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REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED GREELY COMMERCIAL CENTER
5640 BANK STREET, 7041 MITCH OWENS ROAD and 7107 MARCO STREET
CITY OF OTTAWA, ONTARIO

Project # 140208

Submitted to:

Otis Group of Companies
3338 Dufferin Street
Toronto, Ontario
M6A 3A4

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RE: GEOTECHNICAL INVESTIGATION
PROPOSED GREELY COMMERCIAL CENTER
5640 BANK STREET, 7041 MITCH OWENS ROAD and 7107 MARCO STREET
CITY OF OTTAWA, ONTARIO

Dear Sirs:

This report presents the results of a geotechnical investigation carried out for the above noted proposed commercial development to be located at the southwest corner of the intersection of Bank Street and Mitch Owens Road, Greely, City of Ottawa, Ontario (see Key Plan, Figure 1). The purpose of the investigation was to identify the subsurface conditions at the site based on a limited number of boreholes and test pits. Based on the factual information obtained, Kollaard Associates Inc. was to provide guidelines on the geotechnical engineering aspects of the project design; including construction considerations, which could influence design decisions.

1 BACKGROUND INFORMATION AND SITE GEOLOGY

In total, the subject property consists of about 13.7 hectares (34 acres) in plan area located at the southwest corner of the intersection of Bank Street and Mitch Owens Road and is commonly known as 5640 Bank Street,7041 Mitch Owens Road, and 7107 Marco Street, Greely, City of Ottawa, Ontario (see Key Plan, Figure 1). Information provided by ADA Architectural Design and Associates Inc. indicates plans are being prepared to develop the eastern about 5.6 hectares (13.75 acres) of the 13.7 hectares property into a proposed commercial centre. The 5.6 hectares comprising the proposed commercial centre is the subject site for this investigation.

It is understood the proposed commercial centre will consist of a nine unit, single storey strip plaza and four single storey individual buildings together with associated asphaltic surfaced parking and roadways. It is understood that the proposed commercial development will be serviced by private water supply and by private septic systems. It is also understood that there are plans for future

commercial development in the remaining portion of the 13.7 hectare property located west of the subject site.

Preliminary plans indicate that the proposed buildings will have standard steel or wood frame construction with conventional concrete spread footing foundations and concrete slab-on-grade construction. Surface drainage for the proposed buildings will be by means of swales and storm sewers.

Currently, the site is vacant. A review of historic aerial photographs as well as conversation with the original owners of the site indicate that the site was previously developed as a sand and gravel pit. The subject site is bordered on the north by Mitch Owens Drive, on the east by Bank Street, on the south by existing residential development and on the west by the remaining undeveloped portion of 13.7 hectare property followed by Old Prescott Road.

Based on a review of the surficial geology map for the site area, it is expected that the native soils at the site consist of medium to coarse grained sand and gravel with cobbles, boulders, followed by glacial till. Bedrock geology maps indicate that the bedrock underlying the site consists of dolostone and dolomitic limestone of the Oxford Formation.

Three drilled cased water wells were installed at the site as a requirement for a hydrogeological investigation completed for the site by others. From the water well records (Attachment A) it is considered that the geotechnical investigation will likely encounter sand and gravel and boulders from about 14.6 metres to about 15.8 metres below the ground surface. It is considered that limestone bedrock is underlying the site from about 14.6 to 15.8 metres below the ground surface.

2 PROCEDURE

The field work for this investigation was carried out on August 25 to 29, 2014 and September 22, 2014. From August 25 to 29, 2014, twenty-one boreholes, numbered BH1 to BH21 were put down at the site using a track mounted drill rig equipped with a hollow stem auger owned and operated by Marathon Drilling of Greely, Ontario. An additional test hole BH22 was advanced by hand on August 28, 2014 On September 22, 2014, five test pits numbered TP1 to TP5 were put down at the site using a track mounted excavator supplied and operated by a local contractor. The location of the proposed buildings within the commercial development was indicated to us on a site plan provided by ADA Architectural Design Associates Inc., entitled Commercial Development, Mitch Owens Road & Bank Street., Greely (Ottawa), Ontario, Project 2010-060, Drawing Number A1.1, dated September 11, 2014.

BH1 to BH21 were advanced to various depths below the existing ground surface using a track mounted drill rig supplied and operated by a local drilling contractor. Sampling of the overburden materials encountered at the boreholes was carried out at regular 0.75 metre depth intervals using a 50 millimetre diameter drive open conventional split spoon sampler in conjunction with standard penetration testing to depths of about 0.9 to 12.0 metres below the existing ground surface (ASTM D-1586 – Penetration Test and Split Barrel Sampling of Soils and ASTM D-1587 – Thin Walled Tube Sampling of Soils) .

The subsurface soil conditions at the boreholes were identified based on visual examination of the samples recovered and standard penetration tests (ASTM D-1585) as well as laboratory test results on select samples. Groundwater conditions at the boreholes were noted at the time of drilling. Standpipes were installed at BH3-5151, BH8-5116, BH10-5113 and BH17-5119 for subsequent ground water level monitoring. The boreholes were loosely backfilled with the auger cuttings upon completion of drilling.

The test pits were advanced to depths ranging between about 2.1 to 3.4 metres below the existing ground surface. The subsurface conditions encountered at the test pits were classified based on visual and tactile examination of the materials exposed on the sides and bottom of the test pits and the difficulty of digging. The groundwater conditions were observed in the open test pits at the time of excavating. The test pits were loosely backfilled with the excavated materials upon completion of the fieldwork.

Two soil samples were submitted to determine the grain size distribution and hydrometer analysis. One soil sample at BH6-5111 was submitted for grain size distribution and hydrometer analysis (ASTM D422). One soil sample at BH17-5119 was submitted for sieve analysis (ASTM C136). A

sample of soil obtained from test pit 1 was delivered to a chemical laboratory for testing for any indication of potential soil sulphate attack and soil corrosion on buried concrete and steel.

The field work was supervised throughout by a member of our engineering staff who located the boreholes and test pits in the field, logged the boreholes and test pits and cared for the samples obtained. A description of the subsurface conditions encountered at the boreholes and test pits are given in the attached Record of Borehole sheets and Table I – Record of Test Pit sheets. The results of the laboratory testing of the soil samples are presented in the Laboratory Test Results section and Attachment A following the text in this report. The approximate locations of the boreholes and test pits are shown on the attached Site Plan, Figures 2 and 3.

The ground surface elevation at the test pit locations were determined, in the field, relative to a site benchmark provided by WMI & Associates Limited, Greely Commercial Center Grading Plan, Project Number 11-183, Drawing Number GR, dated February 4, 2014. The site benchmark is described as the #3 Concrete Monument 001196530377 located on the north side of Mitch Owens Road, about 250 metres west of the intersection of Mitch Owens Road and Bank Street. The elevation of the concrete monument is referenced as 113.99 metres geodetic.

3 SUBSURFACE CONDITIONS

3.1 General

As previously indicated, a description of the subsurface conditions encountered at the boreholes and test pits is provided in the attached Record of Borehole and Record of Test Pits Sheets following the text of this report. The test pit and borehole logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. Subsurface conditions at locations other than the test hole locations may vary from the conditions encountered at the test holes.

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

The groundwater conditions described in this report refer only to those observed at the location and on the date the observations were noted in the report and on the test pit and borehole logs. Groundwater conditions may vary seasonally, or may be affected by construction activities on or in the vicinity of the site.

The following is a brief overview of the subsurface conditions encountered at the test pits and boreholes. In general, the test pits and boreholes encountered a layer of fill materials followed by native grey brown fine to coarse sand and gravel, fine to coarse sand and gravel, silty sand or silty sand with a trace to some gravel, cobbles and boulders (Glacial Till).

3.2 Fill

At all the test holes, fill materials ranging in thickness from surficial to about 9.6 metres below the existing ground surface were encountered. The fill materials in general consisted of either: silty clay containing trace sand, gravel, cobbles; silty clay containing some sand, gravel, cobbles and large boulders; or silty sand containing some gravel cobbles and boulders and trace clay. Trace to some topsoil, concrete, metal, wood and rubber debris was identified in the fill at localized locations. In general, the fill thickness ranges from less than 0.9 metres to greater than 8.2 metres across the site. Based on the results of the standard penetration tests carried out within the fill, the state of compaction of the silty clay is inconsistent and varies between soft to stiff. The state of packing of the sand fill is also inconsistent and in general varies from compact to dense. The fill material was fully penetrated at all of the borehole and test pit locations with the exception of BH2, BH7, BH12, BH16, BH21 and TP3.

3.3 Sand and Gravel/Sand/Silty Sand

A deposit of loose to compact, grey brown to grey fine to medium/fine to coarse sand and gravel with a trace of silt, clay and cobbles and/or silty sand was encountered below the fill materials at all of the test pits and boreholes where the fill was fully penetrated, except BH6-5111 and the test pits put down on April 24, 2014. The test pits and boreholes terminated in the sand and gravel and or silty sand at depths ranging from about 1.0 to 10.5 metres below the existing ground surface. Based on the standard penetration value (N), which ranged from about 20 to 94 blows per 0.3 metres, the fine to coarse sand and gravel was observed to be in a compact to very dense state of packing. Based on the standard penetration value (N), which ranged from about 2 to 27 blows per 0.3 metres, the silty sand was observed to be in a very loose to compact state of packing.

A sample of sand obtained from BH17-5119 (7.6 to 8.2 metres) was submitted to Stantec for grain size distribution testing (ASTM C136) and hydrometer testing (ASTM D422). The results of the testing are provided in the Laboratory Testing Results section at the end of this report.

The results of the sieve analysis for the sample from BH17-5119 indicates the sample has a gravel content of 27.9 percent, a sand content of 59.9 percent and a silt & clay content of 12.2 percent.

The results of the laboratory testing are located in Attachment A.

3.4 Glacial Till

Glacial till was encountered beneath the fill materials at BH6-5111. The glacial till consisted of gravel, cobbles and boulders, in a matrix of grey brown to grey silty sand, with a trace to some clay. The glacial till was observed to be in a dense to very dense compact state of packing based on the standard penetration value (N), which ranged from about 40 to 94 blows per 0.3 metres. Practical refusal was experienced on a large cobble or boulder at about 3.2 metres below the existing ground surface.

A sample of glacial till obtained from BH6-5111 (1.52 to 2.1 metres) was submitted to Stantec for grain size distribution testing (ASTM C136) and hydrometer testing (ASTM D422). The results of the laboratory grain size distribution analysis for the sand sample obtained from BH6-5111 indicates the sample has a gravel content of about 32 percent, a sand content of about 40 percent and a silt & clay content of about 23 percent.

3.5 Bedrock

Three drilled cased water wells were installed at the site as a requirement for a hydrogeological investigation completed by others for the site. From the water well records (Attachment A) it is considered that the geotechnical investigation will likely encounter sand and gravel and boulders to about 14.6 metres to 15.8 metres below the ground surface. It is considered that limestone bedrock is underlying the site beginning at about 14.6 to 15.8 metres below the ground surface.

3.6 Groundwater

Some groundwater seepage was observed within BH8-5116, BH9-5115, BH10-5113, BH18-5107, BH19-5106 and BH20-5110 at about 2.8, 3.8, 3.8, 5.7, 6.7 and 7.1 metres, respectively, below existing ground surface at the time of drilling. On September 11, 2014, groundwater was measured in standpipes installed in BH8-5116, BH10-5113 and BH17-5119 at depths of about 2.5, 1.2 and 4.6 metres below existing ground surface. BH3-5121 was observed to be dry. The test pits were dry at the time of excavation on September 22, 2014. It should be noted that the groundwater levels may be higher during wet periods of the year such as the early spring.

3.7 Corrosivity on Reinforcement and Sulphate Attack on Portland Cement

The results of the laboratory testing of a soil sample for submitted for chemistry testing related to corrosivity is summarized in the following table.

Item	Threshold of Concern	Test Result	Comment
Chlorides (Cl)	Cl > 0.04 %	< 0.002	Negligible concern
pH	5.0 < pH	8.0	Neutral/Slightly Basic Negligible concern
Resistivity	R < 1500 ohm-cm	11100	Negligible concern
Sulphates (SO_4)	SO_4 > 0.1%	<0.01	Negligible concern

Based on the chemical test results, Type GU General use Hydraulic Cement may be used for this proposed development. No special protection is required for reinforcement steel within the concrete walls.

4 PROPOSED COMMERCIAL DEVELOPMENT BUILDING FOUNDATIONS

4.1 General

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the information from the test holes 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 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 at this site or adjacent properties, and/or resulting from the introduction onto the site of materials from offsite sources are outside the terms of reference for this report.

4.1.1 Foundations for Proposed Commercial Buildings

The results of this investigation indicate that the site is mostly underlain by a deposit of sand and gravel/silty sand and/or glacial till beneath a considerable thickness of deleterious fill materials. Based on the subsurface investigation, it is expected that fill materials will be encountered at all of the proposed building locations. It is expected that the fill material will vary in thickness from less than 0.1 m to about 9.6 metre. The fill was observed to consist of silty clay and/or sand containing, at some locations, a trace to some asphaltic concrete, concrete debris, boulders, and some deleterious materials such as wood and topsoil.

The fill materials are inconsistent and not considered suitable for the support of the proposed building structures using conventional slab on grade foundations.

The selection of the foundation alternatives should be based, among other factors, on the structural requirements of the building, the proposed grades, overall cost for the foundations and soil removal/disposal, availability of equipment, and schedule.

4.1.2 Proposed Building Foundations Alternatives

In view of the thickness and inconsistency of the fill materials encountered at the site, it is considered that the proposed buildings may be founded on:

1) Spread footings bearing on undisturbed native material or on an engineered fill placed on undisturbed fine to coarse sand, silty sand or glacial till, or;
2) On deep foundations such as driven piles deriving support in end bearing on very dense glacial till or bedrock, or;
3) A structurally designed raft foundation placed on an engineering pad bearing on fill material in conjunction with preloading and surcharge of the fill material.

4.2 Alternative 1)

Spread footings bearing on undisturbed native material or on an engineered pad placed on undisturbed native fine to coarse sand and gravel, silty sand or glacial till.

4.2.1 Excavation for Proposed Structures

Any excavation for the proposed structures will likely be carried out through surficial topsoil and fill material consisting of silty clay or silty sand and sand and gravel containing boulders to the native sand, silty sand and gravel/silty sand or glacial till. The sides of the excavation should be sloped in accordance with the requirements of Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the fill material above the ground water level ,can be classified as Type 3 soil and, accordingly, allowance should be made for excavation side slopes of 1 horizontal to 1 vertical extending upwards from the base of the excavation. Should ground water be encountered within the silty sand fill material, the steepness of the excavation side slopes may have to be reduced.

The excavations within the fill and native materials above the groundwater level should not present any serious constraints. In contrast, excavations below the groundwater level if encountered could present some constraints. In that case, there is potential for disturbance to the soil on the sides and bottom of the excavations and relatively flat side slopes may be required to prevent sloughing of material into the excavation unless the groundwater level is lowered in advance of the excavation. In this case, the groundwater inflow should be controlled throughout the excavation by pumping from sumps within the excavation. Notwithstanding, some disturbance and loosening of the subgrade materials could occur, an allowance should be made for subexcavation of any disturbed soil at the subgrade level.

4.2.2 Engineered Fill

Where fill material is encountered below proposed founding level, the fill material should be removed and replaced with compacted granular material (engineered fill). The engineered fill should consist of granular material meeting Ontario Provincial Standards Specifications (OPSS)

requirements for Granular A or Granular B Type II and should be compacted in maximum 300 millimetre thick loose lifts to at least 95 percent of the standard Proctor maximum dry density. To allow the spread of load beneath the footings, the engineered fill should extend out from the edges of the footing a horizontal distance of 0.5 metres and then down and out at 1 horizontal to 1 vertical, or flatter. The excavations for the proposed buildings should be sized to accommodate this fill placement. Currently, OPSS documents allow recycled asphaltic concrete to be used in Granular A and Granular B Type II materials. If the source of recycled material cannot be verified, it is suggested that any granular materials used below the founding level be composed of virgin materials only.

4.2.3 Bearing Capacity

Spread footings founded on undisturbed native materials or on a pad of properly constructed engineered fill placed on undisturbed native materials, may be designed as follows:

Subgrade Material	Maximum Allowable Bearing Pressure for Serviceability limit States (kPa)	Factored Ultimate Bearing Resistance (kPa)
Native Compact Sand or Silty sand	90	150
Dense Glacial Till	200	300
Engineered Fill of less than 1 m thickness	150	200
Engineered Fill of greater than 1 m thickness	200	300

The above allowable bearing pressure/resistance are suitable for footings a minimum of 0.6 metres in width. There are no grade raise restrictions adjacent to the proposed structure associated with this option.

Provided that the engineered fill is compacted to the required density and all loose or disturbed soil is removed from the bearing surfaces prior to concrete placement, the total and differential settlement of the footings should be less than 25 millimetres and 20 millimetres, respectively. The subgrade surface should be inspected by geotechnical personnel prior to the placement of engineered fill material and concrete. Field density testing should be carried out on the engineered fill during placement.

4.2.4 Slab on Grade Support

For predictable performance of the proposed concrete floor slabs, the existing fill should be sub-excavated to a minimum depth of 0.9 metres below the proposed underside of floor slab elevation where not previously excavated. Any deleterious fill such as wood debris or topsoil encountered at that level should be removed. The exposed subgrade surface should then be inspected and approved by geotechnical personnel. Any soft areas evident should be further sub-excavated and replaced with suitable engineered fill. It is recommended that a standard 8 millimetre polyethylene vapour barrier be placed below the concrete floor slab.

The engineered fill materials beneath the proposed concrete floor slab on grade should consist of a minimum of 150 millimetre thickness of crushed stone meeting OPSS Granular A immediately beneath the concrete floor slab followed by sand, or sand and gravel meeting the OPSS for Granular B Type I, or crushed stone meeting OPSS grading requirements for Granular B Type II, or other material approved by the Geotechnical Engineer. The engineered fill materials should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density.

The proposed "Granular A' or 'Granular B' fill beneath the concrete floor slab can be replaced with approval by the geotechnical engineer with recycled crushed concrete meeting the grading requirements for 50 mm minus OPSS Granular B Type II.

The concrete floor slab should be saw cut at regular intervals to minimize random cracking of the slab due to shrinkage of the concrete. The saw cut depth should be about one quarter of the thickness of the slab. The crack control cuts should be placed at a grid spacing not exceeding about 5 metres.

Under slab drainage is not considered necessary provided that the floor slab level is everywhere above the finished exterior ground surface level. If any areas of the proposed buildings are to remain unheated during the winter period, thermal protection of the slab on grade may be required. Further details on the insulation requirements could be provided, if necessary.

4.3 Alternative 2)

Deep Foundations such as driven piles deriving support in end bearing on very dense glacial till or bedrock

4.3.1 Foundation and Bearing Capacity

Where the fill materials extend significantly below the water level or are of sufficient thickness to make it uneconomical to completely remove the fill materials, the foundations for the proposed buildings could be supported on end bearing driven piles. In this case, all load bearing walls and columns should be placed on a foundation supported on end bearing driven pile. Mixed foundation types are not recommended. End bearing driven piles for the proposed structures could consist of concrete filled steel pipe piles or steel H Piles.

The end bearing piles should be driven to termination on either very dense glacial till or bedrock. Termination for closed ended pipe piles can be taken as a minimum number of 10 blows to advance the pile downward a maximum of 12 millimetres, using a hammer developing some 27 kilojoules of energy per blow. Termination for a steel H Pile can be taken as a minimum number of 10 blows to advance the pile downward a maximum of 12 millimetres using a hammer developing some 54 kilojoules of energy per blow.

As a design example, for a 245 millimetre diameter steel pipe pile with a wall thickness of 8.9 millimetres, driven closed ended to termination consisting of a set of 10 blows for the last 12 millimetres using a hammer developing some 27 kilojoules of energy per blow, the Serviceability Limit State (SLS) allowable load could be taken as of 915 kilonewtons. As a second example, for a 194 millimetre diameter steel pipe pile with a wall thickness of 13.8 millimetres, driven closed ended to termination, the SLS allowable load could be taken as 930 kilonewtons. The Ultimate Limit State (ULS) load for the above steel pipe pile designs is 1,800 kilonewtons. The above designs assume that the steel for the pipe piles has a minimum yield strength of 340 megapascals and that the pipe pile is filled with 30 megapascals compressive strength concrete.

As it will not be possible to inspect the H piles for damage and/or bending after driving and in view of the presence of cobbles and boulders in the glacial till through which the piles will be driven, the use of a relatively heavy steel H Pile equipped with a cast steel driving shoe is suggested to minimize the damage to the pile tip which may be caused by these conditions.

As a design example, for an HP 320 x 110 steel H-pile, the SLS allowable load could be taken as 1,150 kilonewtons and the ULS load could be taken as 1,800 kilonewtons, respectively. The H piles should be set to a termination of 10 blows for the last 12 millimetres of penetration using a hammer transferring about 54 kilojoules of energy per blow.

The contractor should be required to submit a copy of the proposed pile type and driving criteria for review and acceptance by the engineer prior to the start of construction. Furthermore, the specifications for the project should make provision for dynamic testing of piles selected by the engineer to verify the transfer energy and pile load capacities.

Based on our previous piling experience in this area, it is possible that several rounds of restriking could be required to achieve performance of the final set. Therefore, provision should be made for restriking all of the piles at least once to confirm the set. Piles that do not meet the design criteria on the first or subsequent restrike would require additional restriking. A minimum of two days should be allowed before restriking a pile.

The post construction settlement of the end bearing driven pile foundations using the above recommended SLS bearing pressures are expected to be less than 12 millimetres.

4.3.2 Concrete Floor Slab on Grade Support

It is assumed that fill materials would not have been removed if a foundation supported by driven piles was selected. For predictable performance of the proposed concrete floor slabs, the existing fill should be sub-excavated to a minimum depth of 0.9 metres below the proposed underside of floor slab elevation. Any deleterious fill such as wood debris or topsoil encountered at that level should be removed. The exposed subgrade surface should then be inspected and approved by geotechnical personnel. Any soft areas evident should be further sub-excavated and replaced with suitable engineered fill.

The fill materials beneath the proposed concrete floor slab on grade should consist of a minimum of 150 millimetre thickness of crushed stone meeting OPSS Granular A immediately beneath the concrete floor slab followed by sand, or sand and gravel meeting the OPSS for Granular B Type I, or crushed stone meeting OPSS grading requirements for Granular B Type II, or other material approved by the Geotechnical Engineer. The engineered fill materials should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. It is recommended that a standard 8 millimetre polyethylene vapour barrier be placed below the concrete floor slab.

The proposed "Granular A' or 'Granular B' fill beneath the concrete floor slab can be replaced with approval by the geotechnical engineer with recycled crushed concrete meeting the grading requirements for 50 mm minus OPSS Granular B Type II.

The concrete floor slab should be saw cut at regular intervals to minimize random cracking of the slab due to shrinkage of the concrete. The saw cut depth should be about one quarter of the

thickness of the slab. The crack control cuts should be placed at a grid spacing not exceeding about 5 metres.

Under slab drainage is not considered necessary provided that the floor slab level is everywhere above the finished exterior ground surface level. If any areas of the proposed buildings are to remain unheated during the winter period, thermal protection of the slab on grade may be required. Further details on the insulation requirements could be provided, if necessary.

4.4 Alternative 3)

A structurally designed raft foundation placed on an engineering pad bearing on fill material in conjunction with preloading and surcharge of the fill material

A significant thickness of silty clay and sand fill materials were encountered along the northern portion of the development. From the proposed site plan it is understood that proposed buildings CRU11, CRU12 and CRU13 will be constructed along this side of the development. These proposed buildings are relatively small structures with footprints of about 745, 370 and 1180 square metres respectively. The risk associated with founding buildings on un-engineered fill materials is unpredictable and potentially excessive differential and total settlement. It is considered that this risk could be mitigated for small buildings by preloading the proposed building area in conjunction with founding the building on an engineered pad.

It is considered that these buildings could be constructed on structurally engineered cast-in-place concrete raft foundations designed to accommodate potential differential movement of 25 millimetres and total settlement of 50 millimetres. Each raft foundation should be placed on an area suitably prepared by a combination of the placement of an engineered pad and preloading outlined below.

4.4.1 Preloading and Surcharging

Preloading and Surcharging the areas of the proposed buildings will allow the subgrade soils to settle in advance of the construction of the engineered pad and proposed building.

Preloading and surcharging consists of placing a temporary surcharge load above the design finished floor level for a period of time or preload period prior to construction of the proposed buildings. The surcharge load will apply a stress equivalent to or in excess of the ‘design’ level, after accounting for the future foundation loads in order to accelerate any potential settlements prior to construction and to reduce the potential for post-construction ‘creep’ settlements which could occur in the long term.

The magnitude of the surcharge load is a dependent on the foundation loading and on the finished grade design elevation, the duration of the preloading period, and on the acceptable magnitude of the post construction settlement.

It is understood that the foundation design for the proposed buildings has not been completed at this time. However it is understood that the buildings will be commercial with a steel post and beam structure. The loading from these buildings typically consists of a sum of the snow load (2.5 kPa), building dead load (3 kPa), building live load (4.8 kPa), and foundation load (4 kPa). Estimated total load is approximately 15 kPa therefore a minimum estimated surcharge of 1 metre above finished floor level will be required. It is considered that the surcharge fill could consist of existing material obtained during constructions from other areas of the development, or could consist of imported fill material.

In order to reduce the potential for post-construction 'creep' settlement and to account for unexpected loading, it is recommended that the surcharge height be increased to 2.5 metres thickness. The upper surface of the surcharge load should extend to about 3.0 metres outside of the outer edge of the proposed building footprints and should be sloped down and out at no steeper than 1 horizontal to 1 vertical (1H:1V). It is expected that any initial consolidation of the existing fill materials under the proposed surcharge load will be relatively rapid. As such an initial settlement monitoring period of 6 months is proposed.

The subgrade settlements would need to be monitored to establish when sufficient settlements have occurred such that construction could proceed. The settlement monitoring should be carried out by measuring the movements of three settlement plates placed at selected locations within the surcharge area of each proposed building for a total of nine plates. Once the monitoring of the settlement plates indicates that sufficient settlements have occurred, the surcharge could be removed and the building constructed.

4.4.2 Settlement Monitoring

The subgrade settlements would need to be monitored to establish when sufficient settlements have occurred such that the proposed building construction could proceed. It is considered that settlement plates will form the most cost-effective and reliable method of monitoring the settlements. A minimum of three settlement plates per building location is recommended for this development. Construction details for the settlement plates are given on Figure 4.

The installation of the settlement plates should occur prior to the placement of the surcharge fill, so that all of the settlements will be captured by the monitoring. The settlement plates must also be installed on a level and stable surface. Non-yielding survey benchmarks will also be required, which will not be affected (or caused to settle) by the construction. During settlement monitoring,

additional data including extent and height of surcharge pile and type and unit weight of surcharge fill material should be collected.

It is proposed that the settlement plate (rod) elevations be collected every week during the initial phase of monitoring (i.e., the first month after completion of surcharge filling). Thereafter, the elevations may be collected on a bi-weekly or monthly basis, depending on the rate of settlement. Given the fairly rapid expected rate of settlement, less frequent monitoring would make it difficult to evaluate the rate of on-going settlement. The rate of settlement may be an important measure of success of the surcharge/pre-load and will be critical information for deciding when sufficient pre-load time has passed and that the surcharge can be removed.

The decision as to when sufficient surcharge/pre-load time has passed will depend primarily upon the most recent rate of settlement, in comparison to the preceding measured rates of settlement. Once the monitoring of the settlement plates indicates that sufficient settlements have occurred, the surcharge could be removed. However, it is also possible that, if the monitoring indicates a high magnitude of on-going secondary compression (i.e., creep) settlements, then the surcharge could potentially need to be increased. Once the surcharge fill has been removed, the engineered pad could be constructed to support the proposed foundations.

4.4.3 Engineered Pad.

The existing fill should be sub-excavated to a minimum depth of 0.9 metres below the proposed underside of raft foundation. The excavation should be sized to accommodate an engineered pad constructed to extend a horizontal distance of 0.5 metre beyond the outside edge of the raft foundation than down and out at a maximum slope of 1 horizontal to 1 vertical. Any deleterious fill such as wood or organic debris encountered at that level should be removed. The exposed subgrade surface should then be inspected and approved by geotechnical personnel. Any soft areas evident should be further sub-excavated. A nonwoven 6 ounce geotextile fabric such as Mirafi 160N or approved alternative should be placed on the approved subgrade surface prior to the placement of any engineered fill. It is recommended that a standard 8 millimetre polyethylene vapour barrier be placed below the concrete floor slab.

The engineered fill should consist of granular material meeting Ontario Provincial Standards Specifications (OPSS) requirements for Granular A or Granular B Type II and should be compacted in maximum 300 millimetre thick loose lifts to at least 95 percent of the standard Proctor maximum dry density. To allow the spread of the load beneath the raft foundation, the engineered fill should extend out from the edges of the footing a horizontal distance of 0.5 metres and then down and out at 1 horizontal to 1 vertical, or flatter. The excavations for the proposed buildings should be sized to accommodate this fill placement.

Provided everywhere the proposed finished floor surfaces are above the exterior finished grade and provided the exterior grade is adequately sloped away from the proposed buildings, no perimeter foundation drainage system is required.

4.4.4 Bearing Capacity

The raft foundation may be designed with an average distributed allowable bearing pressure across the foundation of 20 kPa for Serviceability limit States (kPa) and 40 kPa factored ultimate bearing resistance for ultimate limit states design. Where concentrated loading may occur at column or load bearing wall locations requiring a thickening of the raft foundation, the thickened edge, strip or pad may be designed for a maximum allowable bearing pressure of 100 kPa for SLS design and 175 kPa for ULS assuming all of the load is transferred to the thickened portion only.

4.5 Frost Protection Requirements for Foundation Walls

All exterior footings and those in any unheated parts of the proposed buildings should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated, exterior footings constructed in areas that are to be cleared of snow during the winter period should be provided with at least 1.8 metres of earth cover for frost protection purposes.

The depth of frost cover could be reduced for footings bearing on engineered fill over the fine to coarse sand and gravel, silty sand or glacial till. In this case, the combined thickness of earth cover and the engineered fill should be at least 1.5 metres for frost protection purposes. Alternatively, the required frost protection could be provided using a combination of earth cover and extruded polystyrene insulation. Detailed guidelines for footing insulation frost protection could be provided upon request.

4.6 Foundation Wall Backfill and Drainage

To prevent possible foundation frost jacking, the backfill against the foundations should consist of free draining, non-frost susceptible material such as sand or sand and gravel meeting OPSS Granular B Type I grading requirements. Alternatively, foundations could be backfilled with native material in conjunction with the use of an approved proprietary drainage layer system against the foundation wall. It is pointed out that there is potential for possible frost jacking of the upper portion of some types of these drainage layer systems if frost susceptible material is used as backfill. This could be mitigated by backfilling the upper approximately 0.6 metres with non-frost susceptible granular material.

Where the backfill material will ultimately support a pavement structure or walkway, it is suggested that the foundation wall backfill material be compacted in 250 millimetre thick lifts to 95 percent of the standard Proctor dry density value.

Provided everywhere the proposed finished floor surfaces are above the exterior finished grade and provided the exterior grade is adequately sloped away from the proposed buildings, no perimeter foundation drainage system is required.

4.7 Frost Protection Requirements for Raft Foundation

The subgrade below the raft foundation should be protected from freezing by the use of rigid insulation placed beneath and extending out beyond the edge of the foundation. The rigid insulation should consist of high density extruded polystyrene insulation with a minimum compressive strength of 275 kPa at 5% deformation such as DOW HI40 or approved alternative. The insulation should extend out a minimum of 1.2 metres beyond the outside edge of the foundation. The insulation should also extend a minimum of 1.2 metres beneath the foundation measured from the outside edge and across the entire width of any unheated building space.

It is noted that the subgrade surface should be free of any loose material and completely flat prior to the placement of the rigid insulation. The joints in the insulation should be tapped as required to ensure individual sheets remain tightly placed together. Foot and equipment traffic on the insulation should be minimized as much as possible to prevent cracking of the insulation.

5 Seismic Design for the Proposed Commercial Buildings

5.1 Site Classification

Based on the information from the boreholes and the test pits, for seismic design purposes, in accordance with the 2012 OBC Section 4.1.8.4, Table 4.1.8.4.A., the site classification for seismic site response is Site Class D. The subsurface conditions below the proposed foundation design level consists of loose to moderately well compacted silty clay or sand fill or native undisturbed sand overlying bedrock at 14.6 to 15.8 metres below the existing ground surface.

Alternatively:

Seismic Site Response Site Class Calculation

Average Conditions Encountered At the Site					
Layer	Description	Depth (m)	d_i (m)	$N(60)_i$ (blows / 0.3m)	d_i/N_i
1	Fill	0	4.1	8	0.513
2	Fill	4.1	5.5	13	0.423
4	Fill	9.6	5.25	10	0.270
5	Sand	12.3	0.8	25	0.140
7	Bedrock	15.8	14.1	100	0.142
	$sum(d_i/N(60)_i)$				1.488
	$d_c/(sum(d_i/N(60)_i)$				20.2

Since N(60) = 15 < 20.2 < 50, the seismic site response is Site Class D.

5.2 Potential for Soil Liquefaction

Consideration for the potential for soil liquefaction of the existing silty clay and sand fill underlying sand overburden was determined by considering the ratio between the cyclic resistance ratio (CRR) to the cyclic stress ratio (CSR) for the soils between the proposed underside of footing level and the depth at which refusal to further advancement using standard penetration testing was attained. The CRR value was determined from a mathematical expression as determined by Rauch (1997) of the base curve obtained from Robertson and Fear (1996). The CSR was determined from Seed and Idriss (1971). It is considered that a soil with a normalized SPT of greater than 30 is non-liquefiable. It is also considered that a soil with a CRR/CSR ratio of greater than one is not liquefiable. The average CRR / CSR ratio for the fill and sand materials encountered between the surface and the underlying bedrock is 1.1. As such the subgrade soils at the site are not considered to be liquefiable.

6 SITE SERVICES

Based on a review of the proposed site servicing plan, the site will be serviced by a "Communal onsite septic system, communal well and storm sewers out letting to a storm pond. The sanitary flow from each building will be directed by gravity through sanitary sewers to a lift station where it will be distributed to the septic system. The water services will be provided by pressurized water mains. Both the sanitary sewers and the water services will be installed below frost depth. The storm water flow will be conveyed by storm sewers via gravity flow to a storm pond. From the site servicing drawing, a significant portion of the proposed storm and sanitary sewers will be located in the areas where there are significant fill thicknesses.

In order to avoid potential unacceptable movement of the storm and sanitary sewers due to the further consolidation of the fill, the following is considered:

- Where the sanitary or storm sewer is area effected by the removal of the existing fill and replacement with engineered fill in order to support a proposed building, the engineered fill should be extended to include the sanitary or storm service.
- Where the existing fill does not extend more than 1.0 metres beyond the proposed underside of bedding layer, the existing fill should be removed and replaced with engineered fill.
- Where the sanitary and storm sewers will be located in areas of where the existing fill thickness extends beyond 1.0 metres below the underside of bedding area, the area should be preloaded and surcharged prior to the installation of the sewers. The preloading and surcharging may be completed as detailed for the support of the proposed buildings in Alternative 3 above. The surcharge fill thickness should extend to 2.5 metres above the proposed finished grade of the site where the service is being installed.

6.1 Excavation

The excavations for the site services will be carried out through topsoil, fill and potentially sand and glacial till. The sides of the excavations in overburden materials should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Ontario Occupational Health and Safety Act. Where space constraints dictate, the excavation and backfilling operations should be carried out within a tightly fitting, braced steel trench box. It is expected that the groundwater level will likely not be encountered during excavation however allowance for surface water runoff and variable groundwater levels within the fill should be made.

Any groundwater inflow into the service trenches should be handled by pumping from sumps from within the excavations.

Where the services will be located in areas of significant fill thickness, the service trench should be over excavated an additional 0.5 metres below required to achieve the minimum bedding thickness. The bottom of the trench may be brought back to required bedding elevation using compacted granular material meeting the requirements for OPSS Granular A, Granular B type 1, Granular B type 2 or recycled crushed concrete meeting the grading requirements for 50 mm minus OPSS Granular B Type 2. The granular material should be compacted in lifts to at least 95 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment.

6.2 Pipe Bedding and Cover Materials

It is suggested that the service pipe bedding material consist of at least 150 millimetres of granular material meeting OPSS requirements for Granular A. A provisional allowance should, however, be made for subexcavation of any disturbed material encountered at subgrade level. Granular material meeting OPSS specifications for Granular B Type II could be used as a sub-bedding material. The use of clear crushed stone as bedding or sub-bedding material should not be permitted.

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of granular material, such as OPSS Granular A.

The sub-bedding, bedding and cover materials should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment.

6.3 Trench Backfill

The general backfilling procedures should be carried out in a manner that is compatible with the future use of the area above the service trenches.

In areas where the service trench will be located below or in close proximity to existing or future roadway areas, acceptable existing fill materials should be used as backfill between the roadway subgrade level and the depth of seasonal frost penetrations (i.e. 1.8 metres below finished grade) in order to reduce the potential for differential frost heaving between the area over the trench and the adjacent section of roadway.

Where existing fill is used, it should match the native materials exposed on the trench walls. Some of the native materials from the lower part of the trench excavations may be wet of the optimum water content for compaction. Depending on the weather conditions encountered during construction, some drying of materials and/or recompaction may be required. Any wet materials that cannot be compacted to the required density should either be wasted from the site or should be used outside of existing or future roadway areas. Any boulders larger than 300 millimetres in size should not be used as service trench backfill. Backfill below the zone of seasonal frost penetration could consist of either acceptable existing fill material or imported granular material conforming to OPSS Granular B Type I.

If the existing fill material is not suitable for reuse as described above, the service trenches may be backfilled using material meeting the requirements for OPSS Granular B Type 1 or using recycled crushed concrete meeting the grading requirements for 50 mm minus OPSS Granular B Type 2. In this case the service should be installed with frost tapers extending out from the edge of the service trench at a maximum slope angle of 3 horizontal to 1 vertical beginning at 1.5 metres below finished grade.

To minimize future settlement of the backfill and achieve an acceptable subgrade for the roadways, sidewalks, etc., the trench should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. The specified density may be reduced to 90 percent where the trench backfill is not located within or in close proximity to existing or future roadways, driveways, sidewalks, or any other type of permanent structure.

6.4 Seepage Barriers

It is expected however that the sewer trenches will not extend into the ground water level. Should this occur however, the permanent lowering of the groundwater level at the site can be caused by drainage through the granular bedding and cover materials within the sewer trenches. Groundwater lowering can cause stress within the silty clay fill materials which underlie the site and in turn result in settlement of footings/foundations and services.

Should groundwater be encountered during excavation for the site services, it is recommended that clay dykes be provided within sewer trenches at about 90 metre spacing to minimize the possibility of groundwater lowering at this site due to the presence of the proposed sewers.

7 ACCESS ROADWAY AND PARKING AREA PAVEMENTS

7.1 Preparation

In preparation for pavement construction at this site the existing fill should be sub-excavated to a minimum depth of 1.0 metres below the proposed finished roadway and parking area surface. The excavation should be sized to accommodate a granular structure constructed to extend down and out at a maximum slope of 1 horizontal to 1 vertical from the edge of the parking area or road way. Any deleterious fill such as wood debris or topsoil encountered at that level should be removed. The exposed subgrade surface should then be inspected and approved by geotechnical personnel. Any soft areas evident should be further sub-excavated. The sub-grade should be shaped and crowned to promote drainage of the roadway area granular. A nonwoven 6 ounce geotextile fabric such as Mirafi 160N or approved alternative should be placed on the approved subgrade surface prior to the placement of any engineered fill.

For any areas of the site that require the sub-grade to be raised to proposed roadway area sub-grade level, the material used should consist of OPSS select sub-grade material, OPSS Granular B Type I or Type II, or recycled crushed concrete meeting the grading requirements for 50 mm minus OPSS Granular B Type 2. Materials used for raising the sub-grade to proposed roadway area sub-grade level should be placed in maximum 300 millimetre thick loose lifts and be compacted to at least 95 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment.

7.2 Structure

For pavement areas subject to cars and light trucks the pavement should consist of:

50 millimetres of hot mix asphaltic concrete (HL3) over
150 millimetres of OPSS Granular A base over
300 millimetres of OPSS Granular B, Type II subbase
(50 or 100 millimetre minus crushed stone)

For pavement areas subject to heavy truck/bus loading the pavement should consist of:

40 millimetres of hot mix asphaltic concrete (HL3) over
40 millimetres of hot mix asphaltic concrete (HL8) over
150 millimetres of OPSS Granular A base over
400 millimetres of OPSS Granular B, Type II subbase
(50 or 100 millimetre minus crushed stone)

The specified OPSS Granular B, Type II subbase material may be replaced as approved by the geotechnical engineer by recycled crushed concrete meeting the grading requirements for 50 mm minus OPSS Granular B Type 2. In this case the thickness of the granular subbase layer should be reduced by 50 mm and the Granular A base layer thickness should be increase by 50 mm to 200 mm.

Compaction of the granular pavement materials should be carried out in maximum 300 millimetre thick loose lifts to 100 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment.

The above pavement structures will be adequate on an acceptable sub-grade, that is, one where any roadway fill and service trench backfill has been adequately compacted. If the roadway sub-grade is disturbed or wetted due to construction operations or precipitation, the granular thicknesses given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type II subbase. The adequacy of the design pavement thickness should be assessed by geotechnical personnel at the time of construction.

8 CONSTRUCTION CONSIDERATIONS

It is suggested that the final design drawings for the project, including the proposed site grading plan, be reviewed by the geotechnical engineer to ensure that the guidelines provided in this report have been interpreted as intended and to re-evaluate the guidelines provided in the report with respect to the actual project plans. Items such as actual foundation wall/column loads, whether or not the basement or below grade parking structure is heated, etc could have significant impacts on foundation type, frost protection requirements, etc.

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed development do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design.

All footing areas and any engineered fill areas for the proposed buildings should be inspected by Kollaard Associates Inc. to ensure that a suitable subgrade has been reached and properly prepared. The placing and compaction of any granular materials beneath the foundations should be inspected to ensure that the materials used conform to the grading and compaction specifications.

The placing and compaction of sewer bedding, cover and backfill should be inspected to ensure that the materials used conform to the specifications from both a materials and compaction point of view.

Preloading and Surcharging should be carried out under the supervision of and be monitored by Kollaard Associates Inc.

Any recycled crushed concrete proposed for use in the development should be approved by Kollaard Associates Inc. prior to use.

The subgrade for the access roadway and parking areas should be inspected and approved by geotechnical personnel. In situ density testing should be carried out on the pavement granular materials to ensure the materials meet the specifications from a compaction point of view.

The native sand deposits at this site will be sensitive to disturbance from construction operations, from rainwater or snow melt, and frost. In order to minimize disturbance, construction traffic operating directly on the subgrade should be kept to an absolute minimum and the subgrade should be protected from below freezing temperatures.

The soil samples obtained as part of this investigation will be maintained in storage for a period of 3 months following the issuance of this report, unless otherwise instructed.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we may be of further services to you, please do not hesitate to contact our office.

Regards,
Kollaard Associates Inc.

Dean Tataryn, B.E.S., EP. Steve DeWit, P.Eng.

Attachments: Record of Boreholes
Record of Test Pits
Figure 1 – Key Plan
Figure 2 – 2011 Aerial – Entire Site
Figure 3 – 2011 Aerial – Current Development Site
Figure 4 – Settlement Plate Construction
Attachment A – Laboratory Test Results for Chemical Properties
Attachment B – Laboratory Test Results for Physical Properties – Stantec Laboratory Test Results for Soils
Attachment C – Water Well Records

RECORD OF BOREHOLE BH1-5123

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 25, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		105.53							
0	Topsoil (FILL)		0.00							
	Yellow brown silty sand, some gravel, cobbles and boulders, trace topsoil and granular stone (FILL)			1	SS	25				
1				2	SS	12				
			104.01							
	Grey brown fine to medium SAND, trace to some gravel and cobbles		1.52	3	SS	23				
2			103.40							
	End of Borehole, refusal on large boulder		2.13							Borehole dry on August 25, 2014.
3										
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
LOGGED: DT
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

RECORD OF BOREHOLE BH2-5122

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 25, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		105.24							
0	Topsoil (FILL)		0.00							
	Grey brown silty sand, some gravel, cobbles and boulders, trace clay (FILL)			1	SS	18				
1				2	SS	7				
2				3	SS	23				
			103.11							
	End of Borehole, refusal on large boulder		2.13							Borehole dry on August 25, 2014.
3										
4										
5										
6										
7										
8										

Kollaard Associates Engineers

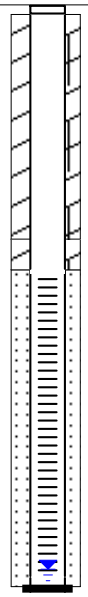
DEPTH SCALE: 1 to 50
LOGGED: DT
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

RECORD OF BOREHOLE BH3-5121

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 25, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		106.00							
0	Topsoil (FILL)		0.00							
	Grey brown silty sand, some gravel, cobbles and boulders, trace of glass at about 1.8 metres depth (FILL)			1	SS	9				
1				2	SS	13				
2				3	SS	23				
			103.54							
	Grey fine to medium SAND, trace to some gravel and cobbles		2.46	4	SS	30				
3				5	SS	24				
4				6	SS	24				
				7	SS	48				
5				8	SS	94				
			100.21							
	End of Borehole, refusal on large boulder or bedrock		5.79							
6										
7										
8										
9										
10										
11										
12										
13										



Borehole dry, August 25, 2014. Water level measured in standpipe at about 5.6 metres below existing ground surface, September 12, 2014.

Kollaard Associates Engineers

DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH4-5120

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 25, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		106.38							
0	Topsoil (FILL)		0.00							
	Grey brown silty sand, some gravel, cobbles and boulders, trace clay and topsoil (FILL)			1	SS	13				
1				2	SS	6				
2				3	SS	8				
				4	SS	22				Borehole dry on August 25, 2014.
3	End of Borehole, practical refusal on large boulder		103.41 2.97							
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
LOGGED: DT
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

RECORD OF BOREHOLE BH5-5118

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 26, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		105.59							
0	Topsoil (FILL)		0.00							
	Grey brown silty sand, some gravel, cobbles and boulders, trace clay and topsoil (FILL)			1	SS	28				
			104.58							
1	Yellow to grey brown fine to medium SAND, trace to some gravel, cobbles		1.01	2	SS	23				
				3	SS	20				
2			103.46							
	End of Borehole		2.13							Borehole dry on August 26, 2014.
3										
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH6-5111

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 26, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		108.25							
0	Topsoil (FILL)		0.00							
	Grey brown silty sand, some gravel, cobbles and boulders, trace clay and topsoil (FILL)			1	SS	10				
			107.27							
1	Grey brown silty sand, some gravel, cobbles and boulders, trace clay (GLACIAL TILL)		0.98	2	SS	40				
				3	SS	74				
2				4	SS	43				Borehole dry on August 26, 2014.
				5	SS	50				
3			105.10							
	End of Borehole, Practical refusal on large boulder		3.15							
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
LOGGED: DT
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

RECORD OF BOREHOLE BH7-5117

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 26, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		105.41							
0	Topsoil (FILL)		0.00							
	Grey brown sand silt, some gravel, cobbles and boulders,sandy silty clay, trace gravel, cobbles, boulders and topsoil (FILL)			1	SS	13				
1				2	SS	23				
2				3	SS	8				
				4	SS	21				Borehole dry on August 26, 2014.
3	End of Borehole, Practical refusal on large boulder		102.42 2.99							
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH8-5116

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 26, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m
	Ground Surface		104.76			
0	Topsoil (FILL)		0.00	1	SS	5
	Grey brown silty clay (FILL)			2	SS	5
1				3	SS	46
2			102.66			
	Grey brown sand,trace gravel, cobbles, boulders and clay (FILL)		2.10	4	SS	18
			101.71			
3	Grey silty clay, trace to some gravel and organics (FILL)		3.05	5	SS	1
4				6	SS	2
				7	SS	WH
5			99.02	8	SS	7
	Dark brown sandy silty clay with organics (FILL)		5.74			
6			98.66			
	Grey brown fine to coarse SAND, some cobbles and boulders		6.10	9	SS	35
			98.06			
	End of Borehole, Practical refusal on large boulder or bedrock		6.70			
7						
8						
9						
10						
11						
12						
13						

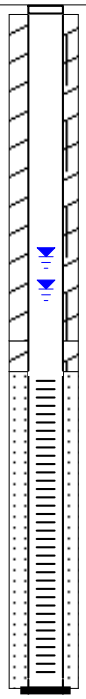
UNDIST. SHEAR STRENGTH
Cu, kPa
20 40 60 80

REM. SHEAR STRENGTH
Cu, kPa
20 40 60 80

DYNAMIC CONE PENETRATION TEST
blows/300 mm
10 30 50 70 90

ADDITIONAL LAB TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



Water level measured in borehole at about 2.8 metres below existing ground surface, August 26, 2014. Water level measured in standpipe at about 2.5 metres below existing ground surface, September 12,

Kollaard Associates Engineers

DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH9-5115

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 26, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		104.70							
0	Topsoil (FILL)		0.00							
	Grey brown silty clay, trace to some sand, gravel (FILL)			1	SS	10				
1				2	SS	8				
2				3	SS	2				
				4	SS	3				
3				5	SS	1				
4				6	SS	4				Water observed in borehole at about 3.8 metres below the existing ground surface, August 26, 2014
5				7	SS	3				
				8	SS	20				
6	Grey brown fine to coarse SAND, trace to some gravel and cobbles		98.96 5.74	9	SS	44				
	End of Borehole, Practical refusal on large boulder		98.00 6.70							
7										
8										

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

Kollaard Associates Engineers

RECORD OF BOREHOLE BH10-5113

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 27, 2014
SHEET 1 of 1
DATUM:

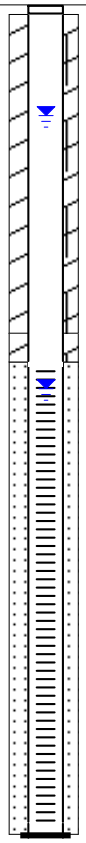
DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m
	Ground Surface		103.78			
0	Topsoil (FILL)		0.00	1	SS	4
	Grey brown silty clay, trace to some sand and gravel (FILL)			2	SS	2
1			101.95	3	SS	18
2	Yellow brown silty sand,some gravel, cobbles and boulders, trace clay (FILL)		1.83 101.50			
	Grey brown silty clay, trace to some sand, gravel and topsoil (FILL)		2.28	4	SS	7
3				5	SS	2
4				6	SS	5
5				7	SS	9
				8	SS	5
6				9	SS	5
7			96.49	10	SS	WH
	Grey fine to medium SAND		7.29	11	SS	4
8			95.55			
	End of Borehole		8.23			
9						
10						
11						
12						
13						

UNDIST. SHEAR STRENGTH (Cu, kPa) × 20 40 60 80 ×
REM. SHEAR STRENGTH (Cu, kPa) ○ 20 40 60 80 ○

DYNAMIC CONE PENETRATION TEST blows/300 mm: 10 30 50 70 90

ADDITIONAL LAB TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



Water level measured in borehole at about 3.8 metres below existing ground surface, August 27, 2014. Water level measured in standpipe at about 0.0 metres below existing ground surface, September 12, 2014.

Kollaard Associates Engineers

DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH11-5114

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 26, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		105.27							
0	Topsoil (FILL)		0.00							
	Grey brown silty clay, trace to some sand, gravel and topsoil(FILL)			1	SS	8				
1				2	SS	3				
2				3	SS	WH				
				4	SS	WH				
3				5	SS	WH				
4				6	SS	WH				
				7	SS	3				
5				8	SS	WH				
6				9	SS	WH				Water observed in borehole at about 3.8 metres below the existing ground surface, August 27, 2014
7			98.03	10	SS	5				
	Grey fine to medium SAND		7.24 97.81							
	End of Borehole		7.46							
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
LOGGED: DT
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

RECORD OF BOREHOLE BH12-5108

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 27, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		106.11							
0	Grey brown silty clay (FILL)		0.00							Borehole dry on August 27, 2014.
6			100.01							
	Grey brown sandy, clayey silt, trace gravel and organics, rubber debris (FILL)		6.10	1	SS	8				
				2	SS	3				
8				3	SS	8				
			97.89							
	End of Borehole		8.22							

DEPTH SCALE: 1 to 50
LOGGED: DT

BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
CHECKED: SD

RECORD OF BOREHOLE BH13-5104

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 28, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		110.68							
0	Topsoil (FILL)		0.00							
	Grey brown SILTY SAND									Borehole dry on August 28, 2014.
5				1	SS	27				
			105.50							
	End of Borehole		5.18							

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

Kollaard Associates Engineers

RECORD OF BOREHOLE BH14-5105

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 28, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		110.30							
0	Topsoil (FILL)		0.00 / 110.10							
	Red brown silty sand,some topsoil (FILL)		0.20 / 109.24							
1	Grey brown silty clay (FILL)		1.06							
2										Borehole dry on August 28, 2014.
3										
4										
5				1	SS	5				
			105.12							
	End of Borehole		5.18							
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH15-5103

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 28, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		104.70							
0	Topsoil (FILL)		0.00							
	Red brown silty sand, some topsoil (FILL)		102.87							
2	Grey brown SILTY SAND		1.83							
5				1	SS	19				Borehole dry on August 28, 2014.
	End of Borehole		99.52 5.18							
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH16-5101

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 28, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		105.00							
0	Topsoil (FILL)		0.00							
	Yellow brown silty sand, some gravel, cobbles and boulders, trace clay (possibly FILL)		104.10							
1	End of Borehole, refusal on large boulder		0.90							Borehole dry on August 28, 2014.
2										
3										
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH17-5119

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 28, 2014
SHEET 1 of 1
DATUM:

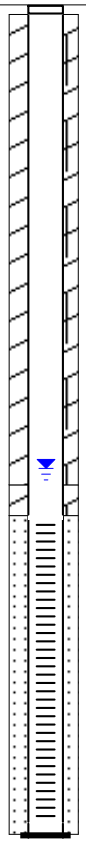
DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m
	Ground Surface		105.69			
0	Topsoil (FILL)		0.00			
	Grey brown silty clay, some sand, gravel, cobbles and topsoil with depth (FILL)					
6			99.59			
	Grey brown fine to medium SAND, trace to some gravel		6.10	1	SS	2
7				2	SS	2
8				3	SS	31
			97.46			
	End of Borehole		8.23			

UNDIST. SHEAR STRENGTH Cu, kPa (20, 40, 60, 80)
REM. SHEAR STRENGTH Cu, kPa (20, 40, 60, 80)

DYNAMIC CONE PENETRATION TEST blows/300 mm (10, 30, 50, 70, 90)

ADDITIONAL LAB TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



Borehole dry, August 28, 2014. Water level measured in standpipe at about 4.6 metres below existing ground surface, September 12, 2014.

Kollaard Associates Engineers

DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH18-5107

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 28/29, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		107.15							
0	Topsoil (FILL)		0.00	1	SS	5				
	Grey brown silty clay (FILL)			2	SS	3				
1										
				3	SS	WH				
2										
				4	SS	1				
3			104.00							
	Grey brown silty sand,some gravel, cobbles and boulders, trace clay and topsoil (FILL)		3.15	5	SS	9				
4			103.04							
	Grey brown fine to medium SAND, trace to some silt		4.11	6	SS	13				
				7	SS	17				
5										
				8	SS	20				
6										
				9	SS	27				
			100.45							
	End of Borehole		6.70							
7										
8										
9										
10										
11										
12										
13										

Water level measured in borehole at about 5.7 metres below existing ground surface, August 28, 2014.

Kollaard Associates Engineers

DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH19-5106

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 29, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		105.37							
0	Topsoil (FILL)		0.00							
	Grey brown silty clay, some sand with depth (FILL)		98.67							Water observed in borehole at about 6.7 metres below existing ground surface, August 29, 2014.
7	Grey fine to mediumSAND		6.70							
11				1	SS	3				
				2	SS	11				
12			93.34							
	End of Borehole		12.03							
13										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH20-5110

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 29, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH Cu, kPa (20 40 60 80) / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		108.52							
0	Topsoil (FILL)		0.00	1	SS	8				
	Grey brown silty clay (FILL)			2	SS	7				
1										
				3	SS	3				
2										
				4	SS	2				
3										
				5	SS	3				
			104.53							
4	Grey brown to grey silty sand, trace to some clay and topsoil and wood (FILL)		3.99	6	SS	11				
				7	SS	5				
5										
				8	SS	6				
6										
				9	SS	5				
7										
				10	SS	4				
8				11	SS	20				Water level measured in borehole at about 7.1 metres below existing ground surface, August 29, 2014.
				12	SS	5				
9										
			98.92	13	SS	3				
	Grey fine to medium SAND, trace to some gravel		9.60							
10				14	SS	38				
			98.01							
	End of Borehole		10.51							
11										
12										
13										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH21-5109

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 140208
DATE OF BORING: August 26, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		107.19							
0	Topsoil (FILL)		0.00							
	Grey brown silty sand, some gravel, cobbles and boulders, trace clay and topsoil (FILL)			1	SS	13				
1				2	SS	23				
	Red brown silty sand (FILL)		105.97 1.22							
			105.67							
	Grey brown silty clay (FILL)		1.52	3	SS	8				
2				4	SS	21				Borehole dry on August 29, 2014.
			104.30							
3	End of Borehole		2.89							
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH22-5112

PROJECT: Proposed Greely Commercial Center
CLIENT: OTIS GROUP OF COMPANIES
LOCATION: 5640 Bank Street and 701 Mitch Owens Road
PENETRATION TEST HAMMER:

PROJECT NUMBER: 140208
DATE OF BORING: August 28, 2014
SHEET 1 of 1
DATUM:

DEPTH SCALE (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH / REM. SHEAR STRENGTH Cu, kPa (20 40 60 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10 30 50 70 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		104.45							
0	TOPSOIL		0.00 104.22							
	Grey brown SILTY SAND, trace gravel and cobbles with depth		0.23 103.71							
	End of Augerhole		0.74							Augerhole dry on August 28, 2014.
1										
2										
3										
4										
5										
6										
7										
8										

Kollaard Associates Engineers

DEPTH SCALE: 1 to 50
BORING METHOD: Hand Auger
AUGER TYPE: Hand Auger
LOGGED: DT
CHECKED: SD

TABLE I

RECORD OF TEST PITS
GEOTECHNICAL INVESTIGATION
PROPOSED GREELY COMMERCIAL CENTER
5640 BANK STREET AND 7041 MITCH OWENS DRIVE
OSGOODE WARD, GREELY
CITY OF OTTAWA, ONTARIO

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP1 (near BH1-5123) (Elev. 105.53)	0.00 – 1.52	Grey brown sand, some gravel, topsoil concrete debris, vinyl siding, wood, clay large boulders (FILL)
	1.52 – 2.13	Grey brown SAND and GRAVEL, trace to some cobbles and boulders with depth
	2.13	End of test pit
Test pit dry, September 23, 2014.		
TP2 (near BH2-5122) (Elev. 105.24)	0.00 – 1.52	Grey brown sand, some gravel, topsoil concrete debris, shale, wood and large boulders (FILL)
	1.52 – 2.13	Grey brown SAND and GRAVEL, trace to some cobbles and boulders with depth
	2.13	End of test pit
Test pit dry, September 23, 2014.		

TABLE I(continued)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP3 (west of BH4-5120) (Elev. 106.38)	0.00 – 3.35	Grey brown sand, some gravel, topsoil concrete debris, wire, wood, clay tile, asphaltic concrete and large boulders (FILL)
	3.35	End of test pit
Test pit dry, September 23, 2014.		
TP4 (north of BH7-5117) (Elev. 105.41)	0.00 – 2.89	Grey brown sand, some gravel, topsoil wood and large boulders (FILL)
	2.89 – 3.35	Grey brown SAND and GRAVEL, trace to some cobbles and boulders with depth
	3.35	End of test pit
Test pit dry, September 23, 2014.		

TABLE I

RECORD OF TEST PITS
SUBSURFACE INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
BANK STREET AT MITCH OWENS ROAD
CITY OF OTTAWA, ONTARIO

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP1	0.0 – 0.6	Grey brown silty sand, some gravel and clay (FILL)
	0.6 – 0.8	TOPSOIL
	0.8 – 2.7	Grey brown silty sand, some gravel, cobbles and large boulders (GLACIAL TILL)
	2.7	End of test pit in glacial till

0.0 depth is about 1.2 metres above level ground at toe of slope and ended about 1.5 metres below level ground at toe of slope

Test pit dry, April 24, 2014.

TP2	0.0 – 0.6	Grey brown silty sand, some gravel and clay and topsoil (FILL)
	0.6 – 1.8	Grey brown silty sand, some gravel, cobbles and large boulders (GLACIAL TILL)
	1.8	End of test pit in glacial till

0.0 depth is about 0.9 metres above level ground at toe of slope and ended about 0.9 metres below level ground at toe of slope

Test pit dry, April 24, 2014.

TABLE I (continued)

RECORD OF TEST PITS

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP3	0.0 – 0.6	Grey brown sandy clay, some gravel and topsoil (FILL)
	0.6 – 2.3	Grey brown SILTY SAND, some gravel
	2.3 – 2.5	Grey brown silty sand, some gravel, cobbles and large boulders (GLACIAL TILL)
	2.5	End of test pit, refusal on large boulder

0.0 depth is about 1.3 metres above level ground at toe of slope and ended about 1.2 metres below level ground at toe of slope

Test pit dry, April 24, 2014.

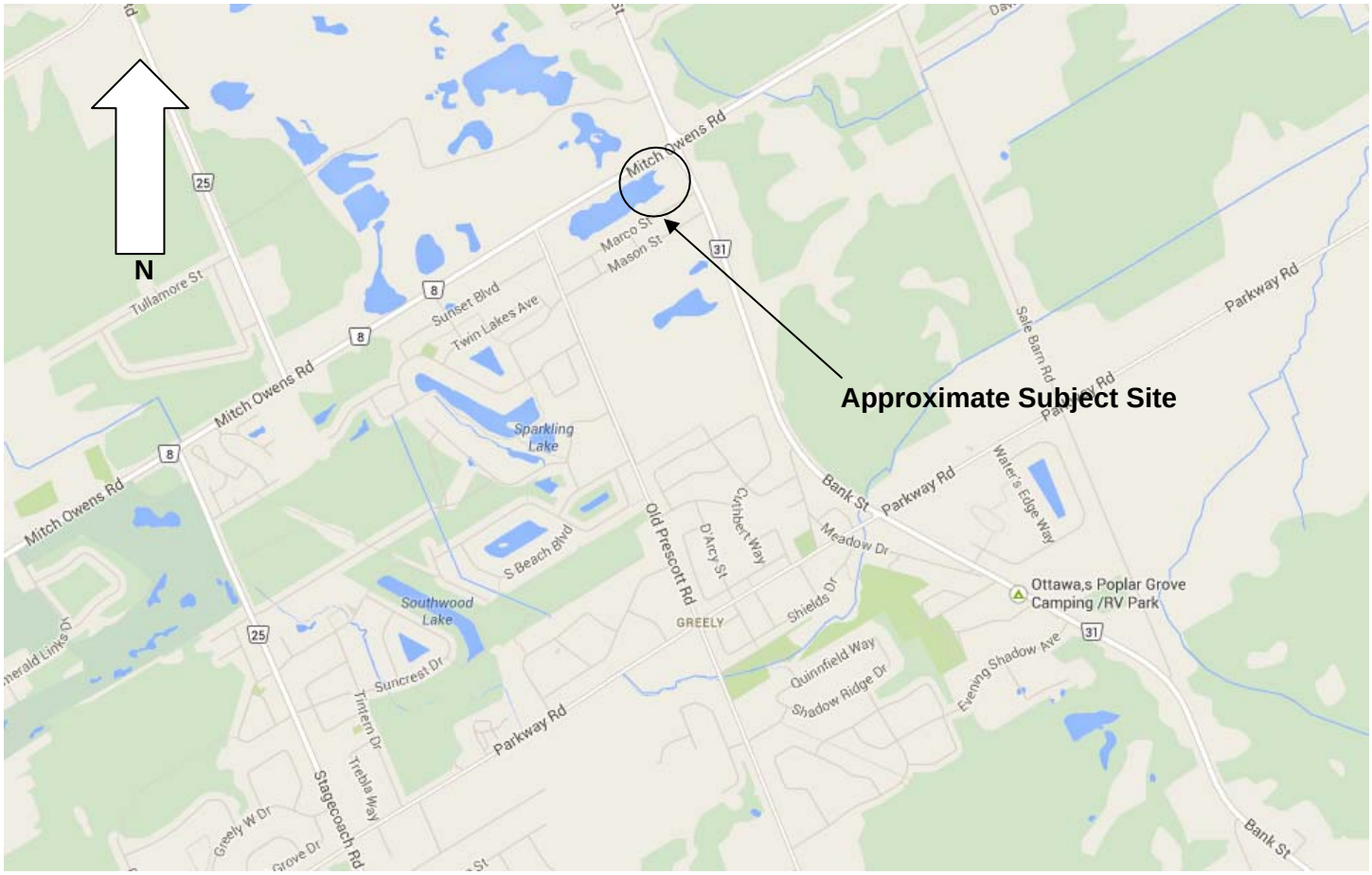
TP4	0.0 – 1.0	Grey brown silty sand, some gravel and clay (FILL)
	1.0 – 1.2	TOPSOIL
	1.2 – 2.7	Grey brown silty sand, some gravel, cobbles and large boulders (GLACIAL TILL)
	2.7	End of test pit in glacial till

0.0 depth is about 1.3 metres above level ground at toe of slope and ended about 1.4 metres below level ground at toe of slope

Test pit dry, April 24, 2014.

KEY PLAN

FIGURE 1



NOT TO SCALE

Kollaard Associates
Engineers

Project No. 140208

Date November 2014

DRAWING NUMBER:

FIGURE 2 (2011 AERIAL)

LEGEND:

APPROXIMATE BOREHOLE LOCATION
BH1–5123

REFERENCE: PLAN SUPPLIED BY CITY OF OTTAWA EMAPS.

SPECIAL NOTE: THIS DRAWING TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING REPORT.

REV.	NAME	DATE	DESCRIPTION

Kollaard Associates
Engineers

PO, BOX 189, 210 PRESCOTT ST
KEMPTVILLE ONTARIO
K0G 1J0 FAX (613) 258–0475
http://www.kollaard.ca

(613) 860–0923
info@kollaard.ca

CLIENT:
ALIUM INVESTMENTS LTD.

PROJECT:
GEOTECHNICAL INVESTIGATION FOR PROPOSED GREELY COMMERCIAL CENTRE

LOCATION:
7041 MITCH OWENS ROAD, 5640 BANK STREET AND 7107 MARCO STREET CITY OF OTTAWA, ONTARIO

DESIGNED BY:	*DATE:*
––	SEPT 18, 2014
DRAWN BY:	*SCALE:*
DT	N.T.S

KOLLAARD FILE NUMBER:
140208

DRAWING NUMBER:

FIGURE 3 (2011 AERIAL)

LEGEND:

BH1–5123 — APPROXIMATE BOREHOLE LOCATION

TP1 — APPROXIMATE TEST PIT LOCATION

TP1(SLOPE) — APPROXIMATE TEST PIT LOCATION

REFERENCE: PLAN SUPPLIED BY CITY OF OTTAWA EMAPS.

SPECIAL NOTE: THIS DRAWING TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING REPORT.

REV.	NAME	DATE	DESCRIPTION

Kollaard Associates
Engineers

PO, BOX 189, 210 PRESCOTT ST
KEMPTVILLE ONTARIO
K0G 1J0 FAX (613) 258-0475
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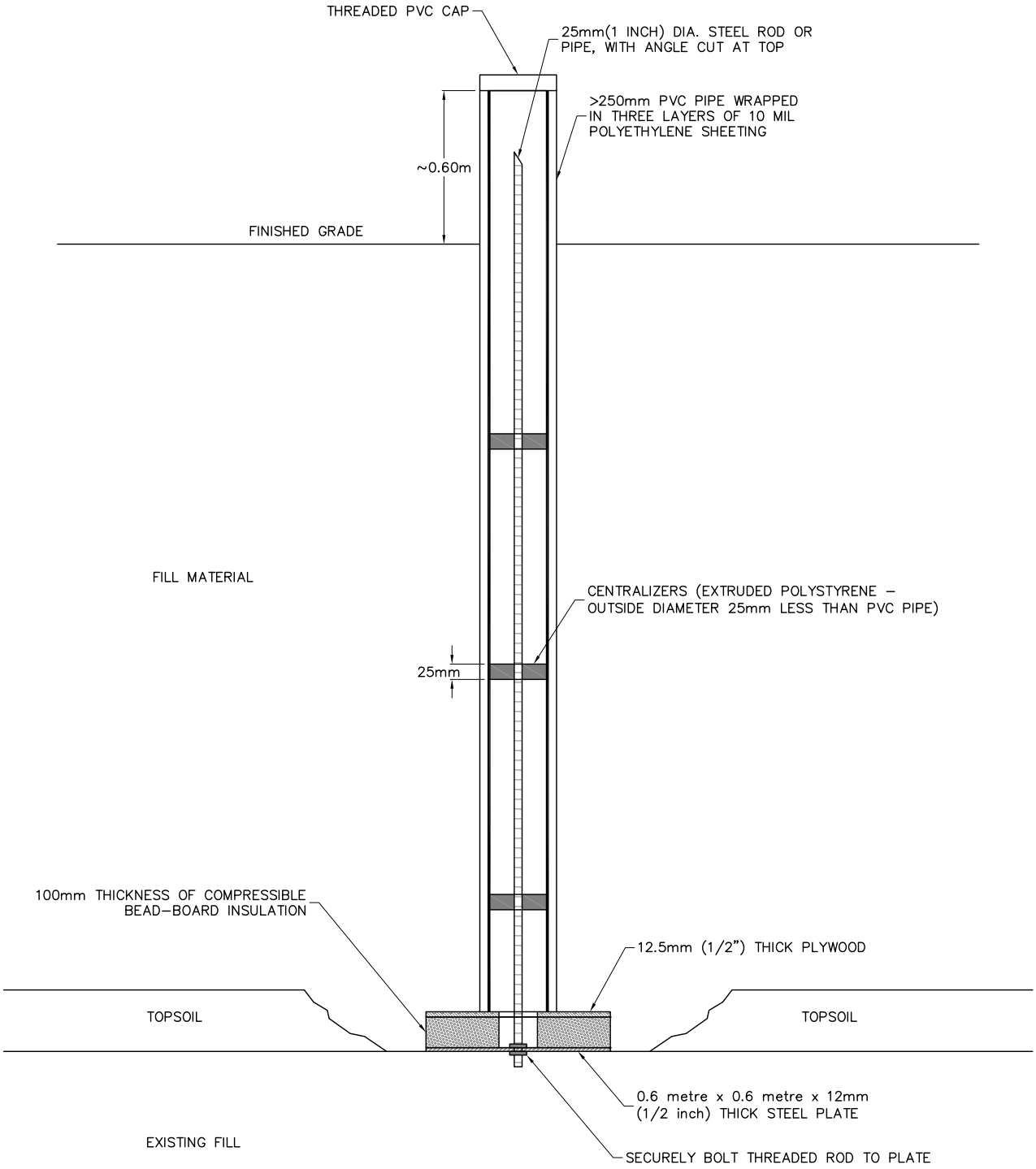
––	SEPT 18, 2014
DRAWN BY:	*SCALE:*
DT	N.T.S

KOLLAARD FILE NUMBER:
140208



NOTE:

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH KOLLAARD ASSOCIATES GEOTECHNICAL REPORT NO. 140208

Kollaard Associates
Engineers

P.O. BOX 189, 210 PRESCOTT ST
KEMPTVILLE, ONTARIO
K0G 1J0 FAX (613) 258–0475
http://www.kollaard.ca

(613) 860–0923
info@kollaard.ca

SCALE: N.T.S.	PROJECT: GREELY COMMERCIAL CENTRE
DATE: OCT. 31, 2014	LOCATION: 5640 BANK STREET, OTTAWA, ON
DESIGN: SD	DRAWING TITLE: SETTLEMENT PLATE CONSTRUCTION
DRAWN: ML	DRAWING NO: FIGURE 4

Attachment A
Laboratory Test Results for Chemical Properties

EXOVA ENVIRONMENTAL ONTARIO

Certificate of Analysis

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0
Attention: Mr. Dean Tataryn
PO#:
Invoice to: Kollaard Associates Inc.

Report Number: 1420324
Date Submitted: 2014-09-23
Date Reported: 2014-09-30
Project: 140208
COC #: 175683

Dear Dean Tataryn:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Lorna Wilson
Laboratory Supervisor, Inorganics

All analysis is completed in Ottawa, Ontario (unless otherwise indicated).

Exova (Ottawa) is certified and accredited for specific parameters by:
CALA, Canadian Association for Laboratory Accreditation (to ISO 17025), OMAFRA, Ontario Ministry of Agriculture, Food and Rural Affairs (for farm soils), Licensed by Ontario MOE for specific tests in drinking water.

Exova (Mississauga) is accredited for specific parameters by:
SCC, Standards Council of Canada (to ISO 17025)

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only.

Guideline values listed on this report are provided for ease of use (informational purposes) only. Exova recommends consulting the official provincial or federal guideline as required.

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0
Attention: Mr. Dean Tataryn
PO#:
Invoice to: Kollaard Associates Inc.

Report Number: 1420324
Date Submitted: 2014-09-23
Date Reported: 2014-09-30
Project: 140208
COC #: 175683

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.
					1135269 / Soil / / 2014-09-22 / BH1-5123
Agri. - Soil	pH	2.0			8.0
General Chemistry	Cl	0.002	%		<0.002
	Electrical Conductivity	0.05	mS/cm		0.09
	Resistivity	1	ohm-cm		11100
	SO4	0.01	%		<0.01

Guideline = *** = Guideline Exceedence**
All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario).
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0
Attention: Mr. Dean Tataryn
PO#:
Invoice to: Kollaard Associates Inc.

Report Number: 1420324
Date Submitted: 2014-09-23
Date Reported: 2014-09-30
Project: 140208
COC #: 175683

QC Summary

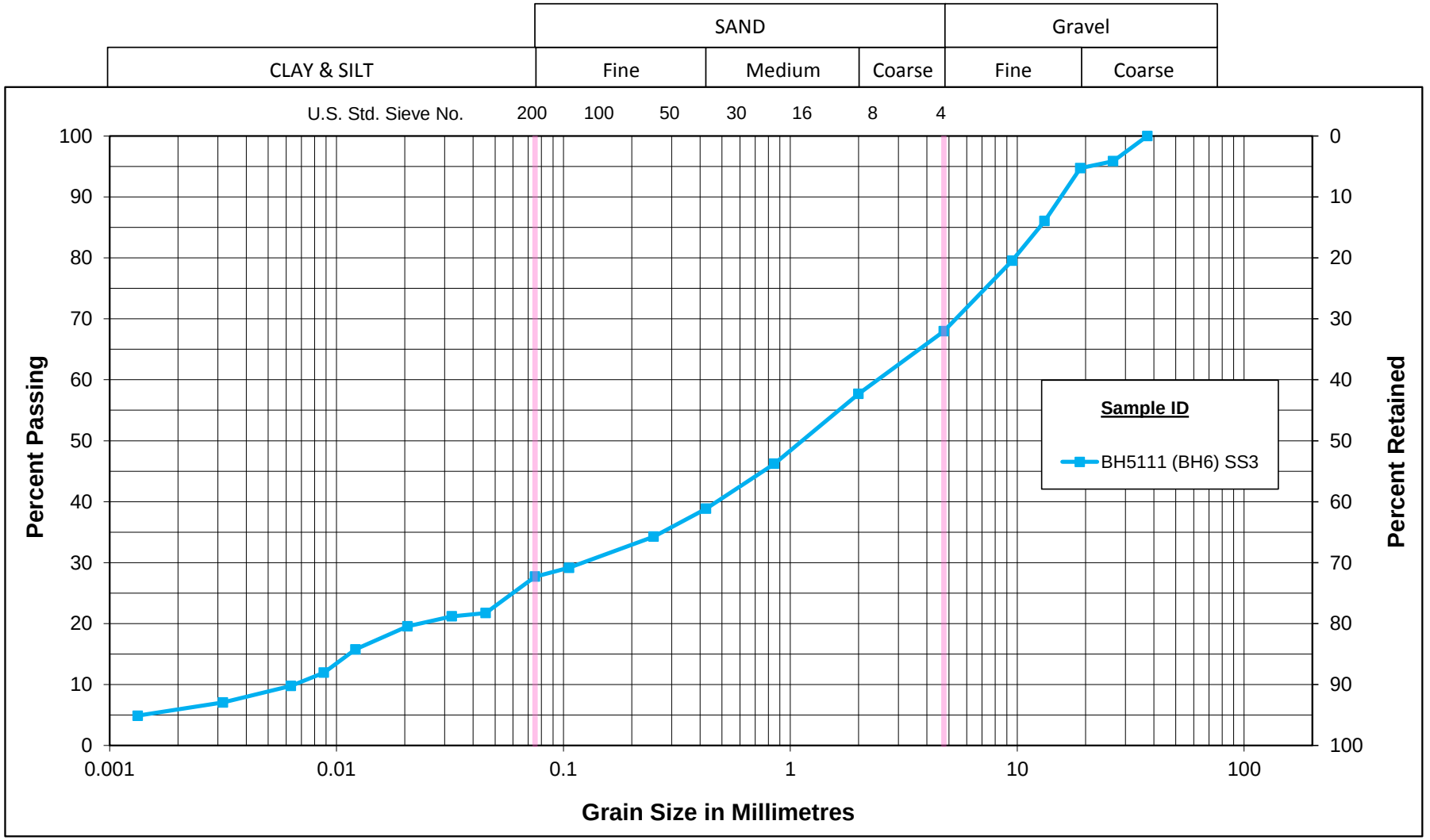
Analyte	Blank	QC % Rec	QC Limits
Run No 276786 **Analysis Date** 2014-09-24 **Method** C CSA A23.2-4B			
Cl	<0.002 %	108	90-110
Run No 276950 **Analysis Date** 2014-09-26 **Method** Cond-Soil			
Electrical Conductivity			85-115
pH			90-110
Run No 277139 **Analysis Date** 2014-09-30 **Method** Resistivity - soil			
Resistivity			
SO4	<0.01 %		70-130

Guideline = *** = Guideline Exceedence**
All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario).
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Attachment B
Laboratory Test Results for Physical Properties

Unified Soil Classification System



Stantec

GRAIN SIZE DISTRIBUTION

Proposed Greely Commercial Centre
Kollaard Associates File #140208

Figure No.

Project No. 122410003

Stantec

2781 Lancaster Road, Suite 101
Ottawa ON, K1B 1A7

Sieve Analysis
LS 602
ASTM C136

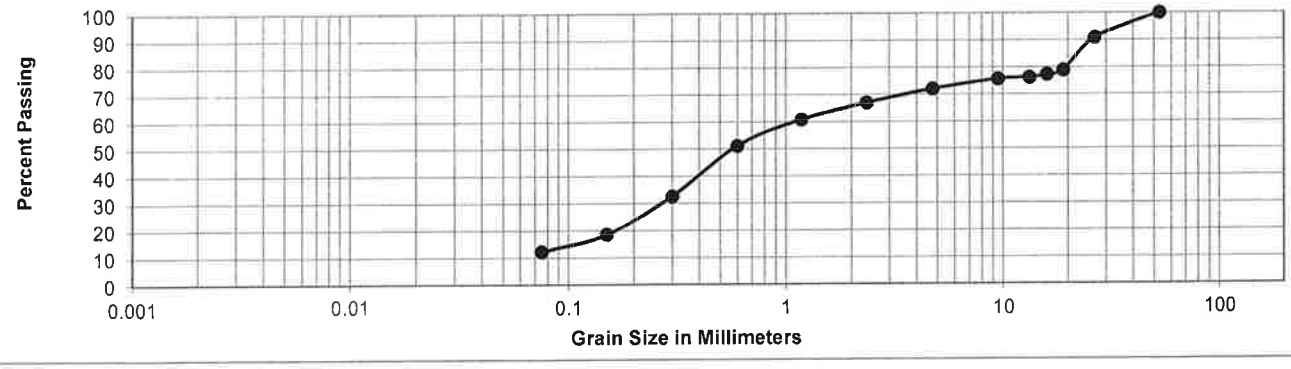
Client:	**Kollaard Associates Engineers, File #140208**	Project Number:	**122410003**
Project:	**Proposed Greely Commercial Centre**		
Material Type:	**Soils / Aggregates:**		
Proposed Use:	**Fill/Granulars**		
Source:	**BH5119 (BH17)**		
Sample Number:	**SS3**		
Sample Depth:	**25'-27'**		
Sampled By:	**Kollaard Associates Engineers**	Tested By:	**Brian Prevost**
Date Sampled:	**August 28, 2014**	Date Tested:	**September 15, 2014**

Wash Test Data	
Sample Weight Before Wash, (g):	**611.3**
Sample Weight After Wash, (g):	**542.6**
Percent Passing No. 200, (g):	**11.2**

Sieve Analysis

Sieve No.	Size of Opening		Cumulative Weight Retained	Percent Passing	No Envelope	
	Inches	mm	g	%	Minimum	Maximum
	6	**150.0**				
	4	**106.0**				
	3	**76.2**				
	2	**53.0**	**0.0**	**100.0**		
	1	**26.5**	56.2	**90.8**		
	3/4	**19.0**	129.3	**78.8**		
	5/8	**16.0**	139.0	**77.3**		
	1/2	**13.2**	145.3	**76.2**		
	3/8	**9.5**	148.8	**75.7**		
	0.187	**4.75**	170.8	**72.1**		
+4		**- 4.75**				
8	**0.0937**	**2.36**	201.7	**67.0**		
16	**0.0469**	**1.18**	239.2	**60.9**		
30	**0.234**	**0.600**	298.3	**51.2**		
50	**0.0117**	**0.300**	411.9	**32.6**		
100	**0.0059**	**0.150**	497.7	**18.6**		
200	**0.0029**	**0.075**	536.7	**12.2**		
		Pan	541.7			

Classification of Sample:	% Gravel:	**27.9**	% Sand:	**59.9**	% Silt & Clay:	**12.2**



Remarks:

Reveiwed By: Brian Prevost **Date:** September 17/2014

V:\01224\active\laboratory_standing_offers\2014 Laboratory Standing Offers\10003 Kollaard Associates\Soils & Aaggregates\September 12, Sieve & Hyd., File #140208\[Wash Sieve, BH5119.xlsx]Cover

Stantec
2781 Lancaster Road, Suite 101
Ottawa ON, K1B 1A7

Particle-Size Analysis of Soils

LS702

ASTM D422

PROJECT DETAILS			
Client:	Kollaard Associates Engineers, File #140208	Project No.:	122410003
Project:	Proposed Greely Commercial Centre	Test Method:	LS702
Material Type:	Soil	Sampled By:	Kollaard Associates
Source:	BH5111 (BH6)	Date Sampled:	August 26, 2014
Sample No.:	SS3	Tested By:	Beth Frank
Sample Depth:	5'-7'	Date Tested:	September 9, 2014

WASH TEST DATA	
Oven Dry Mass In Hydrometer Analysis (g)	51.94
Sample Weight after Hydrometer and Wash (g)	27.19
Percent Passing No. 200 Sieve (%)	**47.7**
Percent Passing Corrected (%)	**27.49**

PERCENT LOSS IN SIEVE	
Sample Weight Before Sieve (g)	**1109.40**
Sample Weight After Sieve (g)	**1108.40**
Percent Loss in Sieve (%)	**0.09**

SOIL INFORMATION		
Liquid Limit (LL)		
Plasticity Index (PI)		
Soil Classification		
Specific Gravity (G_s)	2.750	
Sg. Correction Factor (α)	0.978	
Mass of Dispersing Agent/Litre	24	g

CALCULATION OF DRY SOIL MASS	
Oven Dried Mass (W_o), (g)	34.22
Air Dried Mass (W_a), (g)	34.04
Hygroscopic Corr. Factor ($F=W_o/W_a$)	1.0053
Air Dried Mass in Analysis (M_a), (g)	51.67
Oven Dried Mass in Analysis (M_o), (g)	51.94
Percent Passing 2.0 mm Sieve (P_{10}), (%)	57.69
Sample Represented (W), (g)	90.04

HYDROMETER DETAILS	
Volume of Bulb (V_B), (cm^3)	63.0
Length of Bulb (L_2), (cm)	14.47
Length from '0' Reading to Top of Bulb (L_1), (cm)	10.29
Scale Dimension (h_s), (cm/Div)	0.155
Cross-Sectional Area of Cylinder (A), (cm^2)	27.2
Meniscus Correction (H_m), (g/L)	1.0

SIEVE ANALYSIS		
Sieve Size mm	Cum. Wt. Retained	Percent Passing
75.0		100.0
63.0		100.0
53.0		100.0
37.5	0.0	100.0
26.5	46.0	95.9
19.0	58.6	94.7
13.2	154.9	86.0
9.5	227.2	79.5
4.75	355.5	68.0
2.00	469.4	57.7
Total (C + F)[1]	1108.40	
0.850	**10.33**	46.22
0.425	**16.95**	38.86
0.250	**21.08**	34.28
0.106	**25.68**	29.17
0.075	**27.00**	27.70
PAN	**27.07**	

Note 1: (C + F) = Coarse + Fine

START TIME 7:00 AM

HYDROMETER ANALYSIS

Date	Time	Elapsed Time T Mins	H_s Divisions g/L	H_c Divisions g/L	Temperature T_c °C	Corrected Reading $R = H_s - H_c$ g/L	Percent Passing P %	L cm	η Poise	K	Diameter D mm
09-Sep-14	7:01 AM	1	23.5	3.5	23.0	20.0	21.73	12.56941	9.39251	0.012818	0.04545
09-Sep-14	7:02 AM	2	23.0	3.5	23.0	19.5	21.19	12.64691	9.39251	0.012818	0.03223
09-Sep-14	7:05 AM	5	21.5	3.5	23.0	18.0	19.56	12.87941	9.39251	0.012818	0.02057
09-Sep-14	7:15 AM	15	18.0	3.5	23.0	14.5	15.76	13.42191	9.39251	0.012818	0.01213
09-Sep-14	7:30 AM	30	14.5	3.5	22.5	11.0	11.95	13.96441	9.50295	0.012894	0.00880
09-Sep-14	8:00 AM	60	12.5	3.5	22.5	9.0	9.78	14.27441	9.50295	0.012894	0.00629
09-Sep-14	11:10 AM	250	10.0	3.5	21.5	6.5	7.06	14.66191	9.73081	0.013047	0.00316
10-Sep-14	7:00 AM	1440	8.0	3.5	21.5	4.5	4.89	14.97191	9.73081	0.013047	0.00133

Remarks:

Reviewed By: Brian Prevost
Date: September 17/2014

V:\01224\active\laboratory_standing_offers\2014 Laboratory Standing Offers\10003 Kollaard Associates\Soils & Aaggregates\September 12, Sieve & Hyd., File #140208\Hydrometer.xlsx

Attachment C
Water Well Records

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*

Tag#: A122239

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 2

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	OTIS	markeplette@rogers.com	

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
3338 Dufferin St.	Toronto	ON	M6A3A4	4164892833

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
MITCH OWENS / BANK STREET	OSGOODE		

County/District/Municipality	City/Town/Village	Province	Postal Code
CITY OF OTTAWA (RMOC)	GREELY	Ontario	K4P0A1

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	454755	5013719		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
GREY	CLAY ~~SILT~~	SILT / ORGANICS	overburden	0.0m	0.2m
GREY	CLAY	SILT / SAND / GRAVEL	FILL	0.2m	7.0m
GREY	~~CLAY~~ SAND	STONE / GRAVEL / CLAY	~~FILL~~ NATIVE	7.0m	10.0m

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed (m³/ft³)
0'	18'	bentonite	4.5 ft³
18'	30'	sand	3 ft³

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☑ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify* _____

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☑ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify* _____

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
2"	plastic	.1"	0'	20'

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
2.2"	plastic	10	20'	30'

Status of Well

☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☑ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Water Details

Water found at Depth (m/ft)	Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, *specify*
Water found at Depth (m/ft)	Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, *specify*
Water found at Depth (m/ft)	Kind of Water: ☐ Fresh ☐ Untested ☐ Gas ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	30'	7"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify* _____

If pumping discontinued, give reason:

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping _____ hrs + _____ min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

Well production *(l/min / GPM)*

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level				
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.

Comments: See attached drawing

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Henderson Drilling Inc	7188

Business Address (Street Number/Name)	Municipality
2200 Fraccy Side Road RR#5 Tilbury	Lakeshore

Province	Postal Code	Business E-mail Address
Ontario	N0P2L0	beckyhenderson@sympatico.ca

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
5199350749 3	Henderson, Rob

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3626		2013/04/04

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☐ Yes ☑ No		2012/04/04

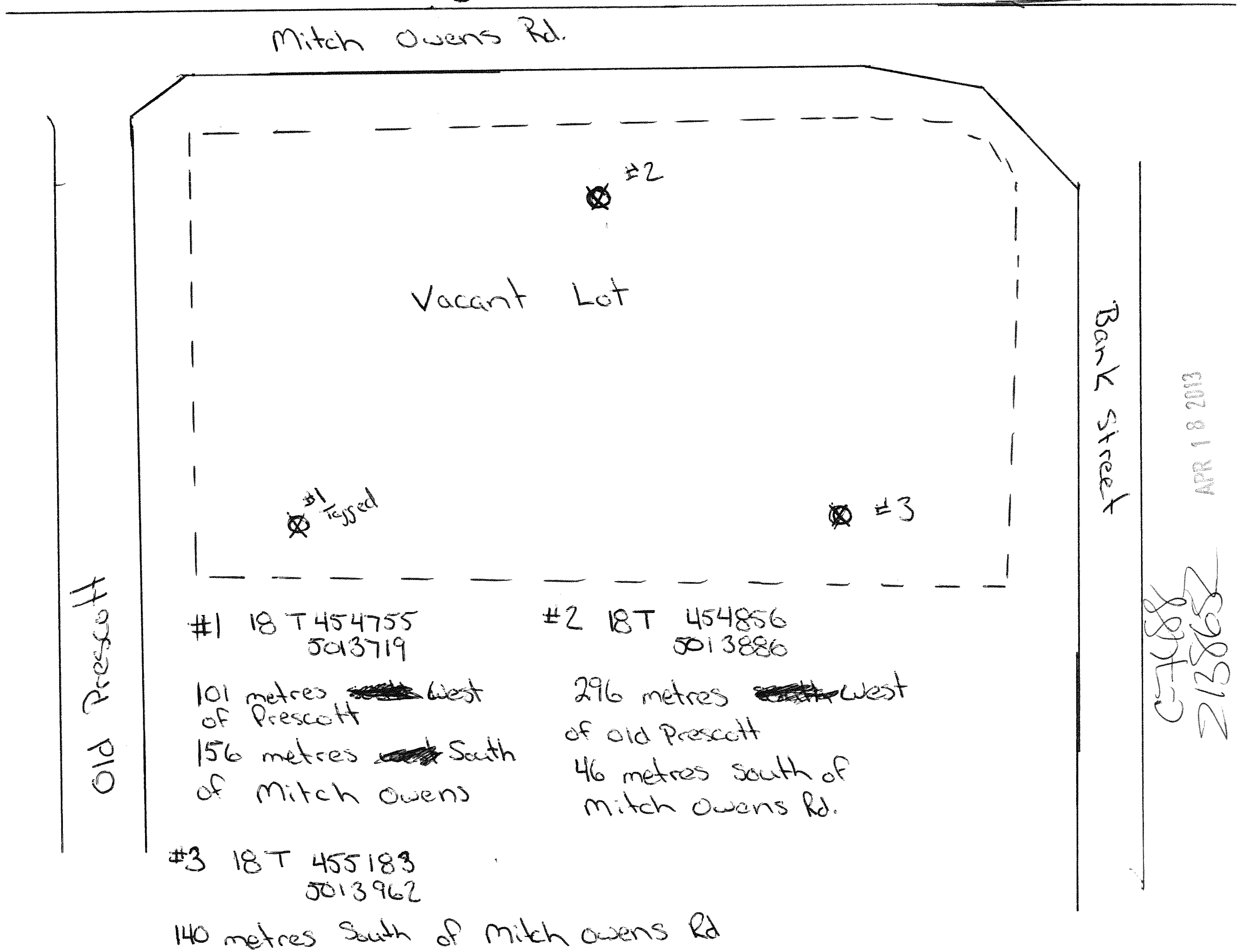
Ministry Use Only

Audit No. Z138652

Received APR 18 2013

Ministry's Copy

N W E S Tag # A122239 Pg 2 of 2
audit # Z138652



APR 1 8 2013

C-7488
Z13865Z

Ontario — Ministry of the Environment

Well Record

Regulation 903 Ontario Water Resources Act

Tag#: A128072

Well (see Instructions on the Back of This Form): A128072

Measurements recorded in: ☐ Metric ☒ Imperial

Page _____ of _____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	Well Constructed by Well Owner
	Eastview Sand & Gravel Limited	Canadian Soil Drill (1972)	☐

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
Box 190. R.R. # 1	Greely	ON	K4P 1N5	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
5639 Bank Streeet	Osgoode	P/L 1	5

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa-Carleton	Greely	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	455253	5014126		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Sand & Gravel	+ Boulders		0'	48'
Grey	Limestone			48'	156'
White	Sandstone	w/ Grey Limestone		156'	164'
White	Sandstone	w/ Grey Limestone		164'	181'
White	Sandstone	w/ Grey Limestone		181'	192'
White	Sandstone	w/ Grey Limestone		192'	200'

Well #1

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
62'	52'	Neat cement	15.6
52'	0'	Bentonite slurry	37.8

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☒ Air percussion
☐ Other, specify _____

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify _____

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6"	Steel	.188"	+2'	62'
5 15/16"	Open Hole		62'	200'

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☒ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Water Details

Water found at Depth (m/ft)	Kind of Water	Gas	Other, specify
164	☐ Fresh ☒ Untested	☐	
181	☐ Fresh ☒ Untested	☐	
192	☐ Fresh ☒ Untested	☐	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0 FT	62 FT	6"
62 FT	200 FT	5 15/16"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify **Not tested**

If pumping discontinued, give reason: ☒

Pump intake set at (m/ft): 180

Pumping rate (l/min / GPM): 20

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 80.6'

If flowing give rate (l/min / GPM): ☒

Recommended pump depth (m/ft): 140' (42 ft-10 GPM)

Recommended pump rate (l/min / GPM): 20

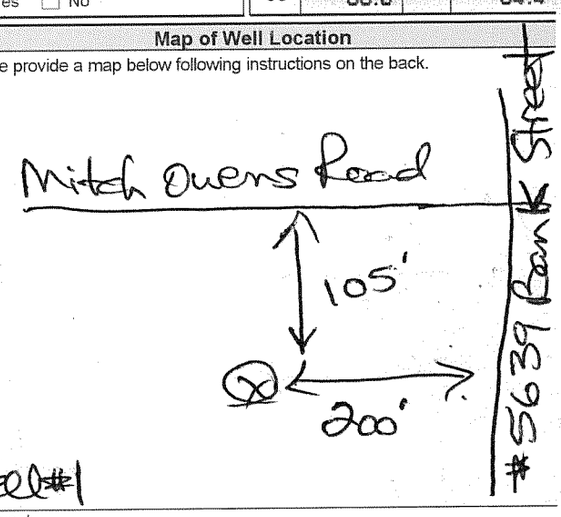
Well production (l/min / GPM): 20

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		34.4'		80.6'
1	42.8	1	58.6	
2	48	2	50.5	
3	53.7	3	45.5	
4	57.1	4	41.5	
5	59.6	5	38.5	
10	67.9	10	34.4	
15	70.5	15	34.4	
20	73.2	20	34.4	
25	74	25	34.4	
30	75	30	34.4	
40	77	40	34.4	
50	79	50	34.4	
60	80.6"	60	34.4"	

Map of Well Location

Please provide a map below following instructions on the back.



Comments: 1/2 HP - 10 GPM set @ 140 ft

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	1119

Business Address (Street Number/Name)	Municipality
6659 Franktown Road, RR#1	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Hanna, Jeremy

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted (Y Y Y Y M M D D)
T 3632		2012 05 31

Well owner's information package delivered	Date Package Delivered (Y Y Y Y M M D D)	Date Work Completed (Y Y Y Y M M D D)
☒ Yes ☐ No	2012 05 08	2012 05 01

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Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☒ Imperial

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Eastview Sand & Gravel Limited	(Canadian Soil Drilling)	

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
Box 190. R.R. # 1	Greely	ON	K4P 1N5	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
5639 Bank Street	Osgoode	P/L 1	5

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa-Carleton	Greely	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	18	455053	5013859		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
	Clay	&	Boulders	0'	16'
	Sand & Gravel	&	Boulders	16'	48'
Grey	Limestone			48'	170'
Grey	Limestone	w/ white	Sand stone	170'	171'
Grey	Limestone	w/ white	Sand Stone	171'	178'
Grey	Limestone	w/ white	Sand Stone	178'	190'

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
60'	50'	Neat cement	10.9
50'	0'	Bentonite slurry	33.6

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☒ Air percussion
☐ Other, *specify*

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify*

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6"	Steel	.188"	+2'	60'
5 15/16"	Open Hole		60'	190'

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☒ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Water Details

Water found at Depth (m/ft)	Gas	Kind of Water	Other, specify
171	☐	☐ Fresh ☐ Untested ☒	
178	☐	☐ Fresh ☐ Untested ☒	
	☐	☐ Fresh ☐ Untested	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0'	60'	6"
60'	190'	5 15/16"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify* **Not tested**

If pumping discontinued, give reason: X

Pump intake set at (m/ft): 180

Pumping rate (l/min / GPM): 20

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 64.8"

If flowing give rate (l/min / GPM): X

Recommended pump depth (m/ft): 140 (1/2 HP-10 GPM)

Recommended pump rate (l/min / GPM): 20

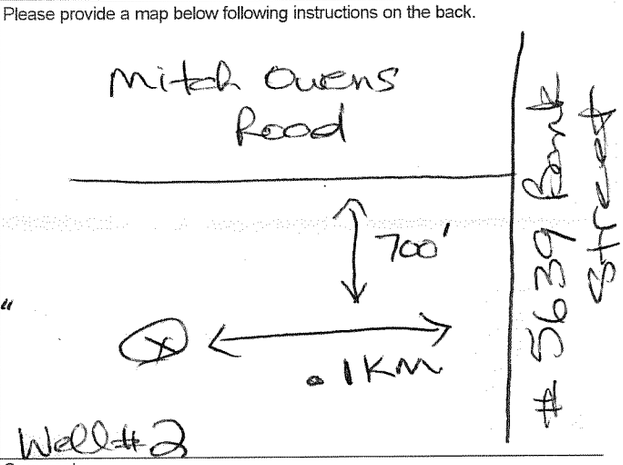
Well production (l/min / GPM): 20

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		26'2"		64'8"
1	35.3		1	44.8
2	40.6		2	39.5
3	44.4		3	36
4	46.7		4	34
5	48.5		5	33
10	54		10	30
15	56		15	27.8
20	57.9		20	26.2
25	58.8		25	26.2
30	59.7		30	26.2
40	61.5		40	26.2
50	63.2		50	26.2
60	64'8"		60	26'2"

Map of Well Location

Please provide a map below following instructions on the back.



Comments: 1/2 HP - 10 GPM set @ 140 ft

Well Contractor and Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Air Rock Drilling Co. Ltd.	1119

Business Address (Street Number/Name)	Municipality
6659 Franktown Road, RR#1	Richmond

Province	Postal Code	Business E-mail Address
ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6138382170	Purcell, Shannon

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted (Y Y Y Y M M D D)
T2122		2012 05 31

Well owner's information package delivered	Date Package Delivered (Y Y Y Y M M D D)	Date Work Completed (Y Y Y Y M M D D)
☒ Yes ☐ No	2012 05 08	2012 05 02

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