November 2008

REPORT ON

GEOTECHNICAL INVESTIGATION PROPOSED RESIDENTIAL DEVELOPMENT 3428 WOODROFFE AVENUE OTTAWA, ONTARIO

Submitted to:
Borrello Development
514 Kochar Drive
Ottawa, Ontario
K2C 4H3

REPORT

Report Number: 08-1121-0147

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November 3, 2008

Project No. 08-1121-0147

Antonino Borrello
Borrello Development
514 Kochar Drive
Ottawa, Ontario
K2C 4H3

RE: GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
3428 WOODROFFE AVENUE
OTTAWA, ONTARIO

Dear Mr. Borrello:

Please find attached two copies of our report on the geotechnical investigation for the proposed residential development at 3428 Woodroffe Avenue in Ottawa, Ontario.

We trust that this report is sufficient for you present requirements. If you have any questions concerning this report, or if we can be of further service to you on this project, please call us.

Yours truly,

GOLDER ASSOCIATES LTD.

S. S. Khan, M. Eng.
Geotechnical Engineer

M. S. Snow, P. Eng.
Principal

SSK/GSW/ch/cg/cm
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ACCUTEST LABORATORIES LTD. REPORT NO. 2825040

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation carried out at the site of a proposed residential subdivision to be located at 3428 Woodroffe Avenue in Ottawa (hereinafter refer to as "site"). The work was carried out in general conformance with our proposal dated September 08, 2008 and authorised by Mr. Antonino Borrello on September 9, 2008.

The purpose of the geotechnical investigation was to assess the subsurface soil and groundwater conditions at the location of the proposed development site by means of a limited number of test pits and, based on an interpretation of the factual information obtained, to provide engineering guidelines on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

The reader is referred to the "Important Information and Limitations of This Report" which follows the text but forms an integral part of this document.

2.0 DESCRIPTION OF SITE AND PROJECT

Plans are being prepared for development of a parcel of land located at 3428 Woodroffe Avenue in Ottawa, Ontario (see Key plan, Figure 1). The property is situated on the west side of Woodroffe Avenue across Stoneleigh Street. As shown on Figure 2, the property is approximately rectangular in shape and measures 160 m x 160 m in plan dimensions. The site is bounded to the east by Woodroffe Avenue, to the north by a vacant land, and to the west and south by private properties with existing structures.

The topography of the site is slight to moderate (5 to 8% slopes) with ground in the centre sloping downward to the west and east. The grade elevation of the site in the center is higher than lands at western and eastern site boundaries by 5 metres and 3 metres, respectively. The site has been cleared of trees and a building structure. Currently, the site is covered (partially) with tall grass and shrubs and, there also exists a small storage structure and a drilled well at an approximate mid location of the site's southern boundary.

The property will be converted into a conventional suburban residential subdivision consisting of single family units. It is understood that the structures will be single to two storeys in height with a basement. An access road from Woodroffe Avenue to the various units is also planned.

Published geologic maps and previous geotechnical investigations within the general area of the site indicate that the subsurface conditions consist of glacial till like material (up to 5 metres thick) overlying limestone bedrock. It is also typical to encounter fill materials overlying the native till material in this area.

3.0 PROCEDURE

The field work for this investigation was carried out on September 25 and 26, 2008. During this period, a total of ten test pits (numbered 08-1 to 08-10, inclusive) were put down at the locations shown on the Site Plan, Figure 2. The test pits were excavated using a rubber-tired backhoe supplied and operated by a local excavating contractor in Ottawa, Ontario. The test pits were advanced to depths varying from 3.8 to 4.9 metres below present ground surface. Test pit BH08-10 was excavated to a depth of about 1.8 metres to evaluate the extent of the fill material at the site.

The soils exposed on the sides of the test pits were classified by visual and tactile examination. Grab samples were obtained from the major soil strata encountered in the test pits. The groundwater seepage conditions were observed in the open pits and the test pits were loosely backfilled upon completion of excavating and sampling. The field work was supervised by a member of our engineering staff who logged the soils encountered and collected the soil samples. The soil samples obtained during the field work were brought to our laboratory for further examination by the project engineer. The soil samples will be retained by Golder for a period of three months following issuance of this report, unless requested otherwise by the client.

Two selected samples of soil were submitted to Accutest Laboratories Ltd. for chemical analysis related to potential impacts of the subsurface environment on buried steel and concrete elements (corrosion and sulphate attack). The results of the chemical testing are provided in Appendix B.

Prior to the fieldwork, the desired location of each test pit was marked on the ground by our staff for utility clearance. Our subcontractor (USL-1) carried out utility locates at the borehole locations and provided a utility clearance report.

The test pit locations were selected by Golder Associates personnel and located in the field relative to existing site features. The ground surface elevations at the test pit locations were surveyed by Golder Associates using a Trimble TSCH GPS unit and referenced to Geodetic datum.

4.0 SUBSURFACE CONDITIONS

4.1 General

The subsurface conditions encountered in test pits 08-1 to 08-10, inclusive, are shown on the Record of Test Pits sheets in Appendix A. The results the chemical testing are provided in Appendix B.

In general, the subsurface conditions on this site consist of topsoil, overlying silty sand, overlying silty to bouldery sand and gravel (glacial till), underlain by limestone bedrock. Bedrock was not encountered during the field investigation.

The following sections present a more detailed overview of the subsurface conditions encountered in the boreholes.

4.2 Topsoil and Fill Material

Topsoil exists at the ground surface at all of the test pit locations except test pit 08-10. The topsoil encountered has a thickness ranging from about 150 to 200 millimetres.

At the location of test pit 08-10, there exists a surficial layer of fill material extending to a depth of 1.30 metres below ground surface at the time of the investigation. The fill consists of brown sand material containing some gravel and cobbles, trace organics and occasional boulders.

4.3 Silty sand and Gravel

Beneath the top soil and fill material, there exists a layer of red brown silty sand and gravel with frequent boulders and occasional traces of organics and rootlets. This layer extends to depths of 0.42 to 1.4 metres below existing ground surface.

4.4 Glacial Till

The silty sand or sandy silt layer is underlain by glacial till. The glacial till consists of a heterogeneous mixture of gravel, cobbles, and boulders in a matrix of silty sand. The glacial till was penetrated to depths ranging from 3.8 to 4.9 metres below existing ground surface. The glacial till was difficult to excavate using the backhoe depth of about 1.5 to 2 metres due to the dense state of packing and presence of oversized boulders (sizes ranging from 0.5 m up to 1.2 metres in dimension).

4.5 Groundwater

No water was encountered at the bottom of the test pits upon completion of the excavation.

It should be noted that groundwater levels are expected to fluctuate seasonally. Higher groundwater levels are expected during wet periods of the year, such as spring.

5.0 DISCUSSION

5.1 General

This section of the report provides the results of our geotechnical investigation based on our interpretation of the subsurface information, geometry of the slopes, and project requirements. Note that the results and recommendations presented herein are subject to the 'Important Information and Limitations of this Report' which follows the text but forms an integral part of this document.

5.2 Foundation Type

The foundations of one to two storey residential buildings can be supported on spread footing foundations, bearing on the glacial till. The topsoil, silty sand and gravel, and fill materials encountered at the ground surface are not suitable for the support of the footings, or the slab, and should be removed from within the building footprint.

For design purposes, a serviceability limit states (SLS) bearing resistance of 150 kilopascals can be assumed for foundations on the glacial till. The ultimate limit states (ULS) bearing resistance of 250 kilopascals can be assumed for design. Bearing surface inspections will be required to confirm these design bearing pressures.

Consideration could also be given to excavating the topsoil, fill and silty sand and gravel and found the spread footings on a pad of engineered fill placed on the glacial till. The engineered fill should be sized to accommodate the spread of load outwards from the edges of the footings at not less than 1 horizontal to 1 vertical to native glacial till. The engineered fill should consist of Ontario Provincial Standard Specification (OPSS) Granular A or Granular B Type II, placed in maximum 300 millimetre thick lifts, and compacted to at least 95 percent of the standard Proctor maximum dray density using suitable vibratory compaction equipment.

The post-construction total and differential settlements of footings sized using the above noted allowable bearing pressures should be less than 25 and 15 millimetres, respectively.

5.3 Seismic Design

The seismic design provisions under Part 4 of the 2006 Ontario Building Code (OBC 2006) depend, in part, on the shear wave velocity or standard penetration test (SPT) results of the upper 30 metres of soil and/or rock below founding level.

For ground oriented residential structures, such as this development, Part 9 instead of Part 4 of the 2006 Ontario Building Code (OBC 2006) is applicable. For design purposes, this site can be assigned a "Site Class" of D.

5.4 Frost Protection

All exterior foundation elements should be provided with a minimum of 1.5 metres of earth cover for frost protection purposes. Isolated, unheated exterior footings adjacent to surfaces which are cleared of snow cover during winter months should be provided with a minimum of 1.8 metres of earth cover.

Insulating the bearing surface with high density insulation could be considered as an alternative to earth cover for frost protection. Further details can be provided if and when required.

5.5 Basement and Garage Floor Slabs

In preparation of the construction of the basement floor, all loose, wet and disturbed material should be removed beneath the floor slab. Provisions should be made for at least 150 millimetres of Ontario Provincial Standard Specification (OPSS) Granular A to form the base of the basement floor slab. The under slab fill should be compacted to at least 95% of the material's standard Proctor maximum dry density using suitable vibratory compaction equipment.

Even though groundwater was not observed during this investigation, it is likely that groundwater may rise during wet periods of the year. To prevent hydrostatic pressure build up beneath the basement floor slab, it is suggested that the granular base for the floor slabs be positively drained. This could be achieved by installing hydraulic link (sleeve) between the underfloor fill and the perimeter weeping tile.

The bulk fill inside the garage to raise the grade up to the underside of the Granular A should consist of OPSS Granular B Type II, placed in maximum 300 millimetre thick lifts, and compacted to at least 95 percent of the standard Proctor maximum dray density using suitable vibratory compaction equipment.

5.6 Basement Walls and Foundation Wall Backfill

The soils at this site are frost-susceptible and should not be used as a backfill against exterior, unheated or well insulated foundation elements due to their high silt content. To avoid problems with frost adhesion and heaving as well as achieving adequate compaction, these foundation elements should either be backfilled with non-frost susceptible sand or sand and gravel conforming to the requirements for OPSS Granular B Type I or, alternatively, a bond break such as the Platon system sheeting could be placed against the foundation walls.

Drainage of the wall backfill should be provided by means of a perforated pipe subdrain in a surround of 19 millimetre clear stone, wrapped in geotextile, which leads by gravity drainage to an adjacent storm sewer or sump pit. Conventional damp proofing of the basement walls is appropriate with the above design approach.

Where design of basement walls in accordance with Part 4 of the 2006 Ontario Building Code is required, walls backfilled with granular material and effectively drained as described above should be designed to resist lateral earth pressures calculated using a triangular distribution of the stress with a base magnitude of $K_o\gamma H$, where:

- K_o is the lateral earth pressure coefficient in the 'at rest' state, 0.5
- γ is the unit weight of the granular backfill, 22 kilonewtons per cubic metre
- H is the height of the basement wall in metres

5.7 Basement Excavations

Excavation for basements will be through topsoil, fill silty sand and gravel and into the glacial till. The silty sand and gravel and glacial till would generally be classified as a Type 2 soil in accordance with the Occupational Health and Safety Act of Ontario. Accordingly side slopes in this material should be cut back at 1 horizontal to 1 vertical.

No unusual problems are anticipated in excavating in the overburden using conventional hydraulic excavating equipment such as hydraulic shovel. Note that the till material contains up to 50% boulder and therefore require extensive removal of the boulders during excavations. Some groundwater inflow into the excavations could be expected. However, for the planned excavation depths, it should be possible to handle the groundwater inflow by pumping from well filtered sumps in the excavations.

5.8 Site Servicing

Excavation for the installation of site services will be made through the silty sand and gravel and glacial till. No unusual problems are anticipated in trenching in the overburden using conventional hydraulic excavating equipment although extensive boulders removal would be required.

As described above, the silty sand and gravel and glacial till would generally be classified as a Type 2 soil in accordance with the Occupational Health and Safety Act of Ontario. Accordingly excavations in the silty sand and gravel and glacial till can be made with side slopes at 1 horizontal to 1 vertical. Alternatively, excavations within the overburden could also be carried out within a fully braced steel trench box, which would minimize the width of the excavation. The use of a trench box will not however eliminate the potential for disturbance outside the trench box limits. Good construction practices using trench boxes can limit the potential zone of disturbance to within about 0.5 metres of the outside of the trench box walls. Boulders larger than 0.3 metres in diameter should also be removed from the excavation side slopes within the glacial till deposit.

Some groundwater inflow into the trenches should be expected. However, it should be possible to handle the groundwater inflow by pumping from well filtered sumps established in the floor of the excavations, provided suitably sized pumps are used.

At least 150 millimetres of OPSS Granular A should be used as pipe bedding for sewer and water pipes. Where unavoidable disturbance to the subgrade surface does occur, it may be necessary to place a sub-bedding layer consisting of compacted OPSS Granular B Type II beneath the Granular A or to thicken the Granular A bedding. The bedding material should in all cases extend to the spring line of the pipe and should be compacted to at least 95 percent of the standard Proctor maximum dry density. The use of clear crushed stone as a bedding layer should not be permitted anywhere on this project since fine particles from the sandy backfill materials or sandy soils on the trench walls could potentially migrate into the voids in the clear crushed stone and cause loss of lateral pipe support.

Cover material, from spring line of the pipe to at least 300 millimetres above the top of pipe, should consist of OPSS Granular A or Granular B Type I with a maximum particle size of 25 millimetres. The cover material should be compacted to at least 95 percent of the standard Proctor maximum dry density.

It should generally be possible to re-use the silty sand and gravel and glacial till as trench backfill. Where cobbles and boulders are present, particles greater than 200 millimetres in dimension should be removed. Where the trench will be covered with hard surfaced areas, the type of native material placed in the frost zone (between subgrade level and 1.8 metres depth) should match the soil exposed on the trench walls for frost heave compatibility. Trench backfill should be placed in maximum 300 millimetre thick lifts and should be compacted to at least 95 percent of the standard Proctor maximum dry density using suitable compaction equipment.

5.9 Pavement Design

In preparation for pavement construction, all topsoil, disturbed, or otherwise deleterious materials should be removed from the roadway areas.

Pavement areas requiring grade raising to proposed subgrade level should be filled using acceptable (compactable and inorganic) earth borrow or OPSS Select Subgrade Material. These materials should be placed in maximum 300 millimetre thick lifts and should be compacted to at least 95 percent of the standard Proctor maximum dry density using suitable compaction equipment.

The surface of the pavement subgrade should be crowned to promote drainage of the roadway granular structure.

The pavement structure for access roadways should consist of:

Pavement Component	Thickness (millimetres)
Asphaltic Concrete	90
OPSS Granular A Base	150
OPSS Granular B Type II Subbase	300

The granular base and subbase materials should be uniformly compacted to at least 100 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment. The asphaltic concrete should be compacted in accordance with Table 9 of OPSS 310.

The composition of the asphaltic concrete pavement in access roadways should be as follows:

Superpave 12.5 mm Surface Course - 40 millimetres

Superpave 19 mm Base Course - 50 millimetres

5.10 Corrosion and Cement Type

Two soil samples from the selected test pits were submitted to Accutest Laboratories Ltd. for basic chemical analysis related to potential corrosion of buried steel elements and potential sulphate attack on buried concrete elements. The results of this testing are provided in Appendix C. The results indicate that concrete made with Type GU Portland cement should be acceptable for substructures. The results do indicate a mild to moderate potential for corrosion of exposed ferrous metal.

5.11 Suitability of Excavated Material

The existing fill and site-excavated soils can be reused as a general grade fill only in the following areas: 1) service trenches, 2) sections of the access road requiring grade raise to proposed subgrade level, and 3) landscaping areas. The excavated glacial till material will, however, require separation of boulders (with radius greater than 200 mm) before reusing it as a backfill material. The existing fill and excavated soils are not suitable for reuse as a backfill material against basement and foundations walls as well as with in the zone of influences of footing and paved structures.

6.0 ADDITIONAL CONSIDERATIONS

All bearing surfaces should be inspected by experienced geotechnical personnel prior to filling or concreting to ensure that strata having adequate bearing capacity have been reached and that the bearing surfaces have been properly prepared. The placing and compaction of any engineered fill should be inspected to ensure that the materials used conform to the specifications from both a grading and compaction viewpoint.

At the time of the writing of this report, only conceptual details for the proposed structure were available. Golder Associates should be retained to review the detailed drawings and specifications for this project prior to tendering to ensure that the guidelines in this report have been adequately interpreted.

REPORT SIGNATURE PAGE

GOLDER ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
M.S. SNOW
11/4/08
PROVINCE OF ONTARIO

Sajjad Khan, M. Eng.
Geotechnical Engineer

M. S. Snow, P. Eng.
Principal

SSK/MSS/cg/cm

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IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

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

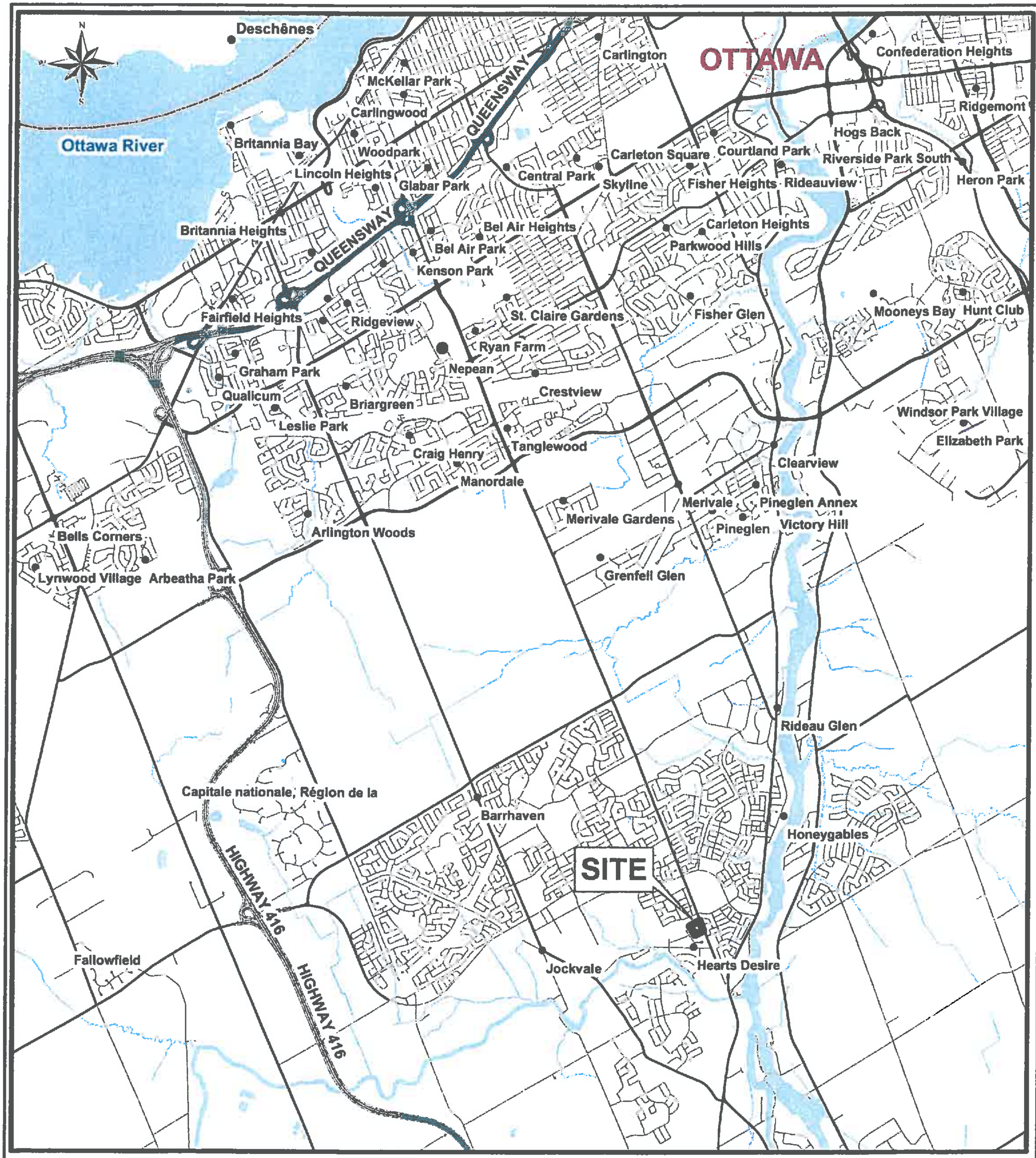
Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

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

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.



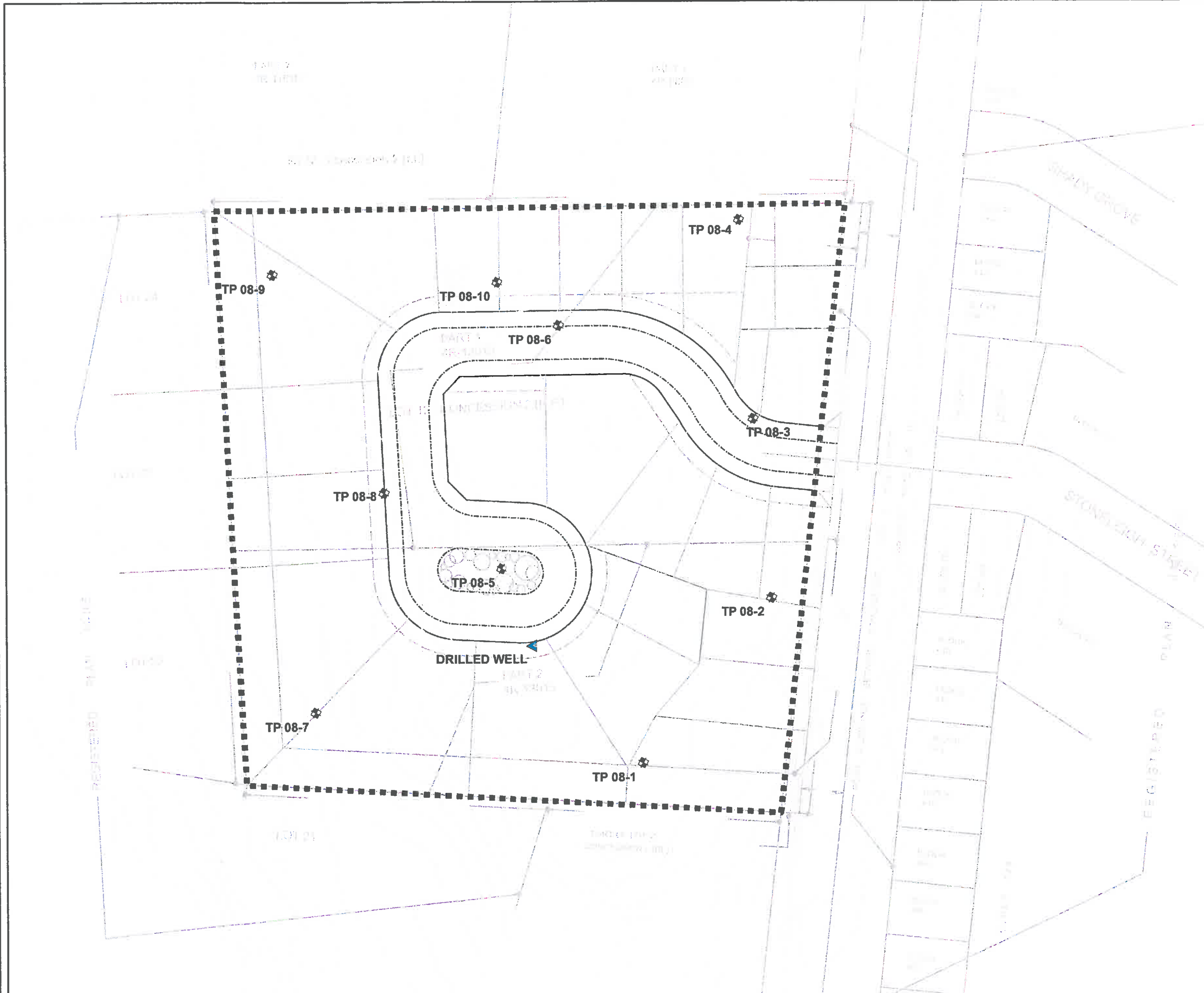
REFERENCE

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18

2,000 0 2,000

SCALE 1:75,000 METRES

Golder Associates Ottawa, Ontario	DATE 6 OCT. 2008 DESIGN GIS PJM	TITLE **KEY PLAN**
PROJECT No. 08-1121-0147	CHECK	PROJECT GEOTECHNICAL INVESTIGATION
SCALE AS SHOWN REV. 0	REVIEW	**FIGURE: 1**



LEGEND

- LOCATION OF EXISTING DRILLED WELL
- TEST PIT LOCATION IN PLAN
- APPROXIMATE PROPERTY LIMITS

25 0 25
SCALE 1:1,000 METRES

REFERENCE

Projection: Transverse Mercator Datum: NAD 83 Coordinate System: MTM Zone 9
Baseplan recieved from Stantec Consulting Inc.

PROJECT	GEOTECHNICAL INVESTIGATION PROPOSED RESIDENTIAL DEVELOPMENT 3428 WOODROFFE AVENUE, OTTAWA, ONTARIO
TITLE	**SITE PLAN**

Golder Associates, Ottawa, Ontario	PROJECT No. 08-1121-0147		SCALE 1:1000	REV. 0
	DESIGN			
	GIS	PJM 3 SEPT. 2008	**FIGURE: 2**	
	CHECK			
	REVIEW			

APPENDIX A

ABBREVIATIONS AND SYMBOLS
RECORD OF TEST PITS

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open Sampler for a distance of 300 mm (12 in.)
DD- Diamond Drilling

Dynamic Penetration Resistance; N_d:
The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive Uncased a 50 mm (2 in.) diameter, 60^0 cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

Peizo-Cone Penetration Test (CPT):
An electronic cone penetrometer with a 60^0 conical tip and a projected end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded Electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm Or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils
$C_{u2}S_u$

Consistency	Kpa	Psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	Over 200	Over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limited
w_l	liquid limit
C	consolidaiton (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	modified Proctor compaction test
SPC	standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
γ	unit weight

Note:
1. Tests which are anisotropically consolidated prior shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	= 3.1416
ln x, natural logarithm of x	
$\log_{10}$ x or log x, logarithm of x to base 10	
g	Acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma'$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma''-u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1 \sigma_2 \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s/\rho_w$) formerly (G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where γ=ρg(i.e. mass density x acceleration due to gravity)

(a) Index Properties (cont'd.)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity Index=(w_l-w_p)
w_s	shrinkage limit
I_L	liquidity index=$(w-w_p)/I_p$
I_c	consistency index=$(w_l-w)/I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index-$(e_{max}-e)/(e_{max}-e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (overconsolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	Overconsolidation ratio=σ'_p/σ'_{vo}

(d) Shear Strength

$\tau_p \tau_r$	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction=tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength (ϕ=0 analysis)
p	mean total stress $(\sigma_1+\sigma_3)/2$
p'	mean effective stress $(\sigma'_1+\sigma'_3)/2$
q	$(\sigma_1-\sigma_3)/2$ or $(\sigma'_1-\sigma'_3)/2$
q_u	compressive strength $(\sigma_1-\sigma_3)$
S_t	sensitivity

Notes: 1. $\tau = c'\sigma' \tan \phi'$

2. Shear strength=(Compressive strength)/2

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Golder Associates

TEST PIT RECORD

TEST PIT #08-1

DATE: # September 25, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	104.73	Dark Brown organic Topsoil with roots	
0.15	104.58	Red brown SILTY SAND and GRAVEL, trace organics and rootlets	
0.42	104.31	Compact to very dense, grey brown silty to bouldery SAND and GRAVEL, some cobble and boulder (GLACIAL TILL)	very difficult digging below 2 metres depth due to increase boulders (up to 0.7 m size) content
0.42	104.31	Very dense BOULDER, SAND and GRAVEL	
4.00	100.73	Bottom of test pit within bouldery TILL	

-- Backhoe refusal at 4.0m
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 2m x 4m

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TEST PIT RECORD

TEST PIT #08-2

DATE: # September 25, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	104.22	Dark Brown organic TOPSOIL with roots	
0.15	104.07	Red brown Silty SAND and GRAVEL, some cobble, trace rootlet	
0.50	103.72	Compact to very dense, grey brown SILTY SAND and GRAVEL, increasing cobble and boulder content with depth (GLACIAL TILL)	very difficult digging below 1.5 metres depth due to increasing boulder (upto 0.7 m size) content
1.50	102.72	Very dense, bouldery (GLACIAL TILL)	
4.00	100.22	Bouldery SAND and GRAVEL with variable silt content (GLACIAL TILL)	

-- End of test pit at 4.0 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

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TEST PIT RECORD

TEST PIT #08-3

DATE: # September 25, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	104.98	Dark Brown organic TOPSOIL with roots	
0.18	104.80	Red brown SAND and GRAVEL, some silt and cobble, trace rootlet	
0.45	104.53	Dense to very dense, grey brown silty to bouldery SAND and GRAVEL (GLACIAL TILL)	Boulder up to 1.2 metres long is noted with in the test pit
4.00	100.98	Bottom of the test pit within very dense bouldery SAND and GRAVEL with variable silt content (GLACIAL TILL)	

-- End of testpit at 4.0 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1 x 3m

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TEST PIT RECORD

TEST PIT #08-4

DATE: # September 25, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	104.71	Dark Brown organic TOPSOIL	
0.20	104.51	Red brown sandy GRAVEL, some cobble, trace to some shells	
0.90	103.81	Compact to dense, grey brown silty SAND and GRAVEL with variable cobble and boulder content (GLACIAL TILL)	very difficult digging below 2 metres depth due to increasing boulder (upto 1.2 m size) content
2.00	102.71	Dense to very dense bouldery	
4.00	100.71	Bottom of Testpit within Bouldery SAND and GRAVEL with variable silt content (GLACIAL TILL)	

-- End of test pit at 4.0 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

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TEST PIT RECORD

TEST PIT #08-5

DATE: # September 25, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	105.76	Dark Brown organic TOPSOIL with roots	
0.18	105.58	Red brown coarse SAND and GRAVEL, some cobble and boulder, trace silt	
1.20	104.56	Dense to very dense, grey brown silty to bouldery SAND and GRAVEL (GLACIAL TILL)	
4.00	101.76	Bottom of Test pit within very dense bouldery SAND and GRAVEL with variable silt content (GLACIAL TILL)	

-- End of test pit at 4.0m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

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TEST PIT RECORD

TEST PIT #08-6

DATE: # September 26, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	105.99	Dark Brown organic TOPSOIL	
0.12	105.87	Grey brown SAND and GRAVEL, some silt, cobble and shell	
0.80	105.19	Brown coarse SAND and GRAVEL with some shells	
1.40	104.59	Dense to very dense silty SAND and GRAVEL/COBBLE, some boulder (GLACIAL TILL)	
4.00	101.99	Bottom of Testpit within very dense silty SAND and GRAVEL with some boulder (GLACIAL TILL)	

-- End of test pit at 4.0 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

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TEST PIT RECORD

TEST PIT #08-7

DATE: # September 25, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	100.63	Dark brown organic TOPSOIL	
0.15	100.48	Red brown silty SAND and GRAVEL, some cobble, trace organics and rootlet	
0.55	100.08	Dense to very dense grey brown silty/bouldery SAND and GRAVEL (GLACIAL TILL)	Very difficult excavation below 2.2 metres depth due to greater boulder content (upto 50%)
3.80	96.83	Bottom of Test pit within very dense bouldery SAND and GRAVEL with variable silt content (GLACIAL TILL)	

-- End of test pit at 3.8 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

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TEST PIT RECORD

TEST PIT #08-8

DATE: # September 25, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	102.54	Dark brown organic TOPSOIL	
0.20	102.34	Red brown silty SAND, some gravel, trace organics	
0.60	101.94	Compact to dense grey brown silty SAND and GRAVEL with variable cobble and boulder (GLACIAL TILL)	very difficult digging below 2 metres depth due to increasing boulder (> 0.15 m size) content
2.00	100.54	- very dense, cobbly and bouldery	
4.90	97.64	Bottom of Testpit within bouldery SAND and GRAVEL with variable silt content (GLACIAL TILL)	

-- End of test pit at 4.9 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

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Golder Associates

TEST PIT RECORD

TEST PIT #08-9

DATE: # September 26, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	101.90	Dark brown organic TOPSOIL with roots	
0.20	101.70	Red brown silty SAND, some gravel, trace organics	
0.70	101.20	Compact to dense grey brown silty SAND and GRAVEL with variable cobble and boulder content (GLACIAL TILL)	very difficult digging below 1 metres depth due to increasing boulder content
1.00	100.90	- becomes very dense and bouldery	
3.10	98.80	Bottom of Testpit within bouldery SAND and GRAVEL with variable silt content (GLACIAL TILL)	

-- End of test pit at 3.1 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

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TEST PIT RECORD

TEST PIT #08-10

DATE: # September 26, 2008

PROJECT: BORRELLO DEVELOPMENT - PROPOSED RESIDENTIAL RESIDENCE
PROJECT No.: 08-1121-0147

EQUIPMENT: Test pit excavated with rubber-tired back-hoe, Type Deere 362

NOTES : Ground surface elevation at the testpit location is referecnced to Goedetic datum

Depth (m)	Elevation (m)	Description	Remarks
0.00	107.04	Dark brown SAND, some gravel and cobbles, trace organics (FILL)	
0.50	106.54	Brown fine SAND (FILL)	
0.80	106.24	Dark brown SAND, some gravel and cobbles, occasional boulder, trace organics (FILL)	very difficult digging below 1 metres depth due to increasing boulder content
1.30	105.74	Native TOPSOIL	
1.45	105.59	Gray borwn silty SAND and GRAVEL (Glacial Till)	
1.80	105.24	Bottom of Testpit	

-- End of test pit at 1.8 m.
-- Test pit walls stable.
-- No water seepage.
-- Dimensions : 1m x 3m

APPENDIX B

ACCUTEST LABORATORIES LTD. REPORT NO. 2825040

ACCUTEST LABORATORIES - A New Bodycote Company

REPORT OF ANALYSIS

Client: Golder Associates Ltd. (Ottawa)
32 Steacie Drive
Kanata, ON
K2K 2A9
Attention: Mr. Sajjad Khan

Report Number: 2825040
Date: 2008-10-09
Date Submitted: 2008-10-01
Project: 08-1121-0147 (5300)
P.O. Number:
Matrix: Soil

Chain of Custody Number: 61171

		LAB ID:						GUIDELINE		
		Sample Date:								
		Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED				
PARAMETER	UNITS	MRL						TYPE	LIMIT	UNITS
Chloride	%	0.002	<0.002	98	90-110	2008-10-07				
Electrical Conductivity	mS/cm	0.01	<0.01	97	80-120	2008-10-07				
pH				98	90-110	2008-10-07				
Resistivity	ohm-cm	1	<1		-	2008-10-07				
Sulphate	%	0.01	<0.01	90	70-130	2008-10-07				

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL: [signature]
Herb Yu
QA Coordinator