	<0.0020		mg/L	
7513238	ABP	RPD	Leachable WAD Cyanide (Free)	2021/08/11	NC		%	20
7513346	AFZ	Matrix Spike	Leachable Arsenic (As)	2021/08/12		100	%	80 - 120
			Leachable Barium (Ba)	2021/08/12		101	%	80 - 120
			Leachable Boron (B)	2021/08/12		105	%	80 - 120
			Leachable Cadmium (Cd)	2021/08/12		99	%	80 - 120
			Leachable Chromium (Cr)	2021/08/12		101	%	80 - 120
			Leachable Lead (Pb)	2021/08/12		97	%	80 - 120
			Leachable Mercury (Hg)	2021/08/12		96	%	80 - 120
			Leachable Selenium (Se)	2021/08/12		102	%	80 - 120
			Leachable Silver (Ag)	2021/08/12		98	%	80 - 120
			Leachable Uranium (U)	2021/08/12		101	%	80 - 120
7513346	AFZ	Leachate Blank	Leachable Arsenic (As)	2021/08/12	<0.2		mg/L	
			Leachable Barium (Ba)	2021/08/12	<0.2		mg/L	
			Leachable Boron (B)	2021/08/12	<0.1		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Leachable Cadmium (Cd)	2021/08/12	<0.05		mg/L	
			Leachable Chromium (Cr)	2021/08/12	<0.1		mg/L	
			Leachable Lead (Pb)	2021/08/12	<0.1		mg/L	
			Leachable Mercury (Hg)	2021/08/12	<0.001		mg/L	
			Leachable Selenium (Se)	2021/08/12	<0.1		mg/L	
			Leachable Silver (Ag)	2021/08/12	<0.01		mg/L	
			Leachable Uranium (U)	2021/08/12	<0.01		mg/L	
7513346	AFZ	Spiked Blank	Leachable Arsenic (As)	2021/08/12		101	%	80 - 120
			Leachable Barium (Ba)	2021/08/12		105	%	80 - 120
			Leachable Boron (B)	2021/08/12		105	%	80 - 120
			Leachable Cadmium (Cd)	2021/08/12		99	%	80 - 120
			Leachable Chromium (Cr)	2021/08/12		102	%	80 - 120
			Leachable Lead (Pb)	2021/08/12		98	%	80 - 120
			Leachable Mercury (Hg)	2021/08/12		97	%	80 - 120
			Leachable Selenium (Se)	2021/08/12		103	%	80 - 120
			Leachable Silver (Ag)	2021/08/12		97	%	80 - 120
			Leachable Uranium (U)	2021/08/12		100	%	80 - 120
7513346	AFZ	Method Blank	Leachable Arsenic (As)	2021/08/12	<0.2		mg/L	
			Leachable Barium (Ba)	2021/08/12	<0.2		mg/L	
			Leachable Boron (B)	2021/08/12	<0.1		mg/L	
			Leachable Cadmium (Cd)	2021/08/12	<0.05		mg/L	
			Leachable Chromium (Cr)	2021/08/12	<0.1		mg/L	
			Leachable Lead (Pb)	2021/08/12	<0.1		mg/L	
			Leachable Mercury (Hg)	2021/08/12	<0.001		mg/L	
			Leachable Selenium (Se)	2021/08/12	<0.1		mg/L	
			Leachable Silver (Ag)	2021/08/12	<0.01		mg/L	
			Leachable Uranium (U)	2021/08/12	<0.01		mg/L	
7513346	AFZ	RPD	Leachable Arsenic (As)	2021/08/12	NC		%	35
			Leachable Barium (Ba)	2021/08/12	1.8		%	35
			Leachable Boron (B)	2021/08/12	1.6		%	35
			Leachable Cadmium (Cd)	2021/08/12	NC		%	35
			Leachable Chromium (Cr)	2021/08/12	NC		%	35
			Leachable Lead (Pb)	2021/08/12	NC		%	35
			Leachable Mercury (Hg)	2021/08/12	NC		%	35
			Leachable Selenium (Se)	2021/08/12	NC		%	35
			Leachable Silver (Ag)	2021/08/12	NC		%	35
			Leachable Uranium (U)	2021/08/12	NC		%	35
7519867	BYM	Matrix Spike	Sulphide	2021/08/13		98	%	75 - 125
			Sulphide	2021/08/13		98	%	75 - 125
7519867	BYM	Spiked Blank	Sulphide	2021/08/13		110	%	75 - 125
			Sulphide	2021/08/13		110	%	75 - 125
7519867	BYM	Method Blank	Sulphide	2021/08/13	<0.5		mg/kg	
			Sulphide	2021/08/13	<0.5		mg/kg	
7519867	BYM	RPD	Sulphide	2021/08/13	6.3		%	30
7519890	TER	Method Blank	Moisture-Subcontracted	2021/08/11	<0.30		%	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Moisture-Subcontracted	2021/08/11	<0.30		%	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Leachate Blank: A blank matrix containing all reagents used in the leaching procedure. Used to determine any process contamination.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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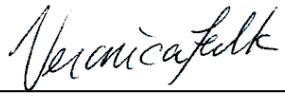
VALIDATION SIGNATURE PAGE

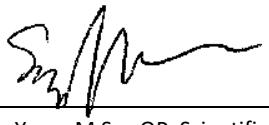
The analytical data and all QC contained in this report were reviewed and validated by:

Anastassia Hamanov, Scientific Specialist



Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

Keino Widjanarko, Project Manager Assistant



Sandy Yuan, M.Sc., QP, Scientific Specialist

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Page 1 of 1

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#5843 Thurber Engineering Ltd	Company Name:		Quotation #:	C05427	BV Labs Job #:	Bottle Order #: 838995
Attention:	Accounts Payable	Attention:	Michael Eastman	P.O. #:			
Address:	2010 Winston Park Dr Suite 103 Oakville ON L6H 5R7	Address:		Project:	25025		
Tel:	(905) 829-8666 Fax:	Tel:	(416) 700-8079 Fax:	Project Name:	Dixie-Dundas Flood Mitigation	COC #: C#838995-01-01	Project Manager: Keino Widjanarko
Email:	accountingON@thurber.ca	Email:	meastman@thurber.ca; mpatel@thurber.ca	Site #:			
				Sampled By:			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___	☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558. ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___	

Include Criteria on Certificate of Analysis (Y/N)? ___

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	ANALYSIS REQUESTED (PLEASE BE SPECIFIC): O.Reg.558 TCLP Inorganics Package	Soil Corrosivity Package	# of Bottles	Comments
1		DIX-01 SS#2 2.5'-4.5'	July 30,21	10:00	Soil		✓	✓	3	
2		DUN-01 SS#3 5'-7'	Aug 03,21	10:30	Soil		✓	✓	3	
3										
4										
5										
6										
7										
8										
9										
10										

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ✓
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

05-Aug-21 11:30
Keino Widjanarko
C1M0105
ASR ENV-1129 YTN

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
MIHIR PATEL	21/08/03	4:15		5/8/21	11:30	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei 12/14/13	Custody Seal Present	Yes	No ✓
		Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

NO ICE

Bureau Veritas Canada (2019) Inc. Razeup/Razeup 1Rev.4 2021/08/05 12:35

Your Project #: Campobello job# C1M0105

Attention: Keino Widjanarko

BUREAU VERITAS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2021/08/15
Report #: R3058670
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C156429
Received: 2021/08/05, 14:41

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Moisture	2	N/A	2021/08/11	AB SOP-00002	CCME PHC-CWS m
Sulphide	2	2021/08/10	2021/08/13	AB SOP-00080	EPA9030B/SM4500S2-DF

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your Project #: Campobello job# C1M0105

Attention: Keino Widjanarko

BUREAU VERITAS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2021/08/15
Report #: R3058670
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C156429
Received: 2021/08/05, 14:41

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bureauveritas.com
Phone# (403) 291-3077
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF CHEMICAL ANALYSES OF SOIL

BV Labs ID		ADF479	ADF480		
Sampling Date		2021/07/30 10:00	2021/08/03 10:30		
	UNITS	**DIX-01 SS # 2 2.5' - 4.5'**	**DUN-01 SS # 3 5' - 7'**	**RDL**	**QC Batch**
Misc. Inorganics					
Sulphide	mg/kg	1.4 (1)	17.3	0.5	A315629

RDL = Reportable Detection Limit
(1) Analyzed past method specified hold time

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PHYSICAL TESTING (SOIL)

BV Labs ID		ADF479	ADF480		
Sampling Date		2021/07/30 10:00	2021/08/03 10:30		
	UNITS	DIX-01 SS # 2 2.5' - 4.5'	DUN-01 SS # 3 5' - 7'	RDL	QC Batch
Physical Properties					
Moisture	%	12	17	0.30	A316071
RDL = Reportable Detection Limit					

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

TEST SUMMARY

BV Labs ID: ADF479
Sample ID: DIX-01 SS # 2 2.5' - 4.5'
Matrix: Soil

Collected: 2021/07/30
Shipped:
Received: 2021/08/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A316071	N/A	2021/08/11	Tobi Erinle
Sulphide	SPEC	A315629	2021/08/10	2021/08/13	Bailey Morrison

BV Labs ID: ADF480
Sample ID: DUN-01 SS # 3 5' - 7'
Matrix: Soil

Collected: 2021/08/03
Shipped:
Received: 2021/08/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	A316071	N/A	2021/08/11	Tobi Erinle
Sulphide	SPEC	A315629	2021/08/10	2021/08/13	Bailey Morrison

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

GENERAL COMMENTS

Results relate only to the items tested.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: C156429
Report Date: 2021/08/15

QUALITY ASSURANCE REPORT

BUREAU VERITAS
Client Project #: Campobello job# C1M0105

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**
A315629	Sulphide	2021/08/13	98	75 - 125	110	75 - 125	<0.5	mg/kg	6.3	30
A316071	Moisture	2021/08/11					<0.30	%	10	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

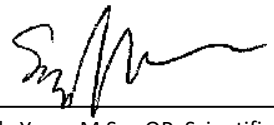
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

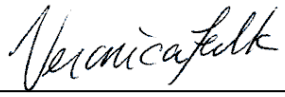
Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Sandy Yuan, M.Sc., QP, Scientific Specialist



Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

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Appendix D Site Photographs

Photo 1. Looking south along Dixie Road towards drill rig setting up at DIX-01. [taken July 2021]

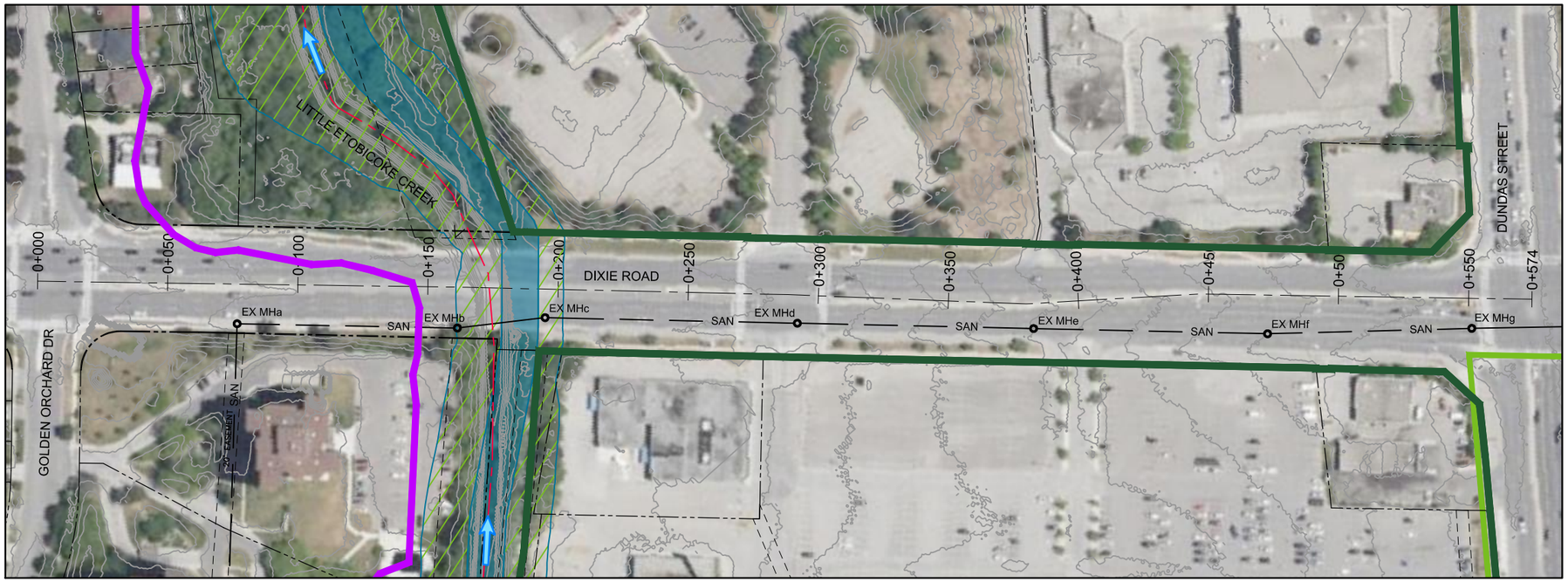
Photo 2. Looking west towards Borehole DIX-01 upon completion of drilling. [taken July 2021]

Photo 3. Looking east along Dundas Street East towards drill rig setting up at DUN-01. [taken August 2021]

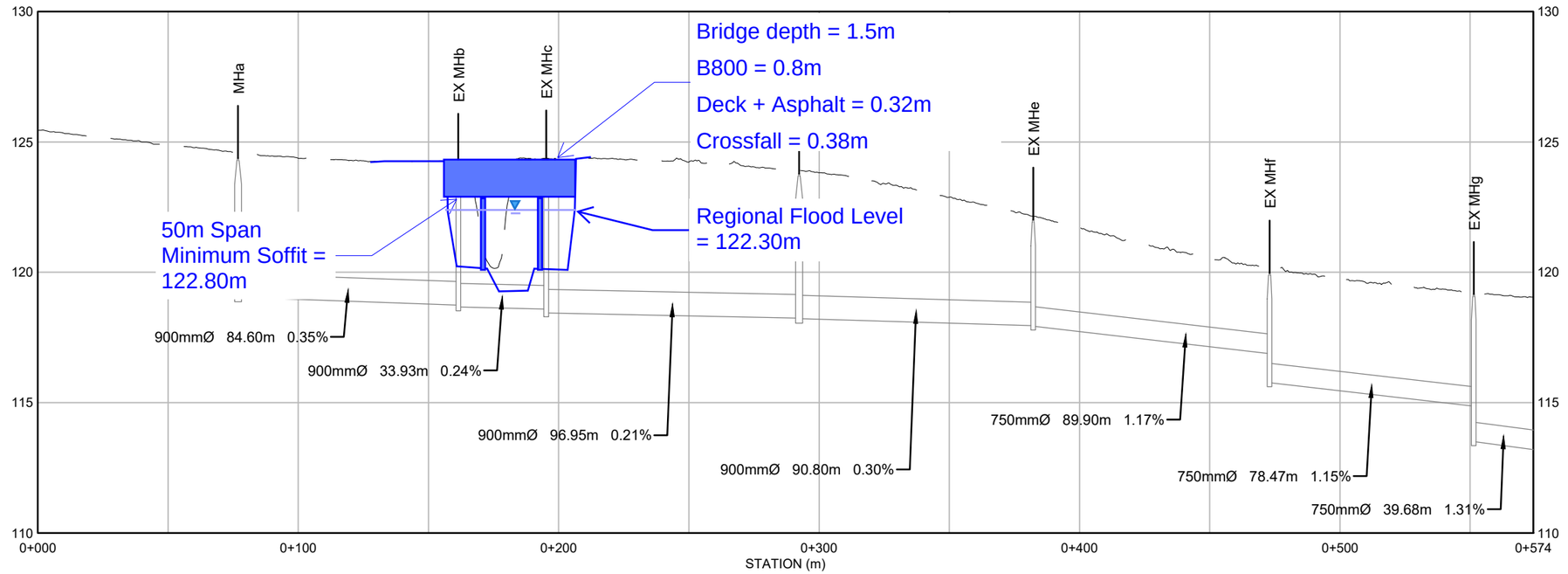
Photo 4. Looking north towards Borehole DUN-01 upon completion of drilling. [taken August 2021]

THURBER

Appendix E Conceptual Bridge Drawings



PLAN



DIXIE ROAD PROFLE

LEGEND

- EXISTING CREEK CENTRELINE
- PROPERTY LINE
- EASEMENT
- CREEK CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- FLOW DIRECTION

1 : 2,000 metres
20 0 20 40
HORIZONTAL SCALE

1 : 200 metres
2 0 2 4
VERTICAL SCALE

Note: 0.5m freeboard above Regional Flood for climate change resiliency

REFERENCE:
1. BASE DIGITAL INFORMATION OBTAINED FROM THE CITY OF MISSISSAUGA, DATA DATED: (SHP AND DGN FORMAT).
2. CONTOUR INFORMATION PROVIDED BY TRCA LiDAR (1m) SURVEY 2017.
3. ADDITIONAL CREEK CONTOUR DATA DERIVED FROM CHANNEL SURVEY (APRIL 2013).

REVISION					
A	2023-02-06	FOR REVIEW	AH	SB	KW
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

DIXIE ROAD CROSSING
50m Span PLAN / PROFILE

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
FEBRUARY 2023	A.HOFBAUER	S.BRAUN	K. WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	1

THURBER ENGINEERING LTD.

February 21, 2020 File: 25025

Matrix Solutions Inc.
Unit 7B, 650 Woodlawn Rd W
Guelph, ON N1K 1B8

Attention: Andrew Doherty, P.Eng.

GEOTECHNICAL DESKTOP STUDY
DIXIE-DUNDAS FLOOD MITIGATION
MISSISSAUGA, ONTARIO

Dear Mr. Doherty:

Thurber Engineering Ltd. (Thurber) is pleased to provide this letter summarizing the results of our geotechnical desktop study in support of a flood mitigation study of Little Etobicoke Creek by the intersection of Dixie Road and Dundas Street East in Mississauga, Ontario.

Activities carried out in association with this geotechnical desktop study consisted of the following:

- A review of available information from the Ministry of Transportation (MTO) Foundation Library service (i.e. Geocres);
- Site visits in order to assess the site conditions within the study area, including existing slopes, creekbanks and pavements; and
- Preparation of a geotechnical desktop study report providing preliminary geotechnical recommendations for slope/creek stabilization and bridge design as well as recommendations for further work during detailed design.

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

SITE AND PROJECT DESCRIPTION

The anticipated extents of flood mitigation work along Little Etobicoke Creek include approximately 500 m upstream of Dixie Road Bridge and downstream to the north side of the Dundas Street East Bridge in Mississauga, Ontario (see Site Plan Sketch following the text of this letter).

The existing Dixie Road Bridge structure is located about 375 m north of Dundas Street East. The existing structure is a single span bridge that carries Dixie Road over Little Etobicoke Creek. The creek flows in a southerly direction towards Lake Ontario. The Dundas Street East Bridge is located approximately 550 m east of Dixie Road.

The purpose of the flood mitigation study is to provide a comprehensive flood remediation plan for the site. The first stage will be a feasibility investigation to narrow down viable technical

solutions that could be implemented to remove the flood spill. The second stage will be to undertake the Municipal Class Environmental Assessment (EA) process culminating in a preferred solution. The third stage will be to complete the detailed design and permitting for the preferred solution. Our geotechnical desktop study was carried out as part of the work for the first stage.

SITE RECONNAISSANCE

Mr. Michael Eastman, P.Eng. of Thurber, completed a site visit on June 6, 2019. The site visit consisted of a visual assessment of the study area from approximately 500 m upstream to 50 m downstream of Dixie Road Bridge. A second site visit was completed by Mr. Michael Eastman, P.Eng. and Mr. Renato Pasqualoni, P.Eng. of Thurber for the expanded study area to the north side of the Dundas Street East Bridge (refer to site photographs in Appendix A). Noteworthy findings from the site visits are discussed below:

- The existing Dixie Road Bridge over Little Etobicoke Creek currently consists of three northbound lanes and four southbound lanes with sidewalks along the east and west sides of the northbound and southbound lanes, respectively.

- In general, the pavement condition over the Dixie Road Bridge and on the north approach is considered in good condition, with few areas of visible distress.

- South of the structure, the pavement condition along Dixie Road is considered in fair to poor condition, with frequent slight to moderate severity wheelpath, transverse, and construction joint cracking.

- The existing Dixie Road Bridge is a single span structure with abutments on the north and south sides of the creek.

- Concrete stormwater outfall structures with armourstone drop-spillways were observed, one on the north side of the creek approximately 7 m downstream of Dixie Road Bridge and one approximately parallel with Goldmar Drive.

- Two pedestrian bridges cross the creek within the study area, one approximately 185 m west (upstream) of Dixie Road Bridge and one about 385 m west (upstream) of Dixie Road Bridge.

- The existing slopes adjacent to the creek are at approximately 2 horizontal to 1 vertical (2H:1V) from approximately 500 m upstream to 50 m downstream of Dixie Road Bridge; however, steeper slopes were observed along the west bank opposite Willowcreek Park and near vertical slopes were noted along the east bank behind Eddie's Meat Market (approximately 40 m north of Dundas Street East Bridge).

- Three to four rows of armourstone with near vertical slopes were present on both sides of the creek from approximately 500 m upstream to 50 m downstream of Dixie Road Bridge; however, portions of the creek approximately parallel with Goldmar Drive, along

Willowcreek Park and behind Eddie's Meat Market had no armourstone, and were confirmed to have significant toe and slope face erosion.

- Gabion baskets were noted along the east bank along Willowcreek Park.
- Thick vegetation was generally present along the slopes throughout the study area, except where the slope was eroded at the toes and face downstream of Dixie Road Bridge, as noted above.
- The creek flows in a southerly direction towards Lake Ontario.
- The creek bed generally consists of fluvial deposits comprising sand and gravel with cobbles and boulders as well as potential slabs of shale bedrock.
- Multiple downed trees were observed within the study area.

REVIEW OF AVAILABLE INFORMATION

A search of available subsurface information from the MTO Foundation Library service (i.e. Geocres) found an existing geotechnical report that was prepared for a previous culvert extension at Dundas Street East. The report, titled "Foundation Investigation for Dixie Creek Culvert Extension, Highway No.5, Ontario, MTO Geocres No. 30M11-169", dated February 4, 1957, was prepared by Racey, Maccallum and Associates Limited. A copy of the geotechnical report is included in Appendix B. Based on the 1957 report, we understand that at Dundas Street East, bedrock consisting of grey shale with interbeds of limestone was encountered at a depth of approximately 3.0 m below the creek level.

From published geological maps of the Ontario Geological Survey, the quaternary geology at the study area is expected to consist of exposed or thinly drift-covered shale and dolostone bedrock or modern alluvium comprising undifferentiated gravel, sand, silt, clay and muck. A copy of Map 2233 is provided in Appendix B.

DISCUSSION

Preliminary Recommendations for Slope/Creek Stabilization

It is anticipated that the slopes on either side of the creek consist of native soil and/or earth fill overburden. Ground conditions must be confirmed prior to final design. The majority of the existing slopes adjacent to the creek appear to be stable within the study area with localized areas of steeper slopes/erosion observed along Willowcreek Park and just north of Dundas Street East . The slopes are predominantly well vegetated and do not appear to show any visible signs of tension cracks, seepage, bulging or instability, with the exception of the noted areas mentioned previously.

Design for widening of the creek will result in cutting back the slopes into the existing overburden. Similar erosion protection measures will be required for new slopes if the existing creek is widened in order to protect the creek (i.e. armour stone walls, vegetation, etc.).

On a preliminary basis, new cut or fill slopes can be designed with an inclination of 3H:1V, or flatter. Where earth fill is to be installed, it should be placed in maximum 200 mm thick lifts and should be compacted to at least 95 percent of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

The excavation operations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA) guidelines as well as good construction practice. Temporary open cut excavations should be made with side slopes no steeper than 1H:1V. Creek and surface water should be directed away from the excavation area to prevent ponding of water. Where site conditions do not allow adequate side slopes as per OHSA, then suitable safety and support measures must be undertaken to the requirements of the OHSA. These measures include installation of a suitable temporary shoring system such as soldier pile and lagging walls, sheet pile walls or cast in place secant walls. Further guidance for temporary shoring can be provided following completion of a detailed geotechnical investigation as part of the third stage.

Excavated soils should be properly managed and disposed in accordance with applicable regulations. Assessment of the quality of soils to remain on site or to be used as clean fill off site should be conducted in accordance with the generic soil quality standards presented in Ontario Regulation (O. Reg.) 153/04. Where impacted soils are encountered, they must be handled as waste under the requirements of O. Reg. 347.

Excavations below the groundwater level will require dewatering. For pumping rates that exceed 50,000 L/day, but less than 400,000 L/day, an Environmental Activity and Sector Registry (EASR) would be required. A Permit to Take Water (PTTW) would be required for pumping rates in excess of 400,000 L/day. The quality of groundwater for discharge to Peel Region storm and/or sanitary sewers should be investigated in order to assess treatment and permitting requirements.

Preliminary Foundation Options for Dixie Road Bridge Widening/Replacement

Various foundation options have been considered for support of the bridge structure. Based on the subsurface conditions encountered across the site from the available information, both shallow and deep foundations are feasible at the bridge structure. Preliminary recommendations on the various foundation options are provided below.

It is anticipated that bedrock will be encountered at a relatively shallow depth (i.e. at approximately 3.0 m). Where bedrock is relatively shallow, the bridge structure may be founded on spread footings bearing directly on bedrock. Additional recommendations including geotechnical resistances can be provided after completion of a detailed geotechnical investigation as part of the third stage.

The bridge may also be supported on caissons socketed into bedrock. The use of a liner or casing will likely be required to advance the caissons through the overburden with minimal loss of ground.

To provide fixity, the caissons should be provided with a minimum socket length equal to 2 times the caisson diameter. Additional recommendations including caisson tip elevations and geotechnical resistances can be provided after completion of the geotechnical investigation as part of the third stage.

Scour and erosion protection will be required for bridge and retaining wall foundations.

RECOMMENDATIONS FOR FURTHER WORK

Preliminary geotechnical and pavement investigations will be required to further assess the subsurface conditions at this site prior to final design. Based on our review of existing conditions and available geological maps, the following presents our recommendations for preliminary investigations:

Geotechnical Investigation

A total of 14 boreholes would be advanced within the study area.

- Four boreholes should be advanced for the new north and south bridge abutments (two boreholes at each abutment) to depths of 8 m (it is assumed that the top 3 m would be through overburden and the lower 5 m would require rock coring); and

- Ten boreholes should be advanced along the creek bank within the study area to depths of 4 m or upon practical refusal on bedrock, in order to provide further recommendations for creek widening and slope design.

Monitoring wells should be sealed into two bridge boreholes to allow subsequent measurement of the groundwater level at the site. Subsequent to the completion of the field investigation, three additional monitoring visits should be carried out to identify fluctuations in the groundwater levels. The monitoring wells installed at the site would be decommissioned in accordance with Ontario Regulation 128/04.

In-situ hydraulic conductivity testing should be undertaken at both monitoring wells to estimate the in-situ hydraulic conductivity of the overburden soils in the vicinity of the well screens. Rising head tests should be carried out by rapidly lowering the water level in the well and recording the resultant water level recovery with an electronic data logger.

In order to assess soil handling and disposal requirements, representative soil samples should be submitted to an independent Canadian Association for Laboratory Accreditation (CALA) accredited laboratory for select analysis of polycyclic aromatic hydrocarbons (PAHs), metals and inorganics, petroleum hydrocarbons (PHCs) fractions F1-F4, volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs). Chemical analysis related to potential sulphate attack on buried concrete and corrosion of buried steel should also be carried out on select soil samples.

In order to assess treatment and discharge options for groundwater, if required, four groundwater samples, two from each monitoring well, should be submitted for analysis of the Region of Peel's

Wastewater Bylaw. Samples should include filtered and unfiltered samples from each well in order to allow for assessment of filtration as a treatment options for groundwater.

Pavement Investigation

Understanding that the scope of the project will only focus on replacing the existing Dixie Road Bridge structure, the scope of the pavement investigation would be limited to determining the existing pavement layer thicknesses on Dixie Road for reinstatement purposes. It is understood that four foundation boreholes will be advanced in the outside lanes for the new structure abutments. For pavement purposes, the information obtained from these boreholes should be augmented by advancing an additional four pavement boreholes (1.5 m deep) located 25 m further from the structure, in the same lane as the foundation boreholes. Additionally, we would also recommend advancing another two pavement boreholes (1.5 m deep) in the median/SB Left-turn lane. It is important to note that additional boreholes may be warranted should pavement widening be required for Dixie Road (to accommodate construction staging) or if pavement rehabilitation recommendations are required for Dixie Road for a longer section away from the structure.

THURBER

CLOSURE

We trust this letter meets your requirements. If you have any questions or require further information, please contact the undersigned at your convenience.

Yours truly,

Thurber Engineering Ltd.

Michael Eastman, P.Eng.
Geotechnical Engineer

Renato Pasqualoni, P.Eng.
Review Principal

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

2. COMPLETE REPORT

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

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

3. BASIS OF REPORT

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

4. USE OF THE REPORT

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

5. INTERPRETATION OF THE REPORT

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

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

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

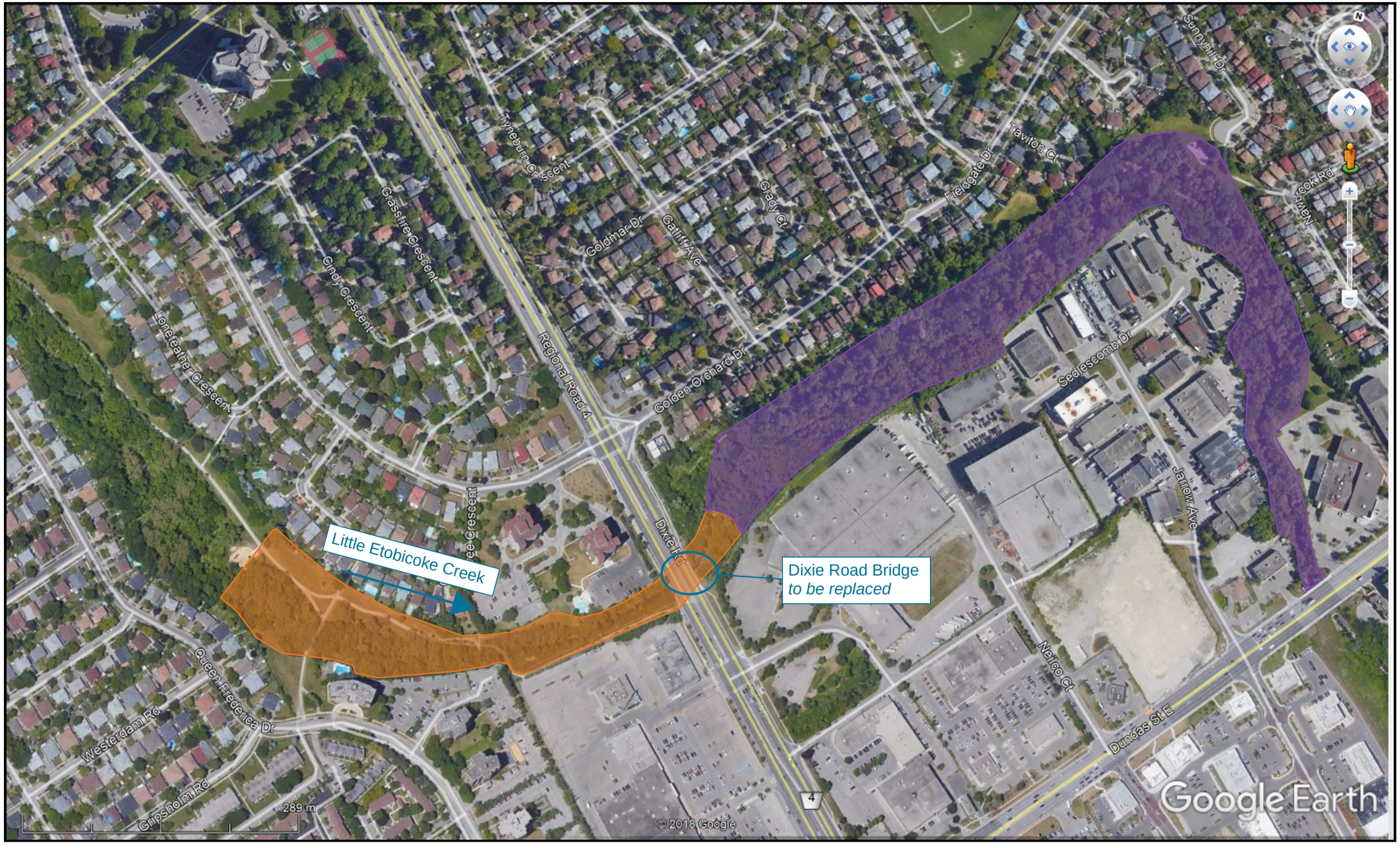
d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted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

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

7. INDEPENDENT JUDGEMENTS OF CLIENT

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



Original Site Area - 500 m Upstream to 50 m Downstream of Dixie Road (Matrix 2018)

Extended Site Area to Dundas Street

Matrix Solutions. 2018. *Consulting Services for the Dixie-Dundas Flood Mitigation*. Proposal for the City of Mississauga

Site Plan Sketch

Dixie-Dundas Flood Mitigation Project

July 8, 2019

THURBER

APPENDIX A

Site Photographs

Photograph 1: Looking north towards Dixie Dundas Bridge from east sidewalk.

Photograph 2: Looking north towards Dixie Dundas Bridge from west sidewalk.

Photograph 3: Looking upstream from east side of Dixie Dundas Bridge.

Photograph 4: Looking north at stormwater outfall structure located approximately 7 m downstream of Dixie Road Bridge.

Photograph 5: Looking upstream from underneath Dixie Dundas Bridge.

Photograph 6: Looking at creek bed from underneath Dixie Dundas Bridge.

Photograph 7: Looking south from west side of Dixie Dundas Bridge.

Photograph 8: Looking upstream from underneath Dixie Dundas Bridge.

Photograph 9: Looking downstream from approximately 50 m west of Dixie Dundas Bridge.

Photograph 10: Looking upstream at a fallen tree located approximately 50 m west of Dixie Dundas Bridge.

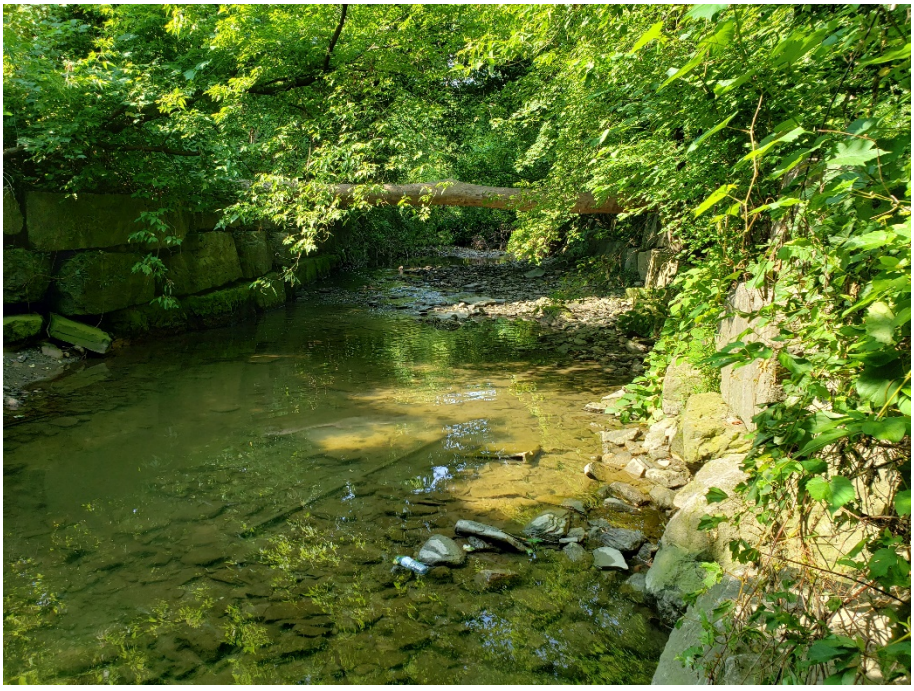
Photograph 11: Looking downstream from a pedestrian bridge located approximately 185 m west of Dixie Dundas Bridge.

Photograph 12: Looking upstream from a pedestrian bridge located approximately 185 m west of Dixie Dundas Bridge.

Photograph 13: Looking downstream from a pedestrian bridge located approximately 385 m west of Dixie Dundas Bridge.

Photograph 14: Looking upstream from a pedestrian bridge located approximately 385 m west of Dixie Dundas Bridge.

Photograph 15: Looking downstream from a walking trail approximately parallel with Goldmar Drive.



Photograph 16: Looking upstream from a walking trail approximately parallel with Goldmar Drive.

Photograph 17: Looking downstream from Willowcreek Park.

Photograph 18: Looking upstream from Willowcreek Park.

Photograph 19: Looking at steep slope along west bank opposite Willowcreek Park.

Photograph 20: Looking at gabion baskets along east bank at Willowcreek Park.

Photograph 21: Looking downstream from behind Eddie’s Meat Market.

Photograph 22: Looking upstream from behind Eddie’s Meat Market.

Photograph 23: Looking at near vertical slope along east bank opposite Eddie’s Meat Market.

Photograph 24: Looking upstream from Dundas Street East Bridge.

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APPENDIX B

Available Information

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M11-169

W.P. No.

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 5

LOCATION DIKE CREEK CULVERT

SYDENHAM

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. NONE

REMARKS:

GI-30 SEPT. 1975

B 9539

RACEY, MacCALLUM AND ASSOCIATES

LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers

AND ASSOCIATED STAFF

MONTREAL VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.E.M., M.E.I.C., A.M.C.S.E.
P. JOHN RACEY, B.Sc. (M.E.), M.E.I.C., P.Eng.
A. ERIC RAMSAY, B.A., B.Sc. (M.E.), M.E.I.C., A.M.I.E.E., P.Eng.

TORONTO DIVISION
20 CARLTON STREET

30 M11 - 169

RECORDS No.

Reference: S-500-663/T-597

4 February 1957

Department of Highways of Ontario,
c/o Harris, Giffels and Vallet,
9 Richmond Street East,
TORONTO, Ontario.

Attention: Mr. L.C. Amadio.

RE: FOUNDATION INVESTIGATION FOR
DIXIE CREEK CULVERT EXTENSION,
HIGHWAY 10.5, ONTARIO.

Dear Sirs:

Herewith are the boring logs for an investigation performed at the above noted site on 25 and 26 January 1957. We are presenting our comments by letter, because the magnitude of the work does not appear to justify the extra cost of a formal report.

Reference to the attached engineering data sheets indicates that firm bedrock, consisting of grey shale with interbeds of limestone, will be encountered at a depth of approximately nine feet below the present river level, or nineteen to twenty feet below the top surface of the existing culvert. On the west side of the bank, in the vicinity of hole no.1, a weathered shale was encountered five feet above bedrock, and this material was partially softened back to a clay state. This weathered rock was not noted in the east boring under the old embankment, which exists just south and parallel to the present highway. In its place was an extremely dense dry stratum of silty sand with gravel, which extends from river level down to rock. The upper five feet of soil at hole no1 consisted of loose brown medium sand, having a water table coincident with river level. This upper material will not necessarily be representative of surface conditions at all points along the culvert extension line, because the area has been altered by the addition of fill and very probably also by flood water.

4 February 1957

During periods of heavy run-off, relatively high water velocities should be anticipated through this extended culvert, and this fact will probably dictate the depth for the establishment of the footings. In view of the proximity of bedrock and the uncertainties regarding the maximum depth to which scouring effects will extend, it would appear that the support of the footings on bedrock is a reasonable, although somewhat conservative, foundation proposal. The installation of braced sheeting and pumping facilities during excavation must be anticipated, but this work will be required regardless of the foundation depth proposed.

We thank you for this opportunity to be of service to you in this regard, and shall be pleased to discuss the soil conditions in greater detail, if culvert support above bedrock is contemplated.

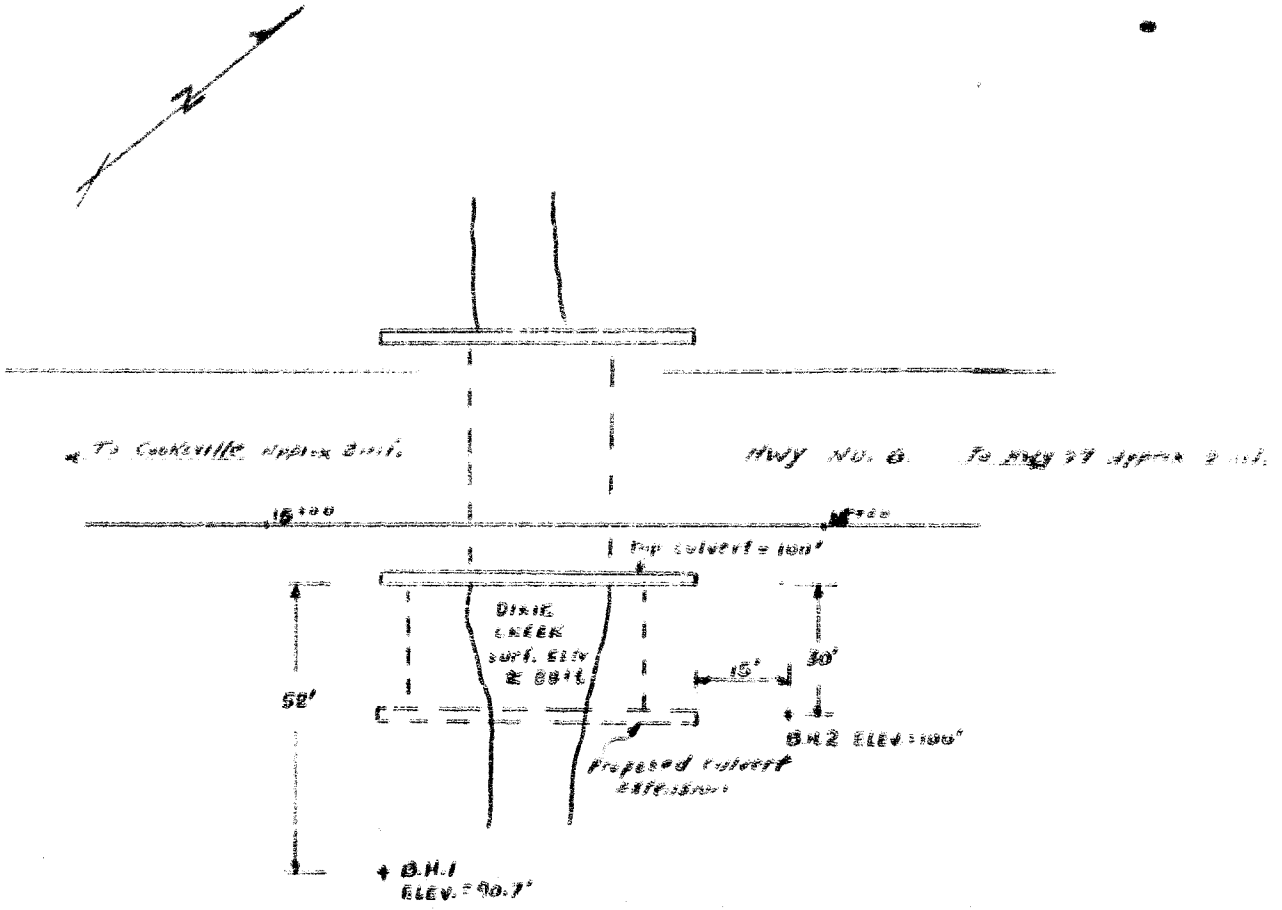
Yours very truly,
RACEY, MacCALLUM AND ASSOCIATES LIMITED

W.A.Trow, P.Eng.,
Divisional Soils Engineer.

WAT/MD
Encls.

Order No. Survey
Prep. By

Enclosure No. 1



30 HILL - 169

SKETCH SHOWING LOCATION OF BORINGS

Rocsy, MacCallum & Associates Ltd.

Cont. No. 2.

Order No. 2500-6431T907 CROW, MACGUIRE AND ASSOCIATES — Driller: Lusk

Engineering Data Sheet for Borehole 1

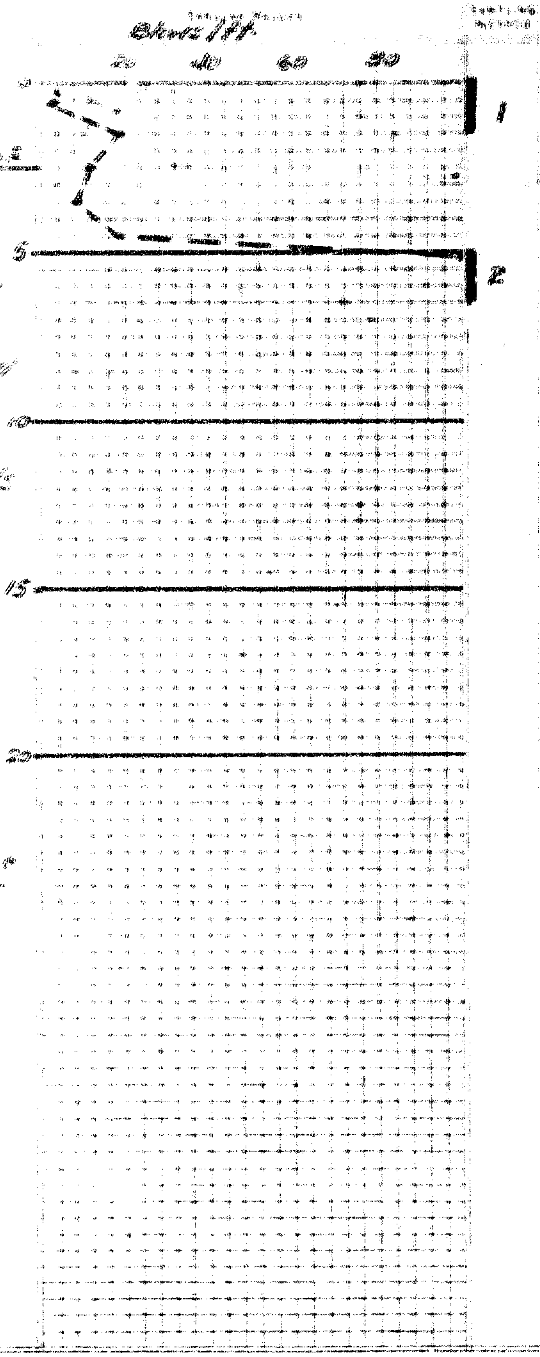
Job Name: DIXIE CREEK CULVERT EXTENSION
Job Location: HWY 5 ± 3 mi. East Castleville Cal.
Hole Location: See Card No. 1
Hole Elevation: 90.7 Datum: Top South End Culvert "100"

Helper

Checked By

Depth	Blows/ft.	Description
0'	40	Ground Surface — Hard organic topsoil; Med. dense brown silty sand
5'	35	Weathered shale partially altered to clay (Refusal to 5" Pennsdell at root.)
8'		Bedrock — gray shale with interbeds of limestone (Full % recovery)

— End of Bore



Legend
———— Penet. Resist. 2" O.D. tube, Energy 4200 "lbs.
Black bar: 2 in. O.D. Shelby tube
* Sash Continuous Flite Penndell used to core

Soil No. 3

Smith RAY(?) ... AND ASSOCIATES

LUSK

Engineering Data Sheet for Borehole: 2

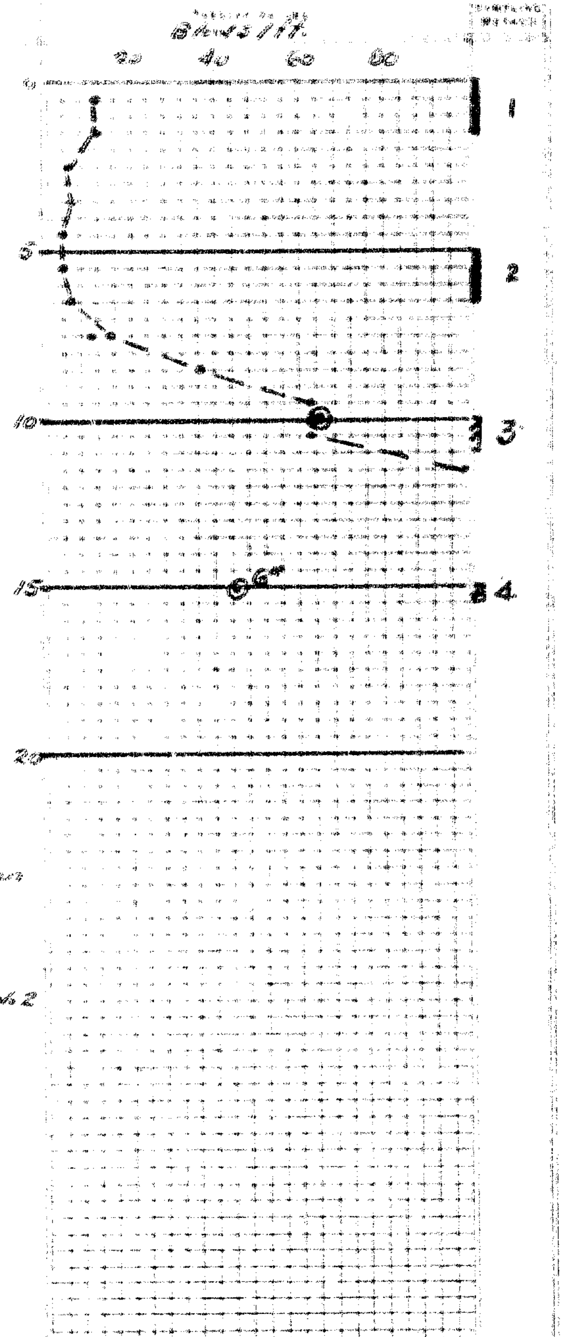
Job Name: DIXIE CREEK CULVERT EXTENSION

Hwy 5 ≈ 3 mi East Cooksville Ont.

See encl. No. 1

Hole Elevation: 100 Datum: Top south rail Culvert = 100'

0	100	Top earth embankment grading to very dense
		Dry brown sandy silt with gravel and some clay
10	90	Very dry silty sand with gravel. Very dense
19"	81	Refusal on dry shale



Legend

⊙ Blows/ft 2" O.D. split spoon

▯ Split spoon

Other symbols as on encl. No. 2

Ontario

Ontario Geological Survey

MAP 2223

QUATERNARY GEOLOGY

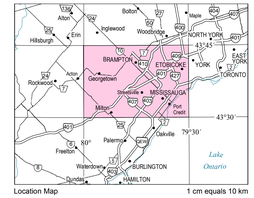
BRAMPTON AREA

Scale 1:50 000

1000 m 0 1 2 km

NTS Reference: 30 M/12

This map is published with the permission of the Director, Ontario Geological Survey.



Location Map 1 cm equals 10 km

LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

RECENT

17 **Fill**

16 **Modern Alluvium:** undifferentiated gravel, sand, silt, clay, muck

15 **Organic Deposits:** peat, muck

PLEISTOCENE

LATE WISCONSIN

14 **Older Terrace Alluvium:** poorly sorted, dirty, sand and gravel

13 **Glacial Lake Iroquois Deposits:** beach gravel

12 **Deltaic and Lacustrine Deposits:** predominantly gravelly sand and silty sand

11 **Deltaic and Lacustrine Deposits:** gravel to gravelly sand

10 **Glaciolacustrine Deposits:** massive to laminated silt and clay; may contain poorly sorted diamicton layers

9 **Outwash Deposits:** predominantly sand

8 **Outwash Deposits:** predominantly gravel

7 **Ice-Contact Deposits:** predominantly poorly sorted sand

6 **Ice-Contact Deposits:** predominantly poorly sorted gravel

5 **Halton Till:** red to brown, gritty to clayey silt till

4 **Lacustrine Deposits:** interstadial silt and clay

3 **Wentworth Till:** stony sand till

2 **Bedrock-Drift Complex:** extensive but discontinuous thin bouldery till, in places sufficiently thick to subdue bedrock topography

PALEOZOIC

1 **Bedrock:** exposed or thinly drift-covered shale and dolostone

SYMBOLS

- Geologic boundary, approximate
- Crest of small moraine (observed, inferred)
- Trend of subdued moraine
- Ice-contact face
- Current or former sand and gravel pit
- Current or former bedrock quarry
- Licensed pit or quarry area
- Esker
- Glacial striae
- Abandoned shoreline
- Bedrock stress-relief feature
- Borehole location (BH1)
- Measured section location (2334)
- Hydroelectric line
- Pipeline

SOURCES OF INFORMATION

Base information on this map is derived from map 30 M/12 of the National Topographic System, scale 1:50 000, NAD83, Zone 17, with additions of more recent road network and quarry locations. Licensed pit/quarry information is from the Ontario Ministry of Natural Resources (MNR), as acquired from the Land Information Ontario Warehouse, current to May, 2004 with updates February, 2005 by staff of MNR Aurora District.

Karrow, P.F. 1991. Quaternary geology of the Brampton area; Ontario Geological Survey, Open File Report 5819, 136p.

——— 1987. Quaternary geology of the Brampton area, western half; Ontario Geological Survey, Preliminary Map P.3072, scale 1:50 000.

Karrow, P.F. and Easton, J. 1990. Quaternary geology, Brampton area; Ontario Geological Survey, Preliminary Map P.3171, scale 1:50 000.

Magnetic declination approximately 10°18'W at the centre of the Brampton map area in 2003, increasing 2' annually.

Contour interval = 10 metres.

CREDITS

Geology by P.F. Karrow and J. Easton, 1984 to 1987.

Edit by G.H. Brown.

Cartographic production by A. Evers.

Every possible effort has been made to ensure the accuracy of the information presented on this map; however, the Ontario Ministry of Northern Development and Mines does not assume any liability for errors that may occur. Users may wish to verify critical information.

Issued 2005.

Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Karrow, P.F. and Easton, J. 2005. Quaternary geology of the Brampton area; Ontario Geological Survey, Map 2223, scale 1:50 000.