Kollaard Associates
Engineers

210 Prescott Street, Unit 1
P.O. Box 189
Kemptville, Ontario K0G 1J0

Civil • Geotechnical •
Structural • Environmental •
Hydrogeology

(613) 860-0923

FAX: (613) 258-0475

REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED MIXED USE BUILDING
114 ISABELLA STREET
CITY OF OTTAWA, ONTARIO

Submitted to:
2702021 Ontario Inc.
c/o Chris Allard and Debbie Belair
110-150 Isabella Street
Ottawa, Ontario
K1S 1V75

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June 11, 2013 (revised July 31, 2019) 190650

2702021 Ontario Inc.
c/o Chris Allard and Debbie Belair
110-150 Isabella Street
Ottawa, Ontario
K1S 1V75

Attention: Chris Allard and Debbie Belair

RE: GEOTECHNICAL INVESTIGATION
PROPOSED MIXED USE BUILDING
114 ISABELLA STREET
CITY OF OTTAWA, ONTARIO

Dear Sirs:

This report presents the results of a geotechnical investigation carried out for the above noted proposed seven storey mixed use building to be located at 114 Isabella Street, City of Ottawa, Ontario. The site is located about 45 metres east of the intersection of O'Connor Street and Isabella Street in the 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. 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.

BACKGROUND INFORMATION AND SITE GEOLOGY

The subject site consists of an area of about 0.03 hectares (0.08 acres) and is commonly known as 114 Isabella Street, Ottawa, Ontario. The site is bordered on the north by Isabella Street, on the east and south by residential development, on the west by commercial development. The site is currently vacant.

It is understood that plans are being prepared for the construction of a seven storey mixed use building consisting of one first floor commercial unit and 20 residential units. The building will be serviced by municipal sewer and water and an access roadway. The mixed use building has a typical floor plan area of approximately 223.3 square metres. The building is likely to be of steel frame and concrete or masonry construction with a partial basement for mechanical purposes. Surface drainage for the proposed building will be by means of swales, catch basins and storm sewers.

Based on a review of the surficial geology map for the site area, it is expected that the site is underlain by deposits of clay and silt. Bedrock geology maps indicate that the bedrock underlying the site likely consists of black shale of the Billings Formation, dark grey almost black limestone of the Eastview Formation and/or limestone of the Ottawa Formation. Drift thickness maps indicate bedrock is likely to be encountered at between 20 to 30 metres below the ground surface.

PROCEDURE

The field work for this investigation was carried out on May 27, 2013 at which time two boreholes, numbered BH1 and BH2 were put down at the site using a track mounted drill rig equipped with a hollow stem auger owned and operated by OGS Inc. of Almonte, Ontario.

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 17.3 metres below the existing ground surface at both borehole locations. In situ vane shear testing was carried out in the cohesive materials encountered at both boreholes. Both boreholes were continued below 17.3 metres as probe holes using dynamic cone penetration testing.

The subsurface soil conditions at BH1 and BH2 were identified based on visual examination of the samples recovered and the results of the in situ vane shear testing and standard penetration tests. Groundwater conditions at the boreholes were noted at the time of drilling. The boreholes were loosely backfilled with the auger cuttings upon completion of drilling. A separate borehole was installed, but not logged, for the purpose of installing a standpipe for subsequent groundwater monitoring purposes. The borehole was installed about 0.5 metres west of BH1. The auger cuttings were observed at the time of drilling.

The field work was supervised throughout by a member of our engineering staff who located the boreholes in the field, logged the boreholes and cared for the samples obtained. A description of the subsurface conditions encountered at BH1 and BH2 are given in the attached Record of Borehole Sheets. The approximate locations of the boreholes are shown on the attached Site Plan, Figure 2.

It is noted that ground vibrations induced by traffic passing on the adjacent street were noticeably detected throughout the site investigation.

SUBSURFACE CONDITIONS

General

As previously indicated, a description of the subsurface conditions encountered at the boreholes is provided in the attached Record of Borehole Sheets. The borehole logs indicate the subsurface conditions at the specific borehole 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 borehole locations may vary from the conditions encountered at the boreholes.

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 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 boreholes.

Fill

Fill material was encountered from the surface at both boreholes to depths ranging from about 1.5 to 1.6 metres below existing ground surface, respectively. The fill was observed to consist of sand, grey crushed stone, topsoil, brick, wood and concrete debris. The fill material was fully penetrated at both borehole locations.

Topsoil

A layer of topsoil was encountered at about 1.5 metres below the fill materials at borehole 1. The topsoil thickness at the boreholes was about 0.2 metres. The material was classified as topsoil based on colour and the presence of organic materials. The identification of the topsoil layer is for geotechnical purposes only and does not constitute a statement as to the suitability of this layer for cultivation and sustainable plant growth.

Silty Clay

A deposit of grey brown to grey silty clay was encountered below the fill and topsoil at both borehole locations. The silty clay layers were encountered at both boreholes at depths ranging from about 1.6 to 1.7 metres and fully penetrated at about 17.1 and 17.3 metres, respectively below existing ground surface.

The upper about 2.4 metre portion of the silty clay has been weathered to a stiff to very stiff grey brown crust. Beneath the grey brown crust the silty clay becomes grey and decreases from stiff to firm in consistency. The results of in situ vane shear testing carried out in the grey brown silty clay gave undrained shear strength values for the most part ranging from about 42 to 90 kilopascals in the grey brown silty clay. The results of the in situ vane shear testing and tactile examination carried out for the silty clay material indicate that the silty clay is stiff to firm in consistency.

Glacial Till

A deposit of grey/black glacial till was encountered beneath the silty clay layer at both of the borehole locations. The glacial till consists of gravel and possible cobbles and boulders in a matrix of silty sand with some clay and shale fragments. The results of standard penetration testing carried out in the glacial till material, which range from 3 to 62 blows per 0.3 metres with an average value of 34 blows per 0.3 metres, indicate a loose to dense state of packing.

Bedrock

The dynamic cone penetration tests carried out at both boreholes gave values of 3 to 18 blows per 0.3 metres to depths of about 21.9 metres below the existing ground surface. The dynamic cone penetration test values increased with depth below 21.9 metres and ranged from 18 to 107 blows per 0.3 metres. At a depth of some 28.8 and 22.4 metres below the existing ground surface at boreholes 1 and 2, respectively, refusal to cone penetration was encountered. It is considered likely that the increase in blow count at about 21.9 metres depth indicates the possible presence of glacial till materials and that refusal to cone penetration possibly indicates the upper surface of the large boulders in borehole 2 at 22.4 metres and possibly bedrock in borehole 1 at about 28.8 metres.

Groundwater

Groundwater seepage was observed in BH1 and BH2 at the time of drilling at depths of about 8.5 metres, below the existing ground surface. Water was measured in a standpipe installed within borehole 1 at a depth of about 7.6 metres below the existing ground surface on May 29, 2013. It should be noted that the groundwater levels may be higher during wet periods of the year such as the early spring.

Sulphate, Resistivity and pH

The results of the laboratory testing of a soil sample for sulphate gave a percent sulphate of 0.03. The National Research Council of Canada (NRC) recognizes four categories of potential sulphate attack of buried concrete based on percent sulphate in soil. From 0 to 0.10 percent the potential is negligible, from 0.10 to 0.20 percent the potential is mild but positive, from 0.20 to 0.50 percent the potential is considerable and 0.50 percent and greater the potential is severe. Based on the above, the soils are considered to have a negligible potential for sulphate attack on buried concrete.

The results of the laboratory testing of a soil sample for resistivity and pH indicates the soil sample tested has an underground corrosion rate of about than 0.9 loss-oz./ft^2/yr. Based on the findings of Fischer and Bue (1981) underground corrosion rates (loss-oz./ft^2/yr) of 0.30 and less are considered nonaggresive, from 0.30 to 0.75 the rate is considered slightly aggressive, from 0.75 to 2.0 the rate is considered aggressive and 2.0 and greater the rate is considered very aggressive. Accordingly, the above mentioned soil sample is considered to have a moderate to severe corrosion rate on buried steel.

PROPOSED MIXED USE BUILDING

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 boreholes 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 presented in this report include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or 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.

Foundation for Proposed Mixed Use Building

The site is underlain by a deposit of sensitive silty clay. Based on the undrained shear strength measurements within the silty clay deposit, this material has a stiff to firm consistency and has a limited capacity to support loads from footings and grade raise fill. The allowable bearing pressure for any footings depends on the depth of the footings below original ground surface, the width of the footings, and the height above the original ground surface of any landscape grade raise adjacent to the dwelling foundation and the thickness of the soils deposit beneath the footings.

With the exception of the topsoil and fill materials encountered at each borehole location, it is considered that the proposed mixed use building may be founded on:

1) Conventional Spread footing foundation bearing on the weathered silty clay at about 2.0 metres below the existing ground surface or;

2) On pile foundations such as driven piles deriving support in end bearing on bedrock in combination with a concrete slab on grade floor.

With the exception of the fill and topsoil, the excavations for the foundations should be taken through any surficial fill, topsoil or otherwise deleterious material to expose the native, undisturbed silty clay. 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.

Alternative 1): Conventional Spread Footing Foundations Bearing Weathered Silty Clay

The allowable bearing pressures for spread footing foundations at this site are based on the necessity to limit the stress increase on the softer, compressible grey silty clay to an acceptable level such that foundation settlements will not be excessive. Important parameters in calculating the stress increase on the grey silty clay and potential settlement are:

1) The thickness of the weathered crust;
2) The size and type (i.e. pad or strip) of the foundation;
3) The amount of surcharge (fill, etc.) in the vicinity of the foundation; and
4) The magnitude and type of ground floor loading.
5) Thickness of silty clay deposit.

The following general design comments are provided for the spread footing alternative for the proposed mixed use building:

- All existing fill materials and topsoil should be removed throughout the building area.
- The interior and exterior spread footings should be founded on the silty clay subgrade below the topsoil layer on the native silty clay at about 2 metres below the existing ground surface.

Bearing pressures for this proposed foundation are as follows:

- Strip footings founded on undisturbed native deposits of silty clay below the fill materials and topsoil surface should be designed using a maximum allowable bearing pressure of 150 kilopascals for serviceability limit states and 500 kilopascals for the factored ultimate bearing resistance. The above allowable bearing pressure/resistance are suitable for footings a maximum of 1.0 metres in width.
- Pad footings founded on undisturbed native deposits of silty clay below the fill materials and topsoil surface should be designed using a maximum allowable bearing pressure of 200 kilopascals for serviceability limit states and 500 kilopascals for the factored ultimate bearing resistance. The above allowable bearing pressure/resistance are suitable for footings a maximum of 2.0 metres square.
- The above allowable bearing pressures are suitable for a grade raise fill thickness adjacent to the structure of up to 0.5 metres in conjunction with the above noted design.

Provided that soil at and below the founding level is not disturbed, and all loose, disturbed or water softened soil is removed, the total and differential settlement of the footings under SLS conditions could be taken as 25 and 20 millimetres, respectively. The subgrade surface should be inspected by geotechnical personnel.

As previously indicated, the vibrations in the ground induced by traffic passing on the adjacent street were noticeably detected throughout the site investigation. It is considered that the observed vibrations will not reduce the above provided allowable bearing pressure and resistance. However, the vibrations may propagate through any structure placed on shallow foundations and result in a loss of comfort to occupants.

Any fill required to raise the footings for the proposed building to founding level should consist of imported 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 200 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 down and out from the edges of the footing at 1 horizontal to 1 vertical, or flatter. The excavations for the proposed building 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.

Alternative 2: Pile Foundations

It is considered that the proposed mixed use building, including the floor slab, could be founded on deep foundations such as driven piles deriving support in end bearing on the bedrock. The following comments are provided for this option:

- All existing fill materials and topsoil should be removed throughout the building area

It is common practice in the Ottawa area to use pipeline steel for piling. We suggest that a similar approach be taken for this project and that closed ended, concrete filled, steel pipe piles be used. The following pile design example is provided:

Pile Type	Geotechnical Reaction at Serviceability Limit States (kilonewtons)	Factored Geotechnical Resistance at ULS (kilonewtons)
Pipe pile 244 mm diameter by 12 mm wall thickness	1,100	1,350

Note: The SLS and ULS loads assume that the yield strength of the steel is at least 340 MPa and that the piles are filled with concrete having a compressive strength of 30 MPa.

Pipe piles should be driven closed ended and fitted with 20 millimetre (minimum) thick end plates.

All of the piles should be driven to refusal. The refusal criteria will be highly dependent on the contractor’s pile driving equipment. Typically, for the drop hammer type piling rigs available in the Ottawa area, a refusal criteria of 20 blows for the last 25 millimetres of penetration would be sufficient to achieve the above loads, assuming that about 35 kilojoules of energy are transferred to the pile per blow.

The boreholes encountered practical refusal on possibly very dense glacial till containing cobbles and boulders and/or bedrock. It is possible that some of the piles may encounter refusal to driving on or within the bouldery glacial till. The use of a pile with a thick wall may allow penetration of the glacial till with less damage. Notwithstanding, some problems with misalignment, plumbness, bending and/or sweeping of the piles, and hard driving conditions could occur due to the presence of cobbles and boulders above the bedrock surface. As such, allowance should be made to drive additional piles and to enlarge some of the pile caps, etc., as required. The requirement for this, if any, would have to be evaluated at the time of construction.

The contractor should be required to submit a copy of the proposed pile type and driving criteria for review prior to the start of actual construction. An allowance should be made in the specifications for re-striking all of the piles at least once, after adjacent piles within 4.0 metres distance have been installed to confirm the permanence of the pile set and to check for upward displacement caused by driving adjacent piles. Piles that do not meet the design set criteria on the first re-strike should receive additional re-striking at 2 day intervals. Furthermore, the specifications should make provision for dynamic testing of selected piles during the early stages of the pile driving operations to verify the transferred energies and pile capacities. In accordance with Ontario Building Code requirements (refer to Clause 4.1.9.4), the pile caps should be interconnected with tie beams.

Frost Protection

All exterior footings and those in any unheated parts of the proposed mixed use building 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. 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.

Groundwater inflow from the native soils into the excavations during construction, if any, should be handled by pumping from sumps within the excavations.

Foundation Walls and Drainage

A conventional, perforated perimeter drain, with a 150 millimetre surround of 20 millimetre minus crushed stone, should be provided at founding level and should lead by gravity flow to a sump pit complete with pump and/or to a storm sewer. The proposed basement should also be provided with under floor drains consisting of perforated pipe with a surround of 20 millimetre minus crushed stone to reduce the potential for buildup of hydrostatic pressure below the basement floor.

The native soils encountered at the site are considered to be frost susceptible. To prevent possible foundation frost jacking, the backfill against unheated walls or isolated walls or piers should consist of the 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. In that case any native material proposed for foundation backfill should be inspected and approved by the geotechnical engineer.

Slab on Grade Support

For predictable performance of the proposed concrete floor slab all existing fill material and any otherwise deleterious material and topsoil should be removed from below the proposed floor slab area. The exposed native subgrade surface should then be inspected and approved by geotechnical personnel. Any soft areas evident should be subexcavated 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. The fill materials should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density.

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 mixed use building 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.

Seismic Design for the Proposed Mixed Use Building

Based on the limited information from the boreholes, for seismic design purposes, in accordance with the 2006 OBC Section 4.1.8.4, Table 4.1.8.4.A., the site classification for seismic site response is Site Class D.

Potential for Soil Liquefaction

As indicated above the results of the boreholes indicate that the native deposits underlying the site consist of stiff to firm silty clay and loose to compact glacial till underlain by bedrock. As these materials are not prone to liquefaction, it is considered that no damage to the proposed mixed use building should occur due to liquefaction of the native subgrade under seismic conditions.

Site Services

Excavation

The excavations for the site services will be carried out through fill, topsoil and into the underlying silty clay. 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. That is, open cut excavations with overburden deposits should be carried out with side slopes of 1 horizontal to 1 vertical, or flatter. Where space constraints dictate, the excavation and backfilling operations should be carried out within a tightly fitting, braced steel trench box. Groundwater seepage into the excavations, if any, should be handled by pumping from sumps in the excavation. Groundwater was not encountered within the upper 6.0 metres at the site. Provisions should be made to prevent surface runoff from discharging into the excavations for services and building.

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 existing fill or 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 a 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 or Granular B Type I (with a maximum particle size of 25 millimetres).

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.

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 native 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 native backfill 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 optimum 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 native material or imported granular material conforming to OPSS Granular B Type I.

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 where the trench backfill is not located or in close proximity to existing or future roadways, driveways, sidewalks, or any other type of permanent structure.

The soils that exist at this site are highly frost susceptible and are prone to significant ice lensing. In order to carry out the work during freezing temperatures and maintain adequate performance of the trench backfill as a roadway subgrade, the service trenches should be opened for as short a time as practicable and the excavations should be carried out only in lengths which allow all of the construction operations, including backfilling, to be fully completed in one working day. The sides of the trenches should not be allowed to freeze. In addition, the backfill should be excavated, stored and replaced without being disturbed by frost or contaminated by snow or ice.

Access Roadway Pavements

In preparation for pavement construction at this site the surficial fill and any soft, wet or deleterious materials should be removed from the proposed access roadway area. The exposed subgrade should be inspected and approved by geotechnical personnel and any soft areas evident should be subexcavated and replaced with suitable earth borrow approved by the geotechnical engineer. The subgrade should be shaped and crowned to promote drainage of the roadway area granulars. Following approval of the preparation of the subgrade, the pavement granulars may be placed.

For any areas of the site that require the subgrade to be raised to proposed roadway area subgrade level, the material used should consist of OPSS select subgrade material or OPSS Granular B Type I or Type II. Materials used for raising the subgrade to proposed roadway area subgrade 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 compaction equipment.

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

50 millimetres of hot mix asphaltic concrete (HL3) or Superpave 12.5 asphaltic concrete
150 millimetres of OPSS Granular A base over
300 millimetres of OPSS Granular B, Type II subbase
(50 or 100 millimetre minus crushed stone)

Performance grade PG 58-34 asphaltic concrete should be specified. Compaction of the granular subbase and base pavement materials should be carried out in maximum 300 millimetre thick loose lifts to at least 98 and 100 percent, respectively, of the standard Proctor maximum dry density value using suitable vibratory compaction equipment.

The above pavement structures will be adequate on an acceptable subgrade, that is, one where any roadway fill and service trench backfill has been adequately compacted. If the roadway subgrade 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 and/or incorporate a non-woven geotextile separator between the roadway subgrade surface and the granular subbase material.

Effects of Trees

This site is underlain by deposits of sensitive silty clay, a material which is known to be susceptible to shrinkage with a change/reduction in moisture content. Research by the Institute for Research in Construction (formerly the Division of Building Research) of the National Research Council of Canada has shown that trees can cause a reduction of moisture content in the sensitive silty clays in the Ottawa area, which can result in significant settlement/damage to nearby buildings supported on shallow foundations bearing on or above the silty clay. Therefore, no deciduous trees should be permitted closer to the building (or any ground supported structures which may be affected by settlement) than the ultimate height of the trees. For groups of trees or trees in rows, the separation distance should be increased to 1.5 times the ultimate height of the trees.

The effects of trees should be considered in landscaping the property.

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 foundation areas and any engineered fill areas for the proposed mixed use building 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 foundation should be inspected to ensure that the materials used conform to the grading and compaction specifications.

The subgrade for the site services and access roadways should be inspected and approved by geotechnical personnel. In situ density testing should be carried out on the service pipe bedding and backfill, and the roadway granular materials to ensure the materials meet the specifications from a compaction point of view.

The native silty clay 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.

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.

LICENSED PROFESSIONAL ENGINEER
June 14, 2013
S.E. deWit
100079612
PROVINCE OF ONTARIO

Dean Tataryn, B.E.S., EP.

Steve DeWit, P.Eng.

Attachments: Record of Boreholes
Table I – Order of Water Demand for Common Trees
Figures 1 and 2
Results of Chemical Laboratory Testing

LIST OF ABBREVIATIONS AND TERMINOLOGY

SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
MS manual sample
RC rock core
ST slotted tube
TO thin-walled open Shelby tube
TP thin-walled piston Shelby tube
WS wash sample

PENETRATION RESISTANCE

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

Dynamic Penetration Resistance
The number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter, 60° cone attached to 'A' size drill rods for a distance of 300 mm.

WH
Sampler advanced by static weight of hammer and drill rods.

WR
Sampler advanced by static weight of drill rods.

PH
Sampler advanced by hydraulic pressure from drill rig.

PM
Sampler advanced by manual pressure.

SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH sieve and hydrometer analysis
U unconfined compression test
Q undrained triaxial test
V field vane, undisturbed and remoulded shear strength

SOIL DESCRIPTIONS

Relative Density	'N' Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

Consistency	Undrained Shear Strength (kPa)
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very Stiff	over 100

LIST OF COMMON SYMBOLS

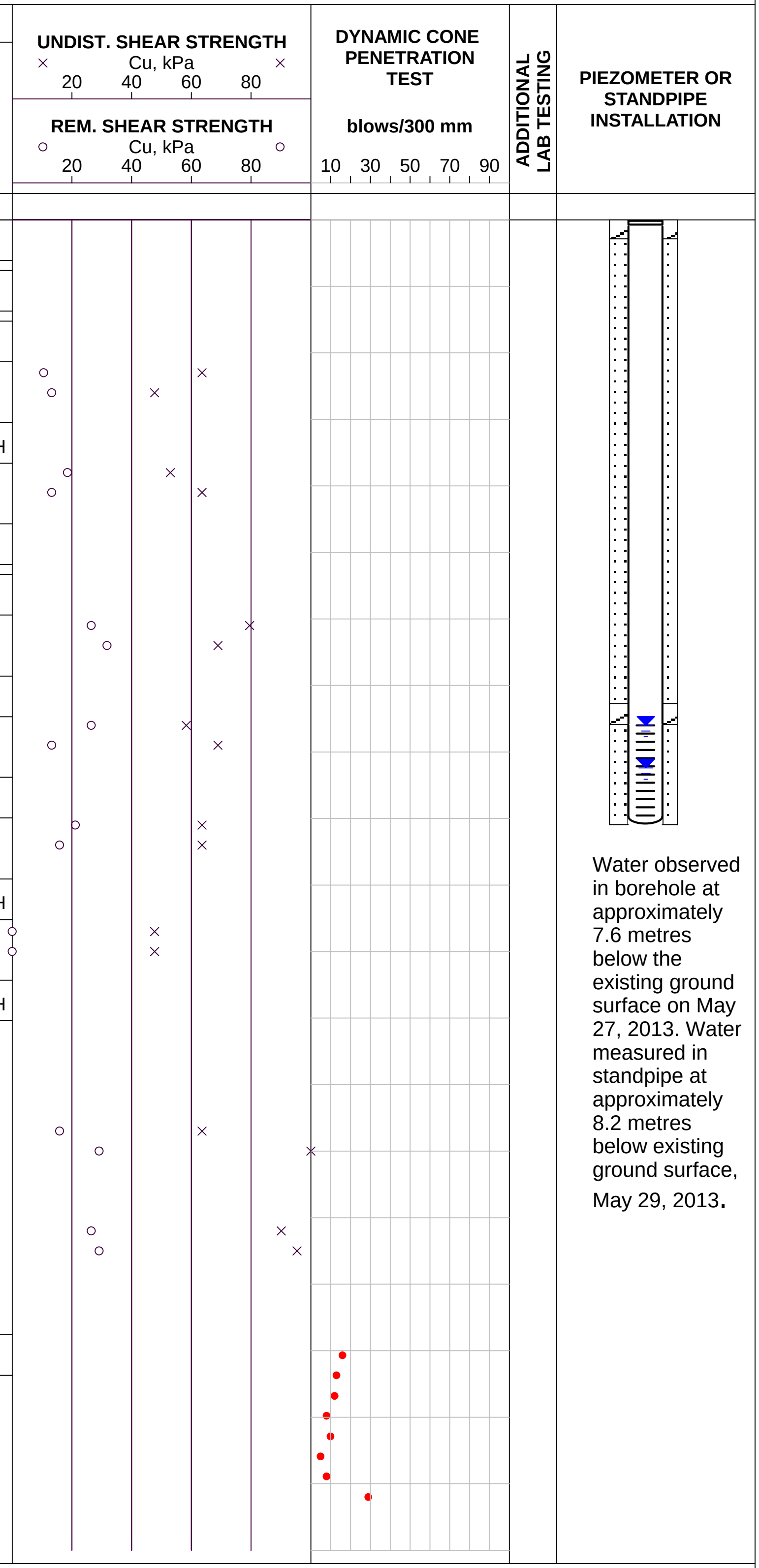
c_u undrained shear strength
e void ratio
C_c compression index
c_v coefficient of consolidation
k coefficient of permeability
I_p plasticity index
n porosity
u pore pressure
w moisture content
w_L liquid limit
w_P plastic limit
ϕ^1 effective angle of friction
γ unit weight of soil
γ^1 unit weight of submerged soil
σ normal stress

RECORD OF BOREHOLE BH1

PROJECT: Proposed Mixed Use Building
CLIENT: 2702021 Ontario Inc.
LOCATION: 114 Isabella Street, Ottawa
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 130293
DATE OF BORING: May 27, 2013
SHEET 1 of 2
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (M)	SAMPLES – NUMBER	TYPE	BLOWS/0.3m
	Ground Surface				
0	Topsoil, gravel, sand, wood (FILL)	0.00	1	SS	16
1			2	SS	7
	TOPSOIL	1.52	3	SS	6
2	Stiff grey brown SILTY CLAY				
	Firm grey SILTY CLAY	2.44			
3			4	SS	WH
5			5	SS	2
			6	SS	1
7			7	SS	1
8			8	SS	1
10			9	SS	WH
11			10	SS	WH
17			11	SS	9
	Borehole continued as Probe Hole black silty clay with some sand, gravel, silt and shale fragments	17.26			
20					



Water observed in borehole at approximately 7.6 metres below the existing ground surface on May 27, 2013. Water measured in standpipe at approximately 8.2 metres below existing ground surface, May 29, 2013.

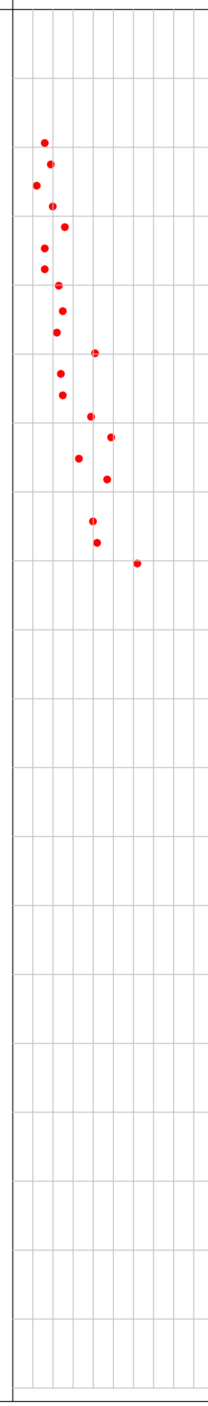
DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH1

PROJECT: Proposed Mixed Use Building
CLIENT: 2702021 Ontario Inc.
LOCATION: 114 Isabella Street, Ottawa
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 130293
DATE OF BORING: May 27, 2013
SHEET 2 of 2
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
21–28										
29	End of Borehole, refusal on large boulders or bedrock		28.80							
30–40										



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

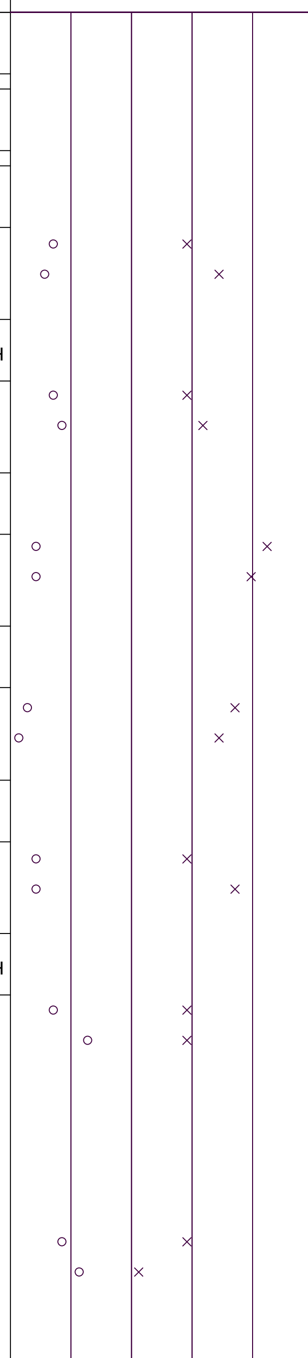
RECORD OF BOREHOLE BH2

PROJECT: Proposed Mixed Use Building Development
CLIENT: 2702021 Ontario Inc.
LOCATION: 114 Isabella Street, Ottawa
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 190650
DATE OF BORING: May 27, 2013
SHEET 1 of 2
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface						
0	Grey crushed stone (FILL)		0.00	1	SS	14	
	Brown topsoil, brick, sand and clay (FILL)		0.30				
1				2	SS	14	
2	Stiff grey brown SILTY CLAY		1.62	3	SS	5	
	Firm to stiff grey SILTY CLAY		2.44				
3				4	SS	WH	
5				5	SS	1	
6				6	SS	2	Water observed in borehole at approximately 8.5 metres below the existing ground surface on May 28, 2013.
8				7	SS	2	
9				8	SS	WH	
10–13							

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



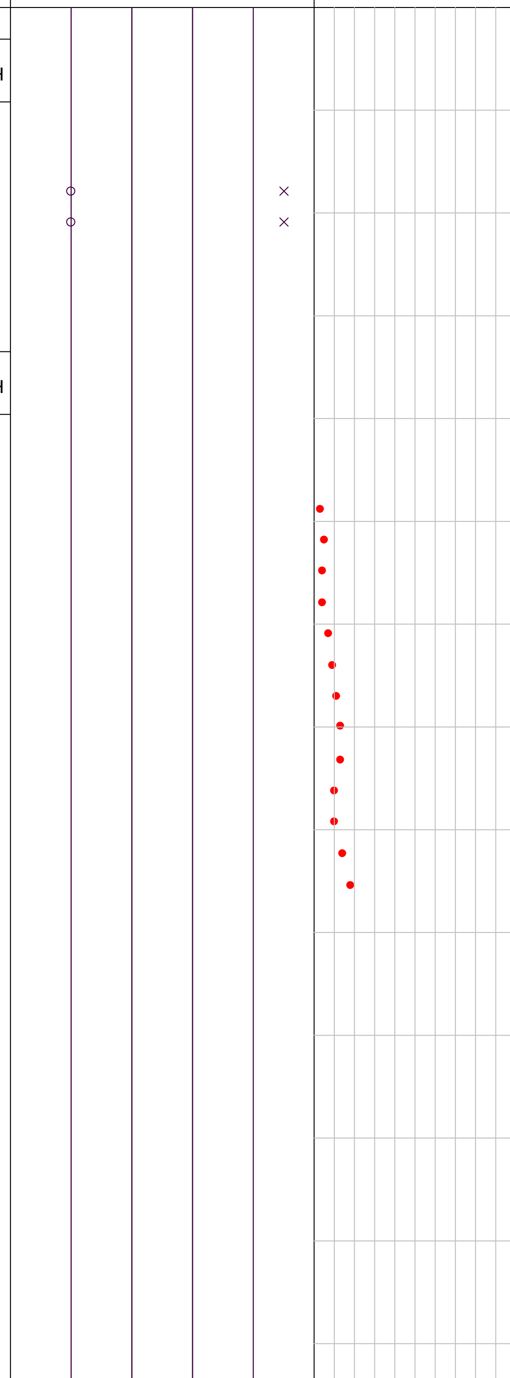
DEPTH SCALE: 1 to 75
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH2

PROJECT: Proposed Mixed Use Building Development
CLIENT: 2702021 Ontario Inc.
LOCATION: 114 Isabella Street, Ottawa
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 190650
DATE OF BORING: May 27, 2013
SHEET 2 of 2
DATUM:

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH × Cu, kPa / 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
14				9	SS	WH				
17	Borehole continued as Probe Hole in grey/black silty clay, some sand, gravel and silt and shale fragments		17.10	10	SS	WH				
22	End of Borehole, Practical refusal on large boulders		22.40							



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

TABLE I

ORDER OF WATER DEMAND FOR COMMON TREES

Some common trees in decreasing order of water demand:

Broad Leaved Deciduous

Poplar
Alder
Aspen
Willow
Elm
Maple
Birch
Ash
Beech
Oak

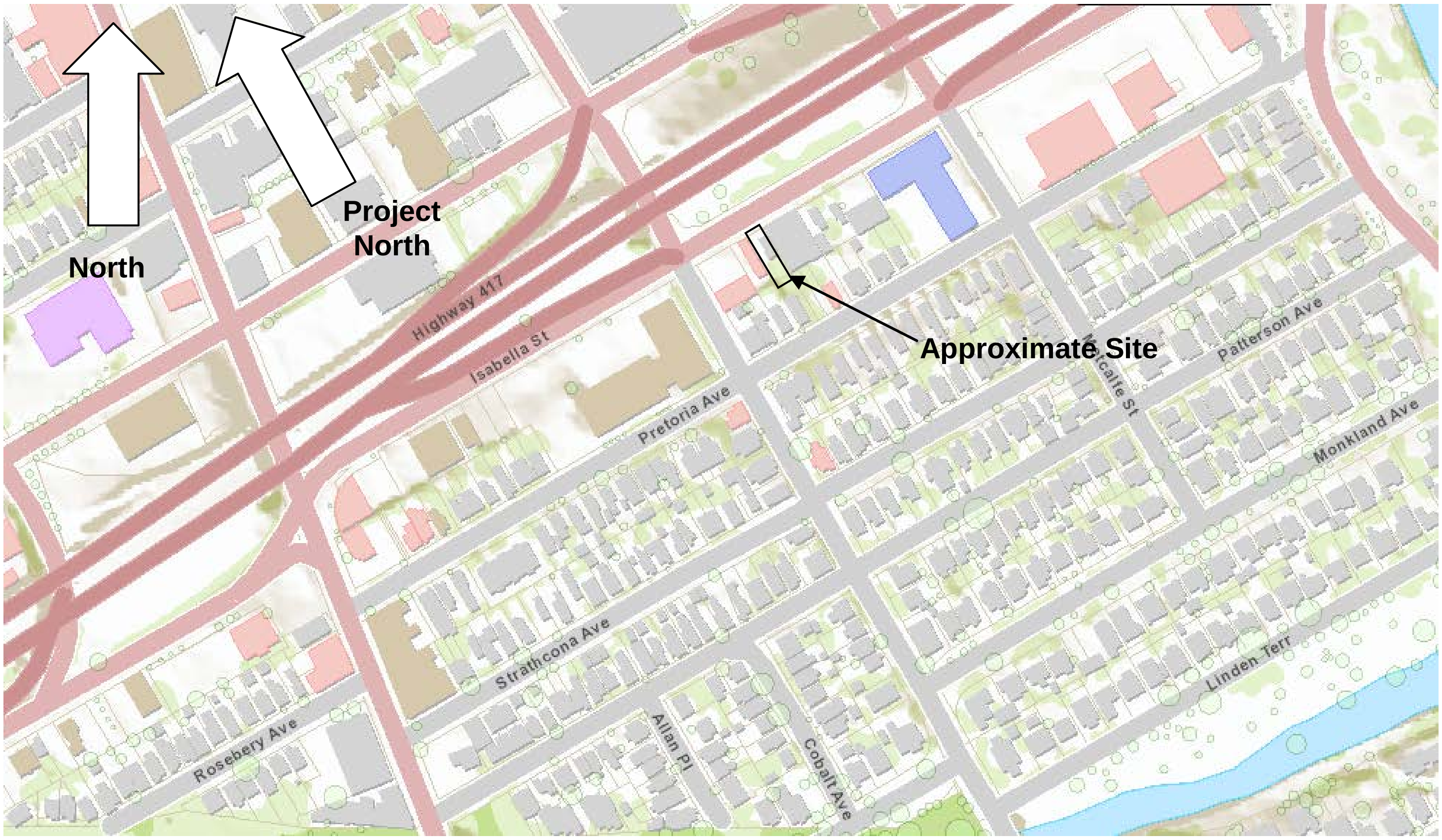
Deciduous Conifer

Larch

Evergreen Conifers

Spruce
Fir
Pine

KEY PLAN	FIGURE 1



NOT TO SCALE

Kollaard Associates Engineers

Project No. 190650

Date June 2013 (rev. July 2019)

DRAWING NUMBER:
SITE PLAN, FIGURE 2

LEGEND:

BH1 APPROXIMATE BOREHOLE 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
1.	DT	31/07/19	CONVERT TO NEW OWNER

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:
2702021 ONTARIO INC.

PROJECT:
GEOTECHNICAL INVESTIGATION FOR PROPOSED MIXED USE DEVELOPMENT

LOCATION:
114 ISABELLA STREET
CITY OF OTTAWA, ONTARIO

DESIGNED BY:	DATE:
--	JUNE 12, 2013
DRAWN BY:	SCALE:
DT	N.T.S

KOLLAARD FILE NUMBER:
190650

Laboratory Test Results for Sulphate, Resistivity and pH

Certificate of Analysis

Client:	Kollaard Associates Inc. 210 Prescott St., Box 189 Kemptville, ON K0G 1J0	Report Number:	1310146
		Date Submitted:	2013-05-29
		Date Reported:	2013-06-04
Attention:	Mr. Dean Tataryn	Project:	190650
PO#:		COC #:	167305
Invoice to:	Kollaard Associates Inc.		

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

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.

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:	1310146
Date Submitted:	2013-05-29
Date Reported:	2013-06-04
Project:	190650
COC #:	167305

Group	Analyte	MRL	Units	Guideline	
				Lab I.D.	1029390
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2013-05-28
				Sample I.D.	BH2 (NE) SS3 5'-7'
Agri. - Soil	Electrical Conductivity	0.05	mS/cm		0.81
	pH	2.0			7.3
General Chemistry	Cl	0.002	%		0.018
	Resistivity	1	ohm-cm		1180
	SO4	0.01	%		0.03

Guideline = *** = Guideline Exceedence**

** = Analysis completed at 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: 1310146
Date Submitted: 2013-05-29
Date Reported: 2013-06-04
Project: 190650
COC #: 167305

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 251592 **Analysis Date** 2013-05-31 **Method** C CSA A23.2-4B			
Cl	<0.002 %	102	90-110
Run No 251594 **Analysis Date** 2013-05-30 **Method** Ag Soil			
Electrical Conductivity	<0.05 mS/cm	96	80-120
pH	<2.0	99	90-110
Resistivity			
SO4	<0.01 %	99	70-130

Guideline = *** = Guideline Exceedence**
** = Analysis completed at 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