GEMTEC
www.gemtec.ca

Geotechnical Investigation
Rehabilitation of Stevenson Crescent
Town of Renfrew, Ontario

GEMTEC
www.gemtec.ca

Submitted to:

Parsons Corporation
1223 Michael Street North, Suite 100
Ottawa, Ontario
K1J 7T2

Geotechnical Investigation
Rehabilitation of Stevenson Crescent
Town of Renfrew, Ontario

May 22, 2025
Project: 100016.023(2)

GEMTEC Consulting Engineers and Scientists Limited
44 Cedar Pointe Drive, Unit 1102
Barrie, ON, Canada
L4N 5R7

May 22, 2025

File: 100016.023(2) – Rev0

Parsons Corporation
1223 Michael Street North, Suite 100
Ottawa, Ontario
K1J 7T2

Attention: Mike Keating, P.Eng.

Re: Geotechnical Investigation
Rehabilitation of Stevenson Crescent, Town of Renfrew, Ontario

Enclosed is our geotechnical investigation report for the above-noted project, in accordance with our proposal dated March 20, 2024. This report was prepared by Trevor Dezan, B.Sc., PMP, and reviewed by John Hagan, P.Eng.

Trevor Dezan, B.Sc., PMP
Project Manager

John Hagan, P.Eng.
Senior Pavement Engineer

TD/JH/af/tc

N:\Projects\100000\100016.023\03_Submittals\100016.023_RPT_Geotechnical Investigation_Stevenson Crescent_2025-05-22_Rev0.docx

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

Conditions and Limitations of This Report

LIST OF APPENDICES

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the detail design of the pavement rehabilitation of Stevenson Crescent in Renfrew, Ontario (referred to herein as 'the Site'). The work is being completed on behalf of the Town of Renfrew in response to an email message from Parsons Corporation (Parsons); Parsons is providing prime engineering consulting services under the Agreement and GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) is a subconsultant to Parsons providing geotechnical investigation and pavement design services.

The purpose of the investigation was to identify and characterize the subsurface conditions at the Site by means of a limited number of boreholes and based on the results of the factual information obtained, to provide engineering guidelines and recommendations on the pavement rehabilitation aspects of this project, along with construction considerations. This report is subject to the Conditions and Limitations of This Report, which follows the text of the report, and are considered an integral part of the report (see Attachments).

The investigation was carried out in general accordance with our proposal dated March 20, 2024.

2.0 PROJECT SITE AND DESCRIPTION

Stevenson Crescent is a 2-lane rural cross section with a total length of approximately 500 m with the current asphalt surface being in poor condition. Extensive moderate to severe alligator, transverse, longitudinal and map cracking, moderate potholing and distortions with frequent manual and machine patching were noted during the investigation. Central Public School is located on Stevenson Crescent making it an active bus route during the school year. The Site and borehole locations are shown on the Borehole Location Plan, Figure 1, presented in Appendix A.

3.0 METHODOLOGY

3.1 Geotechnical Investigation

The field work for the drilling investigation was carried out on May 28, 2024, at which time eight boreholes were advanced using a truck mounted auger rig. The boreholes were advanced through the existing asphalt pavement, to a final depth of about 1.5 metres below surface grade.

Soils and aggregate samples were obtained from the boreholes. The field work was supervised throughout by a member of our engineering staff. Following completion of the drilling, the samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples were submitted for moisture content, grain size distribution and plasticity index.

The results of the drilling investigation are provided on the Record of Boreholes in Appendix B and summarized in the sections below. The approximate locations of the boreholes are shown on

the Borehole Location Plan, Figure 1, in Appendix A. The results of the laboratory classification tests on the soil samples are also provided on the Soils Grading Charts in Appendix C.

3.2 Rehabilitation Design Methods

The existing and required pavement structural capacity for Stevenson Crescent were evaluated according to the Ontario Ministry of Transportation (MTO) report MI-183, *Adaptation and Verification of AASHTO 1993 Pavement Design Guide for Ontario Conditions*.

Structural layer coefficients utilized in the report have been selected based on engineering judgement and the results of laboratory grain size testing, as appropriate.

Assessment of material suitability was made based on the MTO *Pavement Design and Rehabilitation Manual, 2nd Edition*, dated March 2013 and engineering experience, as appropriate.

4.0 GEOTECHNICAL SURVEY DATA

4.1 General

The subsurface conditions described below indicate the conditions at the specific test locations only. Boundaries between zones are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface conditions are indicated depends on the frequency and recovery of samples, the method of sampling and the uniformity of the subsurface conditions. Subsurface conditions at other than the test locations may vary from the conditions encountered in the boreholes.

The soil descriptions in this letter are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgment and GEMTEC does not guarantee descriptions as exact but infers accuracy to the extent that is common in current geotechnical practice.

The results of the drilling investigation are provided on the Record of Borehole sheets in Appendix C.

The following presents an overview of the subsurface conditions.

4.2 Pavement Structure

4.2.1 Asphaltic Concrete

Asphaltic concrete was encountered at all borehole locations drilled through the existing lanes and the thickness of the asphalt was recorded. The asphalt thickness encountered ranged from about 80 to 170 mm with an average thickness of 120 mm.

4.2.2 Granular Base

A layer of crushed granular base material was encountered below the asphaltic concrete at all borehole locations. The granular base material is typically composed of brown crushed sand and gravel, some silt. The thickness of the base material encountered ranged from about 135 to 435 mm with an average thickness of 250 mm.

The results of grain size distribution testing completed on samples of the base material from Boreholes 24-01 and 24-07 are presented in Appendix C. Both samples tested failed to satisfy the current Ontario Provincial Standard Specification OPSS.PROV 1010 gradation specifications for Granular A material due excessive fines.

Moisture content testing carried out on samples of the granular base material ranged from about 3 to 4 percent.

4.2.3 Fill

A layer of fill material was encountered below the granular base at all borehole locations excluding Boreholes 24-03 and 24-06 where subgrade was encountered directly below the granular base. The fill material is typically composed of brown silt and sand, with gravel. The thickness of the fill material encountered ranged from about 140 to 590 mm with an average thickness of 300 mm.

The results of grain size distribution testing completed on samples of the fill material from Boreholes 24-02 and 24-05 are presented in Appendix C. Both samples tested failed to satisfy the current Ontario Provincial Standard Specification OPSS.MUNI 1010 gradation specifications for Granular B, Type I material due to excessive fines. One of the samples tested satisfies the current Ontario Provincial Standard Specification OPSS. MUNI 1010 gradations specifications for Select Subgrade Material (SSM).

Moisture content testing carried out on samples of the fill material ranged from about 6 to 14 percent.

4.3 Subgrade

4.3.1 Clayey Silt

A cohesive deposit of brown clayey silt, trace sand was encountered below the granular / fill materials in all the boreholes advanced at the Site. The clayey silt deposit extended to the termination depth of all of the boreholes.

The results of the grain size distribution testing on a sample of the clayey silt material from Borehole 24-03, is provided in Appendix C and summarized as follows:

Table 4.1 – Summary of Grain Size Distribution (Clayey Silt Subgrade)

Location	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
24-03	0.4 – 0.6	0	2.1	62.2	35.7

The frost heave susceptibility of the subgrade sample tested was assessed using the MTO *Pavement Design and Rehabilitation Manual*, 2nd Edition, dated March 2013, which is based on the percentage of soil particles in the 5µm to 75µm range. The samples were evaluated to have high susceptibility to frost heave.

The water content of the sample was recorded to be about 32 percent.

At Borehole 24-01 potential contamination of the subgrade material was noted during drilling based on visual and olfactory assessment. No further testing was conducted for environmental purposes as it was outside of the scope of this project.

4.4 Groundwater

Unstabilized groundwater levels, measured in the open boreholes upon completion of drilling were noted to be dry. The groundwater levels as encountered in the boreholes were not considered to be stabilized. Further, the groundwater levels will vary depending on seasonal fluctuations, precipitation and local soil permeability and should be expected to be higher during wet periods of the year such as the early spring or following periods of precipitation.

5.0 PAVEMENT REHABILITATION DESIGN AND RECOMMENDATIONS

5.1 General

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the boreholes advanced as part of this investigation and the project requirements. It is stressed that the information in the following sections is provided for the guidance of the designers and is intended for this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this Site. The presence or implications of possible surface and / or subsurface contamination resulting from previous uses or activities of this Site or adjacent properties, and / or resulting from the introduction onto the Site from materials from off-site sources are outside the terms of reference for this report and have not been investigated or addressed.

5.2 Pavement Structure for Design Analysis

The related ESAL and AASHTO designs of the recommended alternatives are attached to this report and summarized in the following sections.

The ESAL calculation is based on estimated traffic data based on information provided by Parsons. Cumulative ESALs over a design period of 10 to 20 years have been used to complete the structural analysis for Stevenson Crescent. Design parameters used to calculate the ESALs are outlined in the table below.

Table 5.1 – Design Inputs for ESALs Evaluation

Parameter	Value
2022 AADT	500
2035 AADT	553
2045 AADT	611
AADT Compound Growth Rate %	1%
Truck Factor	0.78 ESALs / Truck
% Commercial Traffic	1%
School Buses	30/day
School Bus Truck Factor	1.1 ESALs / Bus

The following design parameters and material structural and drainage coefficients for each layer, have been used for pavement design and analysis:

Table 5.2 – Design Inputs for SN Evaluation

Parameter	Selected Value(s)
Cumulative ESALs for Design Period (20 year service life)	147,850
Cumulative ESALs for Design Period (15 year service life)	110,580
Cumulative ESALs for Design Period (10 year service life)	73,520
Initial Serviceability	4.2
Terminal Serviceability	2.0

Parameter	Selected Value(s)
Reliability Level	80%
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus (Low plasticity clays, Fair Condition)	30 MPa
Structural Coefficient of New HMA	0.42
Structural Coefficient of Existing HMA	0.18
Structural / Drainage Coefficients of New Granular Base	0.14 / 1
Structural / Drainage Coefficients of Existing Granular Base	0.11 / 0.9
Structural / Drainage Coefficients of Pulverized Based	0.14 / 1

5.2.1 AASHTO ’93 Method

Based on the subgrade soil condition, the traffic data provided and the average weighted truck factor, approximately 73,520 to 147,850 ESALs are anticipated for a 10 to 20 year design life, depending on the rehabilitation treatment selected. To support the traffic loading, a target structural number (SN) of approximately 65 to 72 is required for design purposes.

5.3 Rehabilitation Alternatives Recommended for Consideration

Based on the observed surface conditions, and facility use (anticipated traffic types and volumes), the following rehabilitation strategies were prepared.

- ***Option 1 (Mill & Pave):*** Partial depth removal to a 50 mm depth, pave with 50 mm of new HMA (SN of 57, 5 year service life). No grade raise. The new typical (average) pavement structure thickness would comprise:
  - 50 mm new Superpave 12.5 HMA;
  - 70 mm existing HMA (average); and,
  - 250 mm existing crushed granular base material.
- ***Option 2 (Full Depth Asphalt Removal and Pave):*** Full depth removal of the existing HMA (120 mm average). Place new Granular A as required to grade and correct cross fall (as required), pave 110 mm new HMA (SN of 71, 20 year service life). No grade raise. The new typical (average) pavement structure thickness would comprise:
  - 50 mm new Superpave 12.5 HMA;
  - 60 mm new SP 19.0 HMA; and,
  - 250 mm existing crushed granular base material.

- ***Option 3 (Pulverize and Pave):*** Full depth reclamation to a depth of 200 mm. Regrade to correct cross fall, pave 100 mm new HMA (SN of 84, 20 year service life). 100 mm grade raise. The new typical (average) pavement structure thickness would comprise:
    - 40 mm new Superpave 12.5 HMA;
    - 60 mm new SP 19.0 HMA;
    - 200 mm pulverized base material; and,
    - 170 mm existing crushed granular base material.
- ***Option 4 (Full Depth Reconstruction):*** Excavate to a depth of 550 mm. Place 300 mm new Granular B Type I, 150 mm of new Granular A and 100 mm of new HMA (SN of 96, 20 year service life). No grade raise. The new typical (average) pavement structure thickness would comprise:
    - 40 mm new Superpave 12.5 HMA;
    - 60 mm new SP 19.0 HMA;
    - 150 mm new OPSS Granular A; and,
    - 300 mm new OPSS Granular B, Type I.

6.0 PAVEMENT RECOMMENDATIONS AND DISCUSSION

Option 1 consisting of a mill and pave strategy is not recommended based on the existing poor pavement condition of the asphalt along Stevenson Crescent. The extensive moderate to severe alligator, map, transverse and longitudinal cracking of the existing asphalt would cause reflective cracking which could result in premature degradation of the pavement structure. Options 2, 3 and 4 all provide a longer service life of 20 years. Option 3 would result in a grade raise of about 100 mm. The grade raise would result in increased construction costs associated with raising manholes and grading / repaving of residential entrances. Along with the increased construction costs associated with pulverization due to the grade raise (raising the existing manholes and grading/repaving the residential entrances), there are also constructability issues. When manholes, catch basins, water valves or any other service access point are located on the roadway, the machine must lift over the access for the service. A smaller machine is then needed to come in and grind out the existing asphalt around the manhole, or it is manually removed from around the manhole. This makes the process longer and more labour intensive. Pulverizing also creates vibrations that would be disruptive to the property owners and surrounding area of Stevenson Crescent. Pulverizing works best on sections of road with no catch basins, manholes, water vales etc. Option 4 would be the most expensive and most disruptive option and a full depth reconstruction is not currently warranted unless servicing rehabilitation/replacement is to be completed.

The recommended pavement strategy for the project is Option 2 (Full Depth Asphalt Removal & Pave) which has a service life of 20 years.

6.1 Materials

6.1.1 Hot-Mix Asphalt and Asphalt Cement

All HMA materials should meet the requirements of OPSS.MUNI 1151 and be constructed and compacted according to the requirements of OPSS.MUNI 313. Aggregates for HMA should conform to OPSS 1003 as amended by SP110S18.

Performance graded asphalt cement (PGAC) 58-34 is recommended for the SP12.5 surface course mix and SP19.0 mix. Asphalt cement should meet the requirements of OPSS.MUNI 1101.

The recommended HMA surface course for this project is Superpave 12.5, to be placed at 50 mm thickness for the lanes throughout the contract. Based on the 20-year ESALs, the mix should be coarse graded and designed for Traffic Category B under OPSS.MUNI 1151.

6.1.2 Granular Material Type and Preparation (if required)

The granular materials used on this project shall consist of Granular A for base requirements. These materials should be in accordance with OPSS.MUNI 1010.

Granular materials should be compacted to 100 percent Standard Proctor Maximum Dry Density. Compaction of granular materials should be carried out in conformance with the procedures outlined in OPSS.MUNI 501.

The exposed base granular surface following full depth asphalt removal should be shaped / graded and prepared according to OPSS.MUNI 301 and should also undergo the same compaction effort as new Granular A material for the project.

6.1.3 Pavement Transitions

All longitudinal and transverse joints should be constructed according to OPSS.PROV 310.07.11. Tack coat should also be applied to the vertical faces of joints as indicated in OPSS.MUNI 310.

7.0 ADDITIONAL CONSIDERATIONS

7.1 Effects of Construction Induced Vibration

Some of the construction operations (such as excavation and granular material compaction) will cause ground vibration on and off of the site. The vibrations will attenuate with distance from the source but may be felt at nearby structures. The magnitude of the vibrations should be much less than that required to cause damage to the nearby structures or services that are in good condition. Nevertheless, we recommend that preconstruction surveys be carried out on any adjacent structures so that any damage claims can be addressed in a fair manner.

7.2 Excess Soil Management

It should be noted that the soil samples recovered during this investigation were not tested to assess the presence of contamination, either naturally occurring or due to human activity. This report does not constitute an excess soil management plan in accordance with Ontario Regulation (O.Reg) 406/19 legislation. The disposal requirements for excess soil from the site have not been assessed.

7.3 Design Review

The details for the proposed construction were not available to us at the time of preparation of this report. It is recommended that the design drawings be reviewed by the geotechnical engineer as the design progresses to ensure that the guidelines provided in this report have been interpreted as intended.

7.4 Construction Observation

The placing and compaction of granular materials and / or engineered fill should be inspected to ensure that the materials used conform to the specifications.

8.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Regards,

GEMTEC Consulting Engineers and Scientists Limited

Trevor Dezan, B.Sc., PMP
Project Manager

LICENSED PROFESSIONAL ENGINEER
J. B. HAGAN
100171186
May 1/2025
PROVINCE OF ONTARIO

John Hagan, P.Eng.
Senior Pavement Engineer

GEMTEC
Consulting Engineers and Scientists

Conditions and Limitations of This Report

1. **Standard of Care:** GEMTEC has prepared this report in a manner consistent with generally accepted engineering or environmental consulting practice in the jurisdiction in which the services are provided at the time of the report. No other warranty, expressed or implied is made.
2. **Copyright:** The contents of this report are subject to copyright owned by GEMTEC, save to the extent that copyright has been legally assigned by us to another party or is used by GEMTEC under license. To the extent that GEMTEC owns the copyright in this report, it may not be copied without our prior written agreement for any purpose other than the purpose indicated in this report. The methodology (if any) contained in this report is provided to the Client in confidence and must not be disclosed or copied to third parties without the prior written agreement of GEMTEC. Disclosure of that information may constitute an actionable breach of confidence or may otherwise prejudice our commercial interests.
3. **Complete Report:** This report is of a summary nature and is not intended to stand alone without reference to the instructions given to GEMTEC by the Client, communications between GEMTEC and the Client and to any other reports prepared by GEMTEC for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. GEMTEC can not be responsible for use of portions of the report without reference to the entire report.
4. **Basis of Report:** This Report has been prepared for the specific site, development, design objectives and purposes that were described to GEMTEC by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this report expressly addresses the proposed development, design objectives and purposes. Any change of site conditions, purpose or development plans may alter the validity of the report and GEMTEC cannot be responsible for use of this report, or portions thereof, unless GEMTEC is requested to review any changes and, if necessary, revise the report.
5. **Time Dependence:** If the proposed project is not undertaken by the Client within 18 months following the issuance of this report, or within the timeframe understood by GEMTEC to be contemplated by the Client, the guidance and recommendations within the report should not be considered valid unless reviewed and amended or validated by GEMTEC in writing.
6. **Use of This Report:** The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without GEMTEC's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, GEMTEC may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process.

   Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.
7. **No Legal Representations:** GEMTEC makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

8. **Decrease in property value:** GEMTEC shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.
9. **Reliance on Provided Information:** The evaluation and conclusions contained in this 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 us. We have relied in good faith upon representations. information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of misstatements, omissions, misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of of the subsurface descriptions.

    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination-or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.
11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.
12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

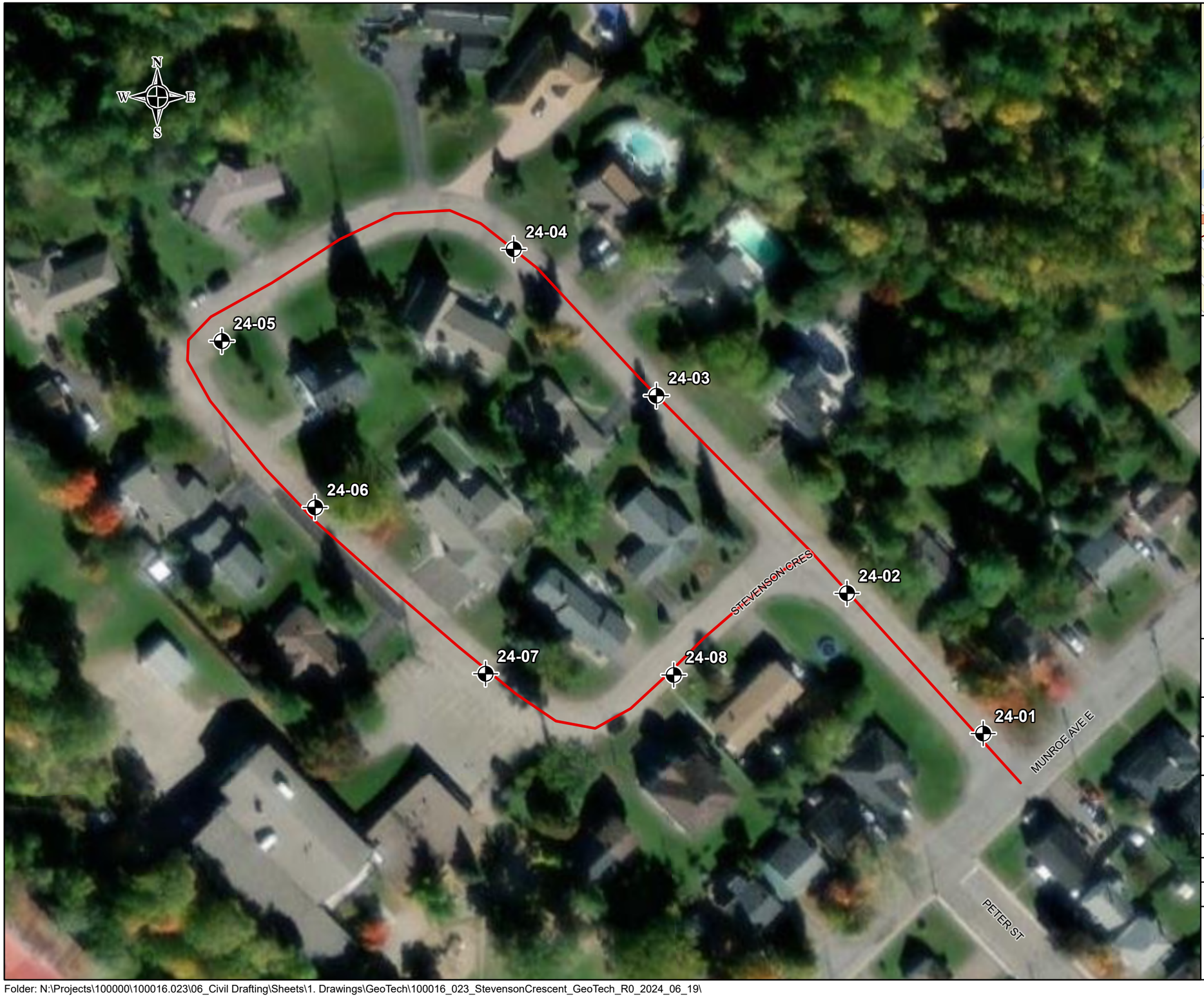
    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not

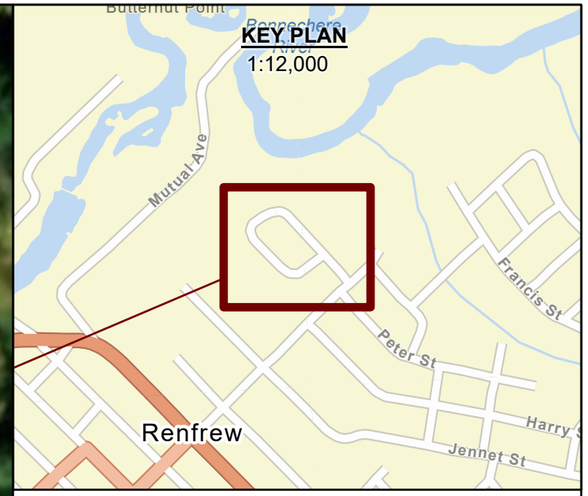
materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.
14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX A

Borehole Location Plan





Legend

24-# BOREHOLE ID

BOREHOLE LOCATION

PROJECT AREA

NOTES:

1. All locations approximate
2. Coordinate system: NAD 1983 UTM Zone 17N
3. Geographic dataset source: Ontario GeoHub.
4. Contains information licensed under the Open Government Licence – Ontario.
5. Service Layer Credits: World Imagery: Maxar, Microsoft
World Street Map: Esri Community Maps Contributors, Province of Ontario, Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

Scale:

1:950

0 25 50 75 Meters

Drawing: BOREHOLE LOCATION PLAN

Client: PARSONS CORPORATION

Project: GEOTECHNICAL INVESTIGATION FOR REHABILITATION OF STEVENSON CRESCENT RENFREW, ONTARIO

Drwn By:	S.J.	Chkd By:	T.D.
Project No.	100016.023	Revision No.	0
Date	JUNE 2024	**FIGURE 1**	

GEMTEC
Consulting Engineers and Scientists
850 Champlain Ave Suite 101,
Oshawa, ON L1J 8C3
T: (289) 274-8476
www.gemtec.ca

Folder: N:\Projects\100000\100016.023\06_Civil Drafting\Sheets\1. Drawings\GeoTech\100016_023_StevensonCrescent_GeoTech_R0_2024_06_19\

APPENDIX B

Record of Boreholes

ABBREVIATIONS AND TERMINOLOGY USED ON RECORDS OF BOREHOLES AND TEST PITS

SAMPLE TYPES	
AS	Auger sample
CA	Casing sample
CS	Chunk sample
BS	Borros piston sample
GS	Grab sample
MS	Manual sample
RC	Rock core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled open shelby tube
TP	Thin-walled piston shelby tube
WS	Wash sample

SOIL TESTS	
w	Water content
PL, w_p	Plastic limit
LL, w_L	Liquid limit
C	Consolidation (oedometer) test
D_R	Relative density
DS	Direct shear test
G_S	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
UC	Unconfined compression test
γ	Unit weight

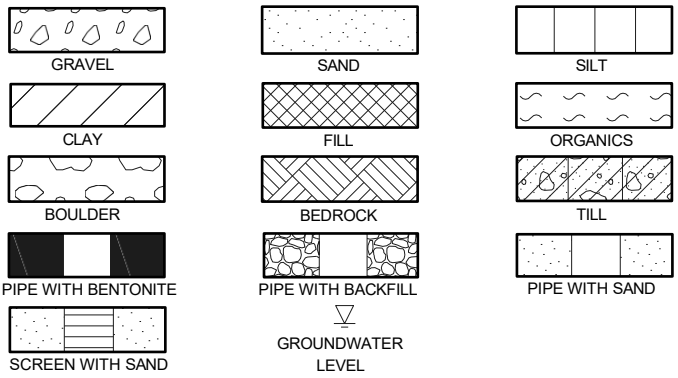
PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 millimetres (30 in.) required to drive a 50 mm split spoon sampler for a distance of 300 mm (12 in.). For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

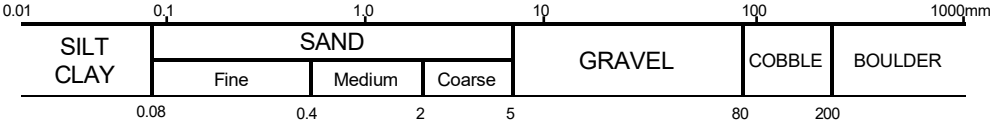
Dynamic Penetration Resistance
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive a 50 mm (2 in.) diameter 60° cone attached to 'A' size drill rods for a distance of 300 mm (12 in.).

WH	Sampler advanced by static weight of hammer and drill rods
WR	Sampler advanced by static weight of drill rods
PH	Sampler advanced by hydraulic pressure from drill rig
PM	Sampler advanced by manual pressure

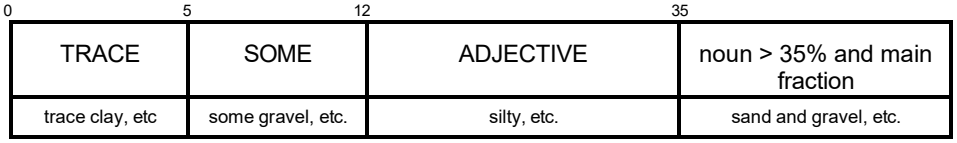
COHESIONLESS SOIL Compactness		COHESIVE SOIL Consistency	
SPT N-Values	Description	Cu, kPa	Description
0-4	Very Loose	0-12	Very Soft
4-10	Loose	12-25	Soft
10-30	Compact	25-50	Firm
30-50	Dense	50-100	Stiff
>50	Very Dense	100-200	Very Stiff
		>200	Hard



GRAIN SIZE



DESCRIPTIVE TERMINOLOGY



GEMTEC
Consulting Engineers and Scientists

RECORD OF BOREHOLES
Stevenson Crescent Rehabilitation
Town of Renfrew, Ontario

GEMTEC Number: 100016.023
July 2024

Borehole ID	GPS Location		Testhole Type	Depth (mm)		Material Description	Laboratory Testing										
	Latitude (°N)	Longitude (°W)					Sample Type	Sample Number	Sample Depth (mm)	Moisture Content (%)	% Gravel	% Sand	% Silt	% Clay	Frost Heave Susceptibility	Liquid Limit / Plastic Limit
Stevenson Crescent																
BH24-01	45.477492	-76.683566	Auger Probe	0	100	Asphalt										
				100	305	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	100 - 305	3.5	42.9	46.9	10.3			
				305	500	Brown SILT and SAND, with gravel, occasional cobbles, moist	GS	SA2	305 - 500							
				500	1500	Grey CLAYEY SILT, trace sand, moist	GS	SA3	500 - 1500							
BH24-02	45.477819	-76.683972	Auger Probe	0	125	Asphalt										
				125	310	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	125 - 310							
				310	450	Brown SILT and SAND, some gravel, occasional cobbles, moist	GS	SA2	310 - 450	13.6	10.4	38.3	51.3			
				450	1500	Brown CLAYEY SILT, trace sand, moist	GS	SA3	450 - 1500							
BH24-03	45.47828	-76.68454	Auger Probe	0	130	Asphalt										
				130	350	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	130 - 350							
				350	1500	Brown CLAYEY SILT, trace sand, moist	GS	SA2	350 - 1500	31.9	0.0	2.1	62.2	35.8	HSFH	36.0 / 17.1
BH24-04	45.47862	-76.68496	Auger Probe	0	80	Asphalt										
				80	380	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	80 - 380							
				380	760	Brown SILT and SAND, with gravel, occasional cobbles, moist	GS	SA2	380 - 760							
				760	1500	Brown CLAYEY SILT, trace sand, moist	GS	SA3	760 - 1500							
BH24-05	45.47845	-76.68590	Auger Probe	0	170	Asphalt										
				170	305	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	170 - 305							
				305	510	Brown SAND, with silt, with gravel, occasional cobbles, moist	GS	SA2	305 - 510	5.6	22.0	53.5	24.4			
				510	1500	Brown CLAYEY SILT, trace sand, moist	GS	SA3	510 - 1500							
BH24-06	45.47807	-76.68563	Auger Probe	0	105	Asphalt										
				105	430	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	105 - 430							
				430	1500	Brown CLAYEY SILT, trace sand, moist	GS	SA2	430 - 1500							
BH24-07	45.47768	-76.68512	Auger Probe	0	125	Asphalt										
				125	560	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	125 - 560	4.0	43.8	42.5	13.6			
				560	1500	Brown CLAYEY SILT, trace sand, moist	GS	SA2	560 - 1500							
BH24-08	45.47766	-76.68453	Auger Probe	0	125	Asphalt										
				125	310	Brown Crushed SAND and GRAVEL, some silt, moist	GS	SA1	125 - 310							
				310	900	Brown SAND, with silt, with gravel, occasional cobbles, moist	GS	SA2	310 - 900							
				900	1500	Brown CLAYEY SILT, trace sand, moist	GS	SA3	900 - 1500							

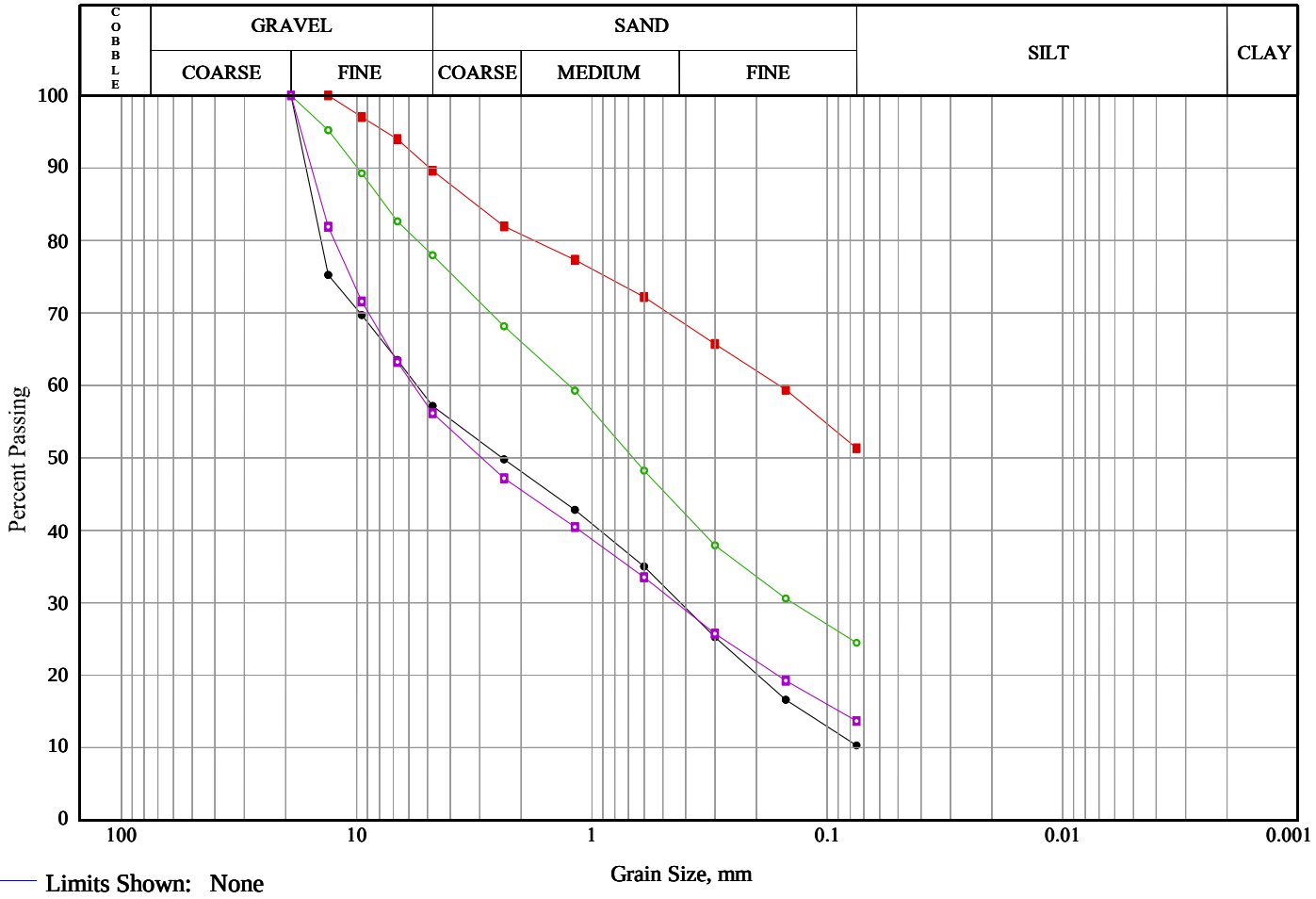
APPENDIX C

Laboratory Test Results

GEMTEC
Consulting Engineers and Scientists

Client:	Parsons Corporation
Project:	Stevenson Crescent, Renfrew, Ontario
Project #:	100016023

Soils Grading Chart



Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
		24-01	SA 1	0.10-0.30	42.9	46.9	10.3	
		24-02	SA 2	0.30-0.45	10.4	38.3	51.3	
		24-05	SA 2	0.30-0.50	22.0	53.5	24.4	
		24-07	SA 1	0.12-0.55	43.8	42.5	13.6	

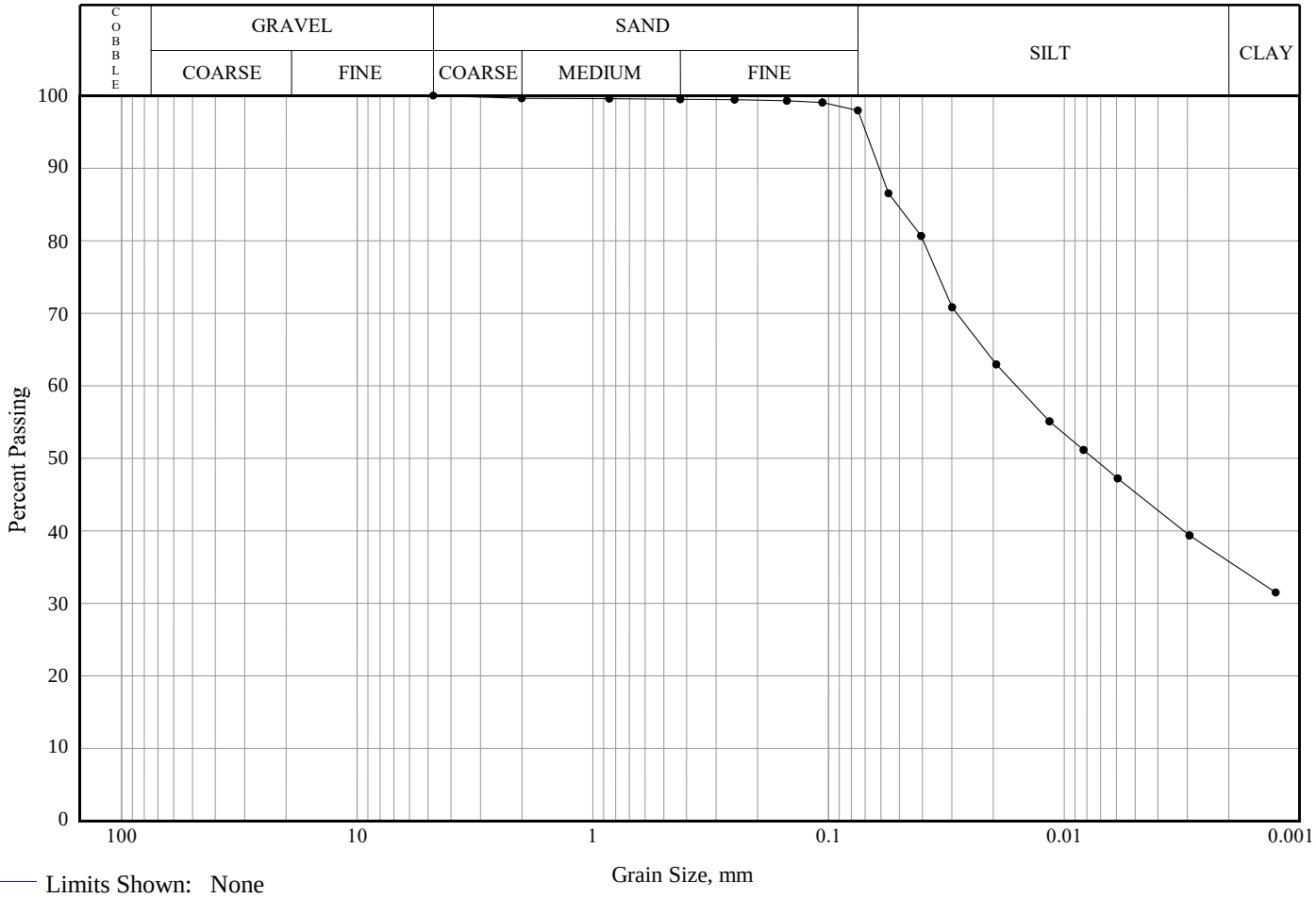
Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
	Sand and gravel , some silt	N/A	---	0.126	0.42	2.41	5.55	15.24	---
	Silt and sand , some gravel	N/A	---	---	---	---	0.16	3.12	---
	Gravelly silty sand	N/A	---	---	0.14	0.67	1.25	7.59	---
	Gravel and sand , some silt	N/A	---	0.089	0.44	2.95	5.73	14.05	---

Note: More information available upon request

GEMTEC
Consulting Engineers and Scientists

Client:	Parsons Corporation
Project:	Stevenson Crescent, Renfrew, Ontario
Project #:	100016023

Soils Grading Chart (LS-702/ ASTM D-422)



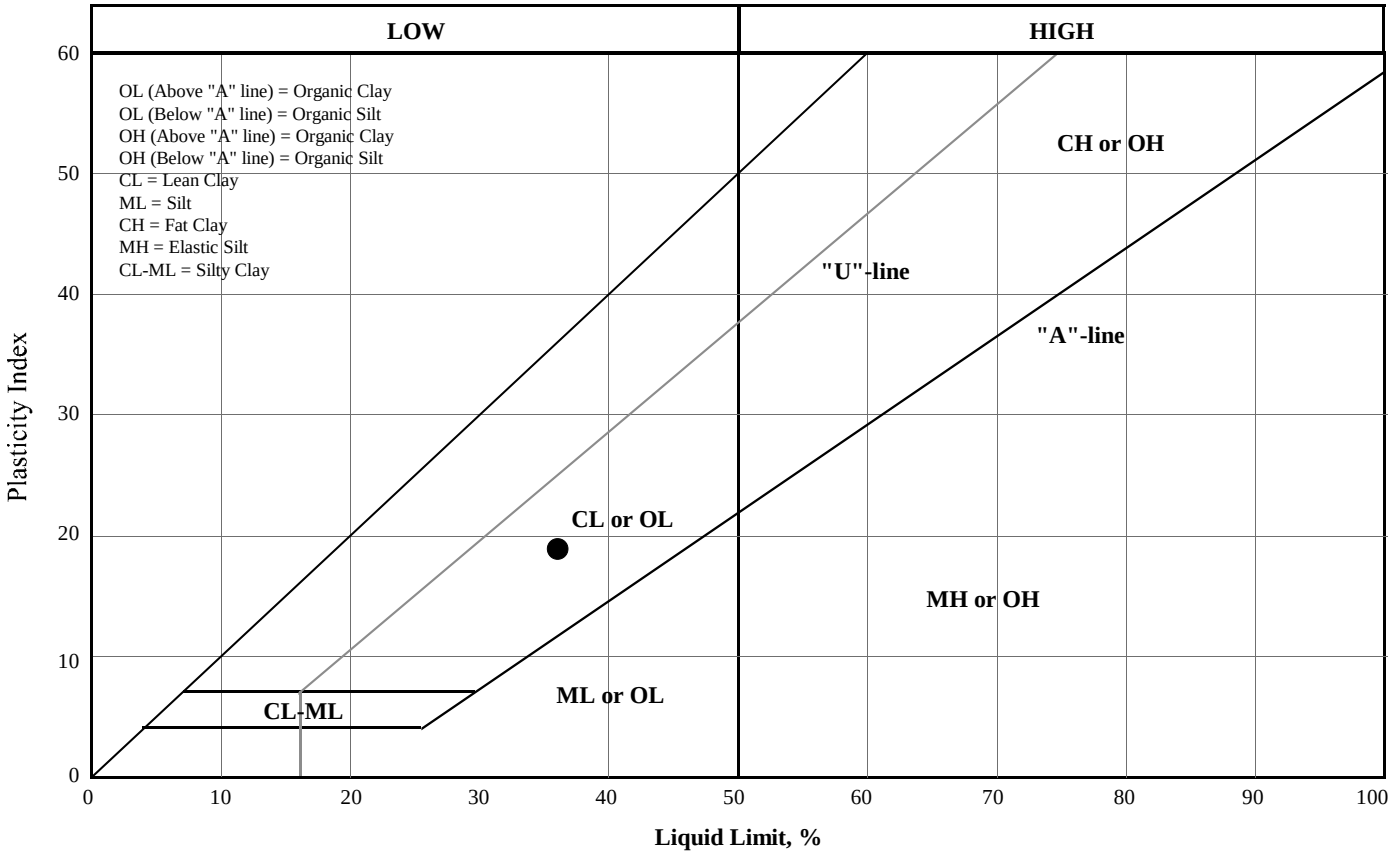
Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—		24-03	SA 2	0.40-0.60	0.0	2.1	62.2	35.8

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
—●—	Silt and clay , trace sand	CL	---	---	---	0.01	0.02	0.05	62.2

Note: More information available upon request

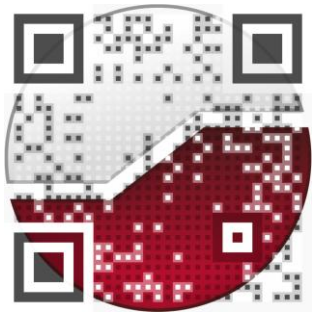
GEMTEC Consulting Engineers and Scientists Ottawa, ON	Client: Parsons Corporation	Plasticity Chart (LS-7034/ASTM D4318)
	Project: Stevenson Crescent, Renfrew, Ontario	
	Project #: 100016023	



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	24-03	SA 2	0.40-0.60	36.0	17.1	19	N/A	31.9

Note: More information available upon request

experience • knowledge • integrity



civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité