SOIL-MAT ENGINEERS & CONSULTANTS LTD.

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PROJECT NO.: SM 188510-G

August 15, 2018
Reissued: May 18, 2021

TARBUTT CONSTRUCTION
189 South Service Road
Grimsby, Ontario
L3M 4H6

Attention: Mr. Jim Tarbutt

GEOTECHNICAL INVESTIGATIONS
PROPOSED RESIDENTIAL DEVELOPMENT
9 KERMAN AVENUE AND 250 MAIN STREET
GRIMSBY, ONTARIO

Dear Mr. Tarbutt,

We have completed the fieldwork, laboratory testing, and report preparation in connection with the above noted project. The work was undertaken in general accordance with our proposal P7471, dated June 8, 2018. Our comments and recommendations, based on our findings at the ten [10] borehole locations, are presented herein.

1. INTRODUCTION

We understand that the project will involve the construction of a residential redevelopment of the subject lands, which are presently a commercial greenhouse operation. The details of the proposed development have not been established at present but are anticipated to consist of townhouse units with single basement levels. Construction would also include the installation of underground services and asphalt paved roadways. The purpose of this geotechnical investigation work is to assess the subsurface soil conditions, and to provide our comments and recommendations with respect to the design and construction of the proposed development, from a geotechnical point of view.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed design, this office must be consulted to review the new design

with respect to the results of this investigation. It is noted that this report is not intended to address the environmental aspects of the site, which have been addressed in separate Phase One and Two ESA reports.

2. PROCEDURE

A total of ten [10] sampled boreholes were advanced at the locations shown on the enclosed Drawing No. 1, Borehole Location Plan. The borings were advanced on June 28 and 29, and July 12, 2018 under the supervision and direction of a representative of SOIL-MAT ENGINEERS, to depths of approximately 4.8 to 5.3 metres below the existing surface. Upon completion of drilling, groundwater monitoring wells were installed at Borehole Nos. 3, 5, 8 and 10 to allow for future measurements of the static groundwater elevation. The monitoring wells were installed to depths of approximately 3.7 to 5.3 metres, consisting of 50-millimetre diameter PVC pipe, screened in the lower 3.1 metres. The monitoring wells were then surrounded with well filter sand to approximately 0.3 metres above the screened section, and then with a bentonite 'hole plug' medium to ground surface, and fitted with a protective steel 'stick up' casing. All remaining boreholes were backfilled in general accordance with Ontario Regulation 903, and the grade reinstated even with the surrounding ground surface.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing, [CSA A119.1]. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD. The ground surface elevation at the borehole locations was referenced to a site specific benchmark, described as the top of the manhole located at the west side of Kerman Avenue, as illustrated on our Borehole Location Plan. This benchmark has been assigned an elevation of 100.00 metres for convenience. If topographic survey information for the site can be provided then these elevations can be revised to geodetic.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Borehole Nos. 1 to 10, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made

during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed at the exact depths of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site is located on the properties identified as 9 and 11 Kerman Avenue, in Grimsby, Ontario. The property is currently occupied by a residential dwelling on the east side fronting to Main Street West [11 Kerman] and a commercial greenhouse occupying the majority of the site [9 Kerman]. The site is bounded to the north by vacant land, to the east by residential dwellings and Kerman Avenue, to the south by residential dwellings and Main Street West, and to the west by residential development. The site is relatively even with a total relief of approximately 2.5 metres dropping from south to north.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Pavement Structure

Borehole No. 1 was advanced through the pavement structure of the existing driveway, which was found to consist of approximately 50 millimetres of asphaltic concrete overlying 500 millimetres of compact granular base. Borehole No. 10 was advanced inside the existing greenhouse where the ground surface was found to consist of 90 millimetre thick interlocking paver stone overlaying approximately 100 millimetres of compact granular base. It is noted that the majority of the green house floor area was exposed soil.

Sand and Gravel Fill

A surficial veneer of sand and gravel fill was encountered in Borehole Nos. 2, 3, 6 and 7 to depths of approximately 75 to 300 millimetres. It should be noted the depth of sand and gravel fill may vary across the site and from the thickness measured at the borehole locations.

Topsoil

A surficial veneer of topsoil approximately 125 to 750 millimetres in thickness was encountered in Borehole Nos. 4, 5, 8 and 9. It should be noted that the depth of topsoil may vary across the site and from the thicknesses measured at these borehole

locations. It should be noted too that the term “topsoil” has been used strictly from a geotechnical point of view and does not necessarily reflect the soils nutrient content or ability to support plant life.

Silty Sand

Silty sand was encountered beneath the pavement structure, sand and gravel fill or topsoil at all boreholes. This fine grained granular soil is brown in colour, contains trace clay and gravel, as well as some coarser sand seams, and is generally in a compact to dense state. The upper levels of the silty sand have a ‘reworked’ appearance, in a loose condition, likely associated with agricultural use, as well as being exposed to continual freeze/thaw cycles. It is noted too that the silty sand soils tend to be in a wet condition which makes them more sensitive to disturbance, such as from drilling. This may have influenced some of the measure N-values to be artificially low in the upper levels. The native silty sand was proven to termination to depths of approximately 4.8 to 5.3 metres at all borehole locations.

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicate the subsurface soils to consist of coarse-textured glaciolacustrine deposits of sand and gravel, with minor silt and clay, consistent with our experience in the area and observations during our fieldwork.

Groundwater Conditions

All boreholes were recorded as ‘wet’ at depths of between approximately 2.1 to 3.4 metres below the ground surface. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes. As noted above, Borehole Nos. 3, 5, 8, and 10 were fitted with monitoring wells to allow for measurement of the static groundwater level. A representative of SOIL-MAT measured the groundwater level in the wells on July 27 and August 1, 2018, which have been summarised as follows:

TABLE A
GROUND WATER LEVEL MEASUREMENTS

Borehole No.	Surface Elevation [m]	July 27, 2018		August 1, 2018	
		Ground Water Depth (m)	Ground Water Elevation (m)	Ground Water Depth (m)	Ground Water Elevation (m)
BH3	99.95	2.58	97.37	1.7	98.25
BH5	101.61	2.51	99.1	2.5	99.11
BH8	101.73	2.75	98.98	2.8	98.93
BH10	100.54	2.0	98.54	2	98.54

* It is noted that the referenced elevations above are relative to a temporary local benchmark and are not geodetic.

These monitoring well observations may be considered to have generally stabilised, given the time elapsed since installation within the silty sand deposit. The present data would indicate a static groundwater level at a depth of approximately 2.0 to 2.5 metres below the existing grade. It is noted that the static groundwater level would also be anticipated to be subject to seasonal fluctuations, being highest during the 'wetter' spring and fall periods of the year.

4. EXCAVATIONS

Excavations for the installation of foundations and municipal services are generally expected to extend to depths of approximately 2 to 4 metres below the existing grade. Excavations into the native silty sand soils may be expected to remain stable for the short construction period at 45 degrees to the horizontal, or steeper. Where wet seams are encountered, during periods of extended precipitation, or where excavations extend below the static groundwater level, the excavations may tend to 'slough' in to as flat as 3 horizontal to 1 vertical, or flatter. Nevertheless, all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects. Excavation slopes steeper than those required in the Safety Act must be supported or a trench box must be provided, and a senior geotechnical engineer from this office should monitor the work.

As noted above the static groundwater level is estimated at depths of between approximately 2 and 2.5 metres below the existing grade, generally near or slightly below the anticipated depths of construction for foundations and water services, while excavations for storm and sanitary sewers will likely extend below this level. The moderate to highly permeable sand soils will yield relatively high rates of infiltration, as

well as infiltration from surface runoff. For excavations to depths of about 2 to 2.5 metres the rate of infiltration should be sufficiently low, such that it should be possible to adequately control groundwater infiltration for the short construction period using conventional construction dewatering methods, such as pumping from sumps in the base of the excavation.

Excavations extending below depths of about 2 to 2.5 metres or more should be anticipated to experience a greater rate of groundwater infiltration, requiring greater pumping efforts, and possibly more sophisticated dewatering methods for deeper excavations. The contractor should be prepared to undertake work in 'wet' conditions, requiring wider excavations, greater dewatering controls, base stabilisation, etc. Excavations should begin at the 'low-end' of the sewer alignment to allow drainage away from the working areas. In this regard it is recommended that a number of test pit excavations be advanced to allow observation of the conditions first hand to assess the requirements of excavation operations during the installation of underground services. More groundwater control should be anticipated when connections are made to existing services. Surface water should be directed away from the excavations.

The base of the excavations above the groundwater level in the native silty sand encountered in the boreholes should generally remain firm and stable, however may be prone to some disturbance and instability, requiring the use of additional bedding or ballast stone. Where excavations approach or extend below the groundwater level the base of excavations would be expected to experience instability and some stabilisation efforts such as the placement of coarse ballast stone, or additional bedding material, may be required depending on the groundwater conditions at the time of construction.

With firm and stable excavation bases, stabilised where required, standard pipe bedding, as typically specified by the Ontario Provincial Standard Specification [OPSS] or by Town of Grimsby, compacted to a minimum of 95 per cent of its standard Proctor density [SPMDD], should suffice. The bedding should be well compacted to provide sufficient support to the pipes and components (i.e. valve chambers, manholes etc.), and to minimise settlements of the roadway above the service trenches. Special attention should be paid to compaction under the pipe haunches.

It is recommended that the invert elevations of any storm sewer pipes for rear yard catch basins be located above the proposed underside of footing elevations of adjacent structures, or that the trench excavations should be filled with lean mix [~5 MPa] concrete or non-shrink fill product to the proposed underside of footing level where the excavations extend below an imaginary one horizontal to one vertical line extending outwards and down from a point 0.3 metres beyond the proposed foundations.

5. BACKFILL CONSIDERATIONS

The majority of the excavated soils will consist of the native silty sand encountered in the boreholes as described above. These soils are generally considered suitable for use as engineered fill, trench backfill, etc., provided that they are free of organics or otherwise deleterious material, and that their moisture content can be controlled to within 3 per cent of their standard Proctor optimum moisture content.

The fine grained granular soils are sensitive to moisture conditions and will become practically impossible to compact if they are 'wet' of their optimum moisture content. The wet to saturated silty and sandy soils will need to be spread out and allowed to air dry if they will not drain sufficiently 'fast' to allow for adequate compaction operations. Water conditioning [wetting or drying] will be required depending upon the weather conditions at the time of construction. It is also noted that these fine grained granular soils will present difficulties in achieving effective compaction where access with compaction equipment is restricted, such as at the end of compaction runs. Dust could a problem during the dry months of the year. The soils encountered on site are also considered to be highly frost susceptible and will have a tendency to 'heave' significantly under sub-freezing weather conditions.

We note that where backfill material is placed near or slightly above its optimum moisture content, the potential for long term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of the 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic and therefore impacting roadway construction. If the soil is well dry of its optimum value, it will appear to be very strong when compacted, but will tend to settle with time as the moisture content in the fill increases to equilibrium condition. The silty sand soils may require high compaction energy to achieve acceptable densities if the moisture content is not close to its standard Proctor optimum value. It is therefore very important that the placement moisture content of the backfill soils be within 3 per cent of its standard Proctor optimum moisture content during placement and compaction to minimise long term subsidence [settlement] of the fill mass. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines.

A representative of SOIL-MAT should be present on-site during the backfilling and compaction operations to confirm the uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs'. All structural fill should be compacted to 100 per cent of its SPMDD. Backfill

within service trenches, areas to be paved, etc., should be compacted to a minimum of 95 per cent of its SPMDD, and to 100 per cent of its SPMDD in the upper 1 metre below the design subgrade level. The appropriate compaction equipment should be employed based on soil type, i.e. pad-toe for cohesive soils and smooth drum/vibratory plate for granular soils. A method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

6. MANHOLES, CATCHBASINS AND VALVE CHAMBERS

Where manholes, catch basins, valve chambers, etc. are founded in the native soils with the founding surfaces carefully prepared to remove all loose and disturbed material, stabilised as required, the bearing surfaces should be practically non-yielding under the anticipated loads. Proper preparation of the founding soils will therefore accentuate the protrusion of these structures above the pavement surface if compaction of the fill around these structures is not adequate, causing settlement of the surrounding paved surfaces. Conversely, the pavement surfaces may rise above the valve chambers under frost action. To alleviate the potential for these types of differential movements, free draining, non-frost susceptible material should be provided as backfill around the structures located within the paved roadway limits, and compacted to 100 percent of its standard Proctor maximum dry density. A geofabric separator should be provided between the free draining material and the on-site fine soils to prevent the intrusion of fines.

Where thrust blocks are to be founded in the native soils, they may be conservatively sized as recommended by the applicable Ontario Provincial Standard Specification using an allowable bearing pressure of 100 kPa [~2,000 psf]. Any backfill required behind the blocks should be a crushed limestone product and should be compacted to 100 percent of its standard Proctor maximum dry density.

7. PAVEMENT CONSIDERATIONS

The roadway areas should be stripped of all topsoil or otherwise unsuitable materials. The exposed subgrade should be proofrolled with 3 to 4 passes of a loaded tandem truck in the presence of a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., immediately prior to the placement of the sub-base material. Any areas of distress revealed by this or other means must be subexcavated and replaced with suitable backfill material, or additional depth of Granular B sub-base material. Alternatively, the soft areas may be stabilised by their displacement into the interstitial spaces of 50-millimetre clear crushed stone ‘punched’ into the soft areas. In more severe ‘wet’

conditions it may be necessary to make use of coarse 'rip-rap' stone to sufficiently stabilise the subgrade level. The need for the treatment of softened subgrade will be reduced if construction is undertaken during the dry summer months and careful attention is paid to the compaction operations. The fill over shallow utilities cut into or across the subdivision streets, such as telephone, hydro, gas, etc. must also be compacted to 100 percent of its standard Proctor maximum dry density.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and mitigate softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The most severe loading conditions on the subgrade typically occur during the course of construction; therefore, precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. These measures would include minimising the amount of heavy traffic travelling over the subgrade, such as during the placement of granular base layers.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as during the fall and spring months, it should be anticipated that additional subgrade preparation will be required, such as additional depth of Ontario Provincial Standard Specification [OPSS] Granular 'B', Type II sub-base material. It is also important that the sub-base and base granular layers of the pavement structure be placed as soon as possible after exposure, preparation and approval of the subgrade level.

The proposed pavement structure would be required to adequately support cars, trucks and intermittent delivery and garbage trucks. For this project, a recommended pavement structure would consist of 300 millimetres of OPSS Granular 'B', Type II sub-base course, 150 millimetres of OPSS Granular 'A' base course, 65 millimetres of HL8 binder course asphaltic concrete, and 40 millimetres of HM3 surface course asphaltic concrete. Notwithstanding, the pavement structure should conform to the relevant Town of Grimsby requirements where they are to be assumed by the Town. It is our opinion that this design is suitable for use on a residential roadway section, provided that the subgrade has been prepared as specified and is good and firm before the sub-base course material is placed. If the subgrade is soft, remedial measures as discussed above may have to be implemented and/or the sub-base thickness may have to be increased. The granular sub-base and base courses and asphaltic concrete layers should be compacted to OPSS or Town of Grimsby requirements. Typical requirements would for granular base materials to be compacted to a minimum of 98 percent of

SPMDD, and asphalt layers to a minimum of 92 percent of Marshall maximum relative density [MRD]. A program of in-place density testing must be carried out to monitor that compaction requirements are being met. We note that this pavement structure is not to be considered as a construction roadway design.

To minimise segregation of the finished asphalt mat, a uniform asphalt temperature must be maintained throughout the mat during placement and compaction. Frequently, significant temperature gradients exist in the delivered and placed asphalt with cooler portions of the mat resisting compaction and presenting a 'honey combed' surface. As the spreader moves forward, a responsible member of the paving crew should monitor the pavement surface, to ensure smoothness and uniformity. The contractor can mitigate the surface segregation by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

Asphalt paving of driveways should be consistent with the general recommendations provided above. Proper preparation of the subgrade soils is essential to good long-term performance of the pavement. Likewise, sufficient depth and compaction of granular base materials and adequate drainage will be important in achieving good long-term performance, i.e. preventing/limiting premature cracking, subgrade failure, rutting, etc. A recommended light duty pavement structure for residential driveways would consist of a minimum of 200 millimetres of OPSS Granular 'A' base course, compacted to 100 percent standard Proctor maximum dry density, followed by 50 millimetres of HL3 or HL3F asphaltic concrete, compacted to a minimum of 93 percent of MRD.

8. HOUSE AND TOWNHOUSE CONSTRUCTION

The native soils encountered at the borehole locations are considered capable of supporting the loads typically associated with townhouse construction on conventional spread footings. Based on the subsurface conditions, including the potential influence of established groundwater conditions, it is recommended that foundations be designed on the basis of bearing pressures of 100 kPa [~2,000 psf] SLS and 150 kPa [~3,000 psf] ULS in the native soils. It is noted that the founding level must extend through any upper disturbed zone in the native soils. However, it is also important that the founding level ideally be designed at no deeper than 2.0 metres below the existing grade, in order to minimum difficulties with disturbance of the founding soils due to groundwater conditions. The founding surfaces must be hand cleaned of any loose or disturbed material, along with any ponded water, immediately prior to placement of foundation concrete.

The support conditions afforded by the native soils are generally not uniform across the building footprint, nor are the loads on the various foundations elements. As such it is recommended that consideration be given to the provision of nominal reinforcement in the footings and foundation walls to account for variable support and loading conditions. The use of nominal reinforcement is considered good construction practice as it will act to reduce the potential for cracking in the foundation walls due to minor settlements, heaving, shrinkage, etc. and will assist in resisting the pressures generated against the foundation walls by the backfill. Such nominal reinforcement is an economical approach to the reduction and prevention of costly foundation repairs after completion and later in the life of the buildings. This reinforcement would typically consist of two continuous 15M steel bars placed in the footings [directly below the foundation wall], and similarly two steel bars placed approximately 300 millimeters from the top of the foundation walls at a minimum, depending on ground conditions exposed during construction. These reinforcement bars would be bent to reinforce all corners and under basement windows, and be provided with sufficient overlap at staggered splice locations. At 'steps' in the foundations and at window locations, the reinforcing steel should transition diagonally, rather than at 90 degrees, to maintain the continuous tensile capacity of the reinforcement. Where footings are founded on, or partially on, engineered fill the above provision for nominal reinforcement would be required.

All basement foundation walls should be suitably damp proofed, including the provision of a 'dimple board' type drainage product, and provided with a perimeter drainage tile system outlet to a gravity sewer connection or positive sump pit a minimum of 150 millimetres below the basement floor slab. The clear stone material surrounding the weeping tile should be encased with a geotextile material to prevent the migration of fines from the foundation wall backfill into the clear stone product. It is likely that sump pit systems will be required, and as such we would recommend that the sump pump system should be constructed with an 'oversized' reservoir and a 'back-flow' prevention valve so that the sump pump will not cycle repeatedly within short time periods. The enclosed Drawing Nos. 2 shows schematics of the typical requirements for foundation construction with a basement level.

All footings exposed to the environment must be provided with a minimum of 1.2 meters of earth or equivalent insulation to protect against frost penetration. This frost protection would also be required if construction were undertaken during the winter months. All footings must be proportioned to satisfy the requirements of the Ontario Provincial Building Code.

It is imperative that a soils engineer be retained from this office to provide geotechnical engineering services during the excavation and foundation construction phases of the

project. This is to observe compliance with the design concepts and recommendations outlined in this report, and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the borehole locations.

9. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are only intended to describe conditions at the borehole locations. Contractors placing bids or undertaking this project should carry out due diligence in order to verify the results of this investigation and to determine how the subsurface conditions will affect their operations.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

Yours very truly
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Yaroslav Mormil, B. Eng.

Ian Shaw, P. Eng.
Senior Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Borehole Log Nos. 1 to 10, inclusive

Distribution: Tarbutt Construction [pdf by email]

LEGEND

BH# Borehole Location

TBM Temporary Benchmark
[Catch Basin on west side of Kerman Avenue. Assumed elevation of 100.00 metres]

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 188510-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Preliminary Geotechnical Investigation
Proposed Residential Development
9 Kerman Avenue
Grimsby, Ontario

Borehole Location Plan

Project No. SM 188510-G

Date: August 2018

Drawn: MC	Checked: IS

SM 188510-G Borehole Location Plan

Drawing No. 1

Log of Borehole No. 1

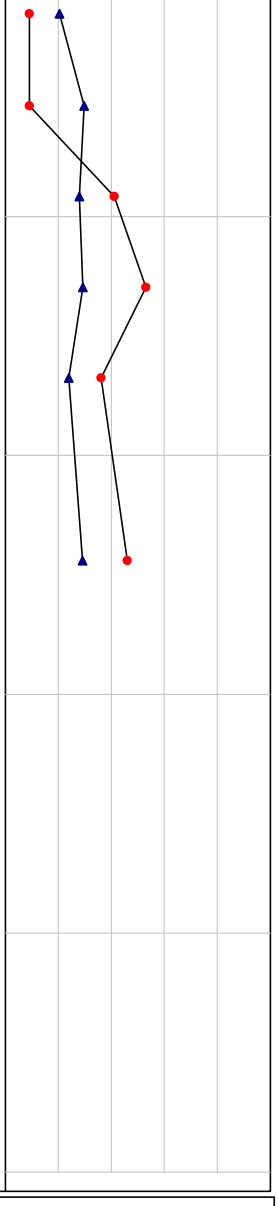
Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
:
:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	99.72	Ground Surface								
0–2 / 0–1	99.17	**Pavement Structure** Approximately 50 millimetres of asphaltic concrete over 500 millimetres of compact granular base.								
2–16 / 1–5	94.52	**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, loose to very dense.		SS	1	10,6,3,2	9			
				SS	2	4,4,5,5	9			
				SS	3	18,21,20,30	41			
				SS	4	26,26,27,29	53			
				SS	5	14,19,17,24	36			
				SS	6	17,21,25,30	46			
16–17 / 5	94.52	End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using direct push probe equipment on June 28, 2018 to termination at a depth of 5.2 metres.

2. Borehole was recorded as open to 3.4 metres and 'wet' at a depth of 2.7 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Direct Push Method
Drill Date: June 28, 2018
Hole Size: 100 millimetres
Drilling Contractor: DDSI

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T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Temporary Benchmark
Field Logged by: MC
Checked by: IS
Sheet: 1 of 1

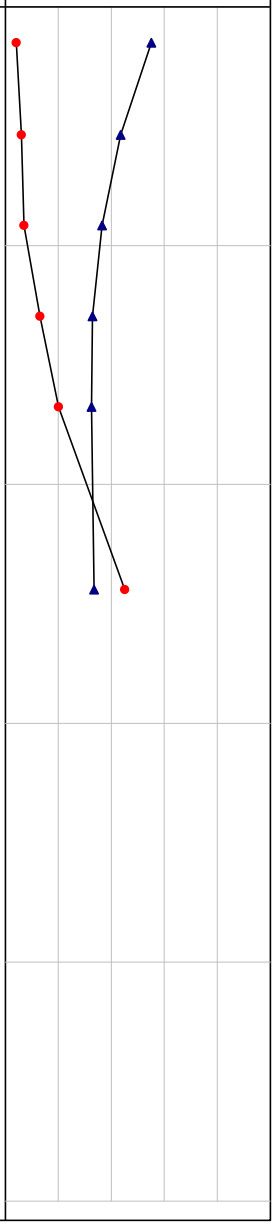
Log of Borehole No. 2

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
:
:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	99.98	Ground Surface								
0 / 0	99.68	**Sand and Gravel Fill** Approximately 300 millimetres of sand and gravel fill.		SS	1	6,2,2,2	4			
3 / 1		**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, very loose to dense.		SS	2	3,2,4,3	6			
7 / 2				SS	3	2,3,4,3	7			
10 / 3				SS	4	11,7,6,7	13			
13 / 4				SS	5	7,11,9,11	20			
16 / 5	94.78			SS	6	34,24,21,32	45			
17		End of Borehole								
20 / 6		NOTES: 1. Borehole was advanced using direct push probe equipment on June 28, 2018 to termination at a depth of 5.2 metres. 2. Borehole was recorded as 'wet' at a depth of 2.1 metres upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.								
23 / 7										
26 / 8										
29 / 9										
33										



Drill Method: Direct Push Method
Drill Date: June 28, 2018
Hole Size: 100 millimetres
Drilling Contractor: DDSI

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Temporary Benchmark
Field Logged by: MC
Checked by: IS
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
:
:

Soil-Mat

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		99.95	Ground Surface							
0	0		**Sand and Gravel Fill** Approximately 125 millimetres of sand and gravel fill.							
1			**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, loose to very dense.	SS	1	6,4,6,8	10			
2	1			SS	2	4,3,4,6	7			
3				SS	3	2,3,2,8	5			
4				SS	4	6,8,20,25	28			
5	2			SS	5	30,50/4"	100			
6				SS	6	35,44,50/5"	100			
7	3			SS	7	8,30,45,46	75			
8		94.75	End of Borehole							
9	4		NOTES: 1. Borehole was advanced using solid stem auger equipment on July 12, 2018 to termination at a depth of 5.2 metres. 2. Borehole was recorded as open to a depth of 2.6 metres and 'wet' at a depth of 2.3 metres upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client. 4. A monitoring well was installed. The following free groundwater level readings have been measured: July 27th - 2.58 metres August 1st - 1.70 metres							
10										
11										
12										
13	4									
14										
15										
16										
17	5									
18										
19										
20	6									
21										
22										
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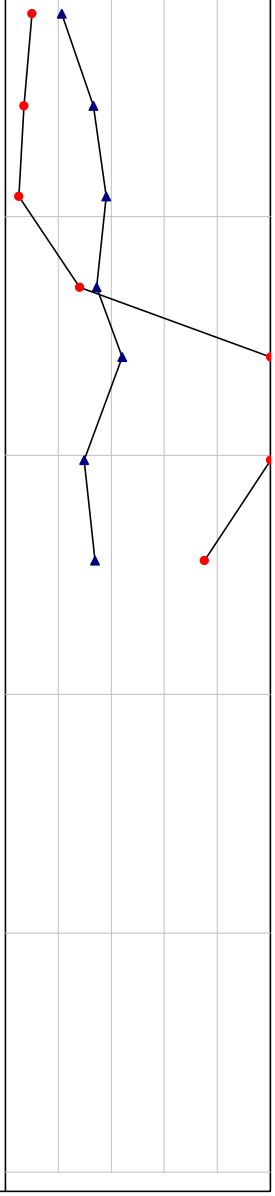
26	8									
27										
28										
29	9									
30										
31										
32										
33										



Drill Method: Solid Stem Augers
Drill Date: July 12, 2018
Hole Size: 100 millimetres
Drilling Contractor: Kodiak Drilling

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Log of Borehole No. 4

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
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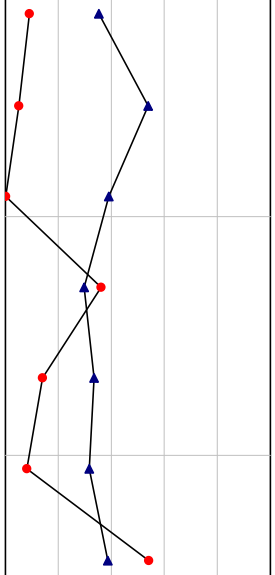
Soil-Mat

Depth (ft)	Depth (m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		100.72	Ground Surface								
0	0	100.47	**Topsoil** Approximately 250 millimetres of topsoil.		SS	1	2,5,4,3	9			
3	1		**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, very loose to very dense.		SS	2	2,2,3,2	5			
6	2				SS	3	1,0,0,6	0			
9	3				SS	4	12,18,18,20	36			
11	4				SS	5	8,9,5,10	14			
13	4				SS	6	1,3,5,19	8			
16	5	95.52			SS	7	16,28,26,27	54			
17			End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on June 28, 2018 to termination at a depth of 5.2 metres.

2. Borehole was recorded as open to 3.7 metres and 'wet' at a depth of 3.0 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Soild Stem Augers
Drill Date: June 28, 2018
Hole Size: 100 millimetres
Drilling Contractor: DDSI

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Log of Borehole No. 5

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 Kerman Avenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
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Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	101.61	Ground Surface							
0–3 / 0–1		**Topsoil** Approximately 125 millimetres of topsoil.							
3–16 / 1–5		**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, loose to compact.	SS	1	1,1,1,2	2			
			SS	2	2,2,3,8	5			
			SS	3	4,8,6,7	14			
			SS	4	7,13,15,18	28			
			SS	5	7,10,10,12	20			
16 / 5	96.41	End of Borehole	SS	6	5,8,9,13	17			

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using hollow stem auger equipment on June 29, 2018 to termination at a depth of 5.2 metres.

2. Borehole was recorded as 'wet' at a depth of 2.3 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:

July 27th - 2.51 metres
August 1st - 2.50 metres

Drill Method: Hollow Stem Augers
Drill Date: June 29, 2018
Hole Size: 175 millimetres
Drilling Contractor: DDSI

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Log of Borehole No. 6

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
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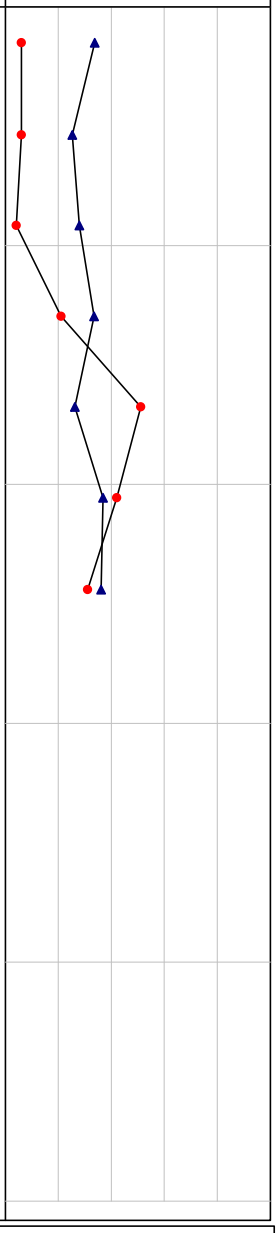
Soil-Mat

Depth (ft)	Depth (m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		101.76	Ground Surface								
0–5	0–1.5		**Sand and Gravel Fill** Approximately 75 millimtres of sand and gravel fill.		SS	1	4,4,2,2	6			
			Silty Sand Brown, reworked in upper levels, trace clay and gravel, loose to very dense.		SS	2	3,3,3,2	6			
					SS	3	3,3,1,2	4			
					SS	4	10,9,12,16	21			
					SS	5	26,24,27,32	51			
					SS	6	38,24,18,20	42			
16–17	5	96.56			SS	7	22,15,16,27	31			
			End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using direct push probe equipment on June 28, 2018 to termination at a depth of 5.2 metres.

2. Borehole was recorded as open to 3.0 metres and 'wet' at a depth of 2.4 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Direct Push Method
Drill Date: June 28, 2018
Hole Size: 100 millimetres
Drilling Contractor: DDSI

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Log of Borehole No. 7

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
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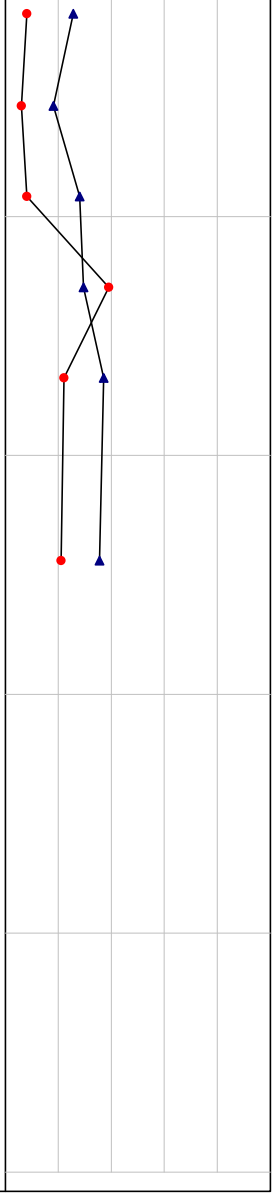
Soil-Mat

Depth (ft)	Depth (m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		102.61	Ground Surface								
0	0	102.38	**Sand and Gravel Fill** Approximately 225 millimetres of sand and gravel fill.		SS	1	7,5,3,3	8			
3	1		**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, loose to dense.		SS	2	2,3,3,3	6			
7	2				SS	3	3,4,4,4	8			
10	3				SS	4	9,19,20,22	39			
13	4				SS	5	9,12,10,12	22			
16	5	97.41			SS	6	3,9,12,18	21			
17			End of Borehole								
20	6		NOTES: 1. Borehole was advanced using hollow stem auger equipment on June 29, 2018 to termination at a depth of 5.2 metres. 2. Borehole was recorded as open to 3.4 metres and 'wet' at a depth of 3.4 metres upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.								
23	7										
26	8										
29	9										
33											



Drill Method: Hollow Stem Augers
Drill Date: June 29, 2018
Hole Size: 175 millimetres
Drilling Contractor: DDSI

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Log of Borehole No. 8

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
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Soil-Mat

Depth (ft)	Depth (m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		101.73	Ground Surface							
0	0	101.50	**Topsoil** Approximately 225 millimetres of topsoil.							
1–3	1		**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, loose to dense.	SS	1	2,3,3,3	6			
3–5	1			SS	2	3,4,3,3	7			
5–7	2			SS	3	3,2,2,5	4			
7–9	2			SS	4	8,6,6,13	12			
9–11	3			SS	5	11,15,19,20	34			
15–17	5	96.39		SS	6	3,5,8,32	13			
17	5		End of Borehole							

NOTES:

1. Borehole was advanced using hollow stem auger equipment on June 29, 2018 to termination at a depth of 5.3 metres.

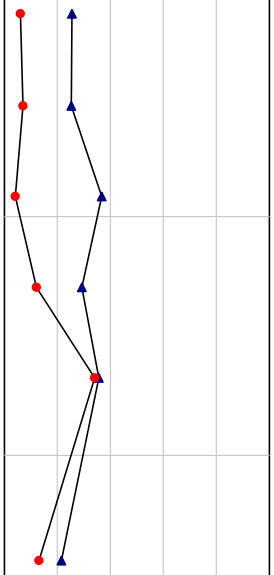
2. Borehole was recorded as 'wet' at a depth of 3.0 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:

July 27th - 2.75 metres
August 1st - 2.80 metres

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow Stem Augers
Drill Date: June 29, 2018
Hole Size: 175 millimetres
Drilling Contractor: DDSI

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Log of Borehole No. 9

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
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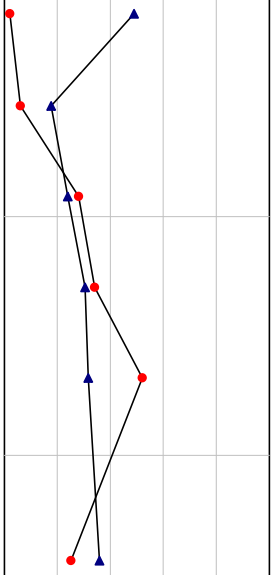
Soil-Mat

Depth (ft)	Depth (m)	Elevation (m)	Description	Sample Type	Sample Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		100.19	Ground Surface							
0-2	0	100.19 – 99.44	**Topsoil** Approximately 750 millimetres of topsoil.	SS	1	1,1,1,0	2			
3-16	1-5	99.44 – 94.99	**Silty Sand** Brown, reworked in upper levels, trace clay and gravel, loose to very dense.	SS	2	2,2,4,8	6			
				SS	3	12,14,14,20	28			
				SS	4	18,16,18,23	34			
				SS	5	32,28,24,20	52			
				SS	6	15,15,10,17	25			
17	5	94.99	End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using direct push probe equipment on June 29, 2018 to termination at a depth of 5.2 metres.

2. Borehole was recorded as open to 3.4 metres and 'wet' at a depth of 2.6 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Direct Push Method
Drill Date: June 29, 2018
Hole Size: 175 millimetres
Drilling Contractor: DDSI

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Log of Borehole No. 10

Project No: SM 188510-G
Project: Proposed Residential Development
Location: 9 & 11 KermanAvenue,Grimsby
Client: Tarbutt Construction

Project Manager: Ian Shaw, P.Eng.
Borehole Location: See Drawing No.1
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Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	100.54	Ground Surface							
0 / 0	100.35	**Pavement Structure** Approximately 90 millimetre thick interlocking tile over 100 millimetres of compact granular base.							
		Silty Sand Brown, reworked in upper levels, trace clay and gravel, loose to very dense.	SS	1	2,2,2,2	4			
			SS	2	1,2,3,3	5			
			SS	3	14,4,6,4	10			
			SS	4	5,6,10,12	16			
			SS	5	13,24,34,40	58			
			SS	6	50/5"	100			
15 / 4	95.74		SS	7	24,50/5"	100			
16 / 5		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using soilid stem auger equipment on July 12, 2018 to termination at a depth of 4.8 metres.

2. Borehole was recorded as open to a depth of 2.4 metres and 'wet' at a depth of 2.3 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

4. A monitoring well was installed. The following free groundwater level readings have been measured:

July 27th - 2.00 metres
August 1st - 2.00 metres

Drill Method: Solid Stem Augers
Drill Date: July 12, 2018
Hole Size: 100 millimetres
Drilling Contractor: Kodiak Drilling

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