Royal Canadian Mounted Police / Gendarmerie royale du Canada

RETURN BIDS TO :

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Bid Receiving Unit / Grope de la réception des sousmissions

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VISITOR'S CENTRE
Royal Canadian Mounted Police
73 Leikin Drive, Ottawa, Ontario

Telephone No.

no de téléphone: (613) 843-3798

AMENDMENT TO THE INVITATION TO TENDER

Royal Canadian Mounted Police

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services and construction listed herein and on any attached sheets at the price(s) set out therefore.

MODIFICATION À L'APPEL D'OFFRES

Gendarmerie royale du Canada

Nous offrons par la présente de vendre à Sa Majesté l Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici sur toute feuille ci-annexée, au(x) prix indiqué(s).

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Vendor/Firm Name and Address

Raison sociale et adresse du fournisseur/de l'entrepreneur

Telehone No. – No de téléphone:

( )

Facsimile No. – No de télécopieur:

( )

Title-Sujet **Construction of a new Heliport (Helicopter Helipad)**		
Solicitation No. – No. de l'invitation **201502534**	**Amend. – Modif.** No. : 7	**Date** Dec. 16, 2014 / 16 dec, 2014
Client Reference No. - No. de Référence du Client **201502534**		
GETS Reference No. – No de Référence du SEAG PW-14-00657496		
Solicitation Closes – L'invitation prend fin **at – à 2:00 P.M. EST** **on – January 15th, 2015.**		
F.O.B. - F.A.B. Destination		
Address Enquiries to: - Adresser toute questions à : Jordan McKenna		
Telephone No. - No de téléphone 613-843-5518		**Fax:** 613-825-0082
Destination of Goods - Destinations des biens: **See Herein**		
Instructions : See Herein / Voir aux présentes		
Delivery Required – Livraison exigée: **See Herein**		
Name and Title of person authorized to sign on behalf of Vendor/Firm. **Nom et titre de la personne autorisée à signer au nom du fournisseur/de l'entrepreneur**		

Royal Canadian Mounted Police | Gendarmerie royale du Canada

Amendment No. 7 – Addendum 2

.

Construction of a new Heliport (Helicopter Helipad)
SOLICITATION NO. : **201502534**

Date: Dec. 16th, 2014

THE FOLLOWING GEOTECHNICAL REFERENCE DOCUMENT TO THE TENDER IS EFFECTIVE IMMEDIATELY.

1 General

1.1 **GEOTECHNICAL INVESTIGATION**

.1 A copy of the following detailed geotechnical information is appended to this Document:

Geotechnical Investigation Report
Proposed Single/Two Storey Building
Niagara-On-The-Lake, Ontario
Prepared by: LVM Inc.
Report No.: 124-P041600-0100-GE-0001-01
Date: 2011 09 29
46 pages

Technical Memorandum
Additional Pavement Recommendations
Niagara-On-The-Lake, Ontario
Prepared by: LVM Inc.
Reference No.: P-0000031
Date: February 17, 2012
3 pages

Technical Memorandum
RCMP Heliport – TLOF Pavement Design – Engineering Brief
Niagara-On-The-Lake, Ontario
Prepared by: WSP Canada Inc.
Project No.: 131-23055-00
Date: July 8, 2014
3 pages

.2 This geotechnical information records properties of subsurface conditions and recommendations for the design of foundations, pavements and soil remediation as outlined in the information provided.

.3 The geotechnical information by its nature, cannot reveal all conditions that exist or can occur on the Site. Should subsurface conditions be found to vary substantially from the reports, immediately notify the Departmental Representative in writing and await instructions.

.4 Contractor shall not be entitled to extra payment or extension of Contract Time for work which is required and which is reasonably inferable in the geotechnical information as being necessary.

.5 In case of discrepancies between recommendations contained in geotechnical information and requirements of Contract Documents, the latter shall govern. Advise the Departmental Representative in writing of any discrepancies discovered.

END OF SECTION

Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

Proposed Single/Two Storey Building on Lot 181 York Road, Niagara-On-The-Lake, Ontario

GEOTECHNICAL INVESTIGATION REPORT

Date: 2011 09 29
Ref. N°: 124-P041600-0100-GE-0001-01

LVM

LVM

Public Works and Government Services Canada

Proposed Single/Two Storey Building on Lot 181, York Road Niagara-On-The-Lake, Ontario

Geotechnical Investigation Report

LVM inc.

Prepared by:

Karolina Konarski, B.Eng., E.I.T.
Engineering Assistant

Ala Abu Obeid, P.Eng.
Geotechnical Engineer
Project Manager

LICENSED PROFESSIONAL ENGINEER
A. N. ABU OBEID
100113422
31/08/11
PROVINCE OF ONTARIO

Approved by :

Alain Duclos, P.Eng.
Senior Pavements/Geotechnical Engineer
Review Engineer

TABLE OF CONTENTS

APPENDICES

Property and Confidentiality

Test results mentioned herein are only valid for the sample(s) stated in this report.

LVM's subcontractors who may have accomplished work either on site or in laboratory are duly qualified as stated in our Quality Manual's procurement procedure. Should you require any further information, please contact your Project Manager."

REVISION AND PUBLICATION REGISTER

Revision N°	Date	Modification And/Or Publication Details
00	2011-08-31	Provision of Final Report
01	2011-09-29	Revision/Addition of Borehole Location Drawings as per Client Request

SUMMARY

LVM inc. has completed a geotechnical investigation in order to provide geotechnical design parameters for a proposed Single/Two storey building to be constructed on Lot 181, York Road, in Niagara-On-The-Lake, Ontario. This work was carried out at the request of Jack To, P.Eng. of Public Works and Government Services Canada - Ontario Region, following the submission of a work program and fee proposal.

A total of fourteen boreholes were advanced to varying depths (1.5 m, 3 m and 6 m) below the existing grades at locations selected by LVM. The deep boreholes (6 m depth) were placed within the potential footprint of the proposed building, while remaining boreholes were placed within the proposed parking lots and landscaping areas. The boreholes were carried out to determine the subgrade soil types and groundwater conditions for the design and construction of the proposed building and parking lots.

In general, the subsurface conditions in the study area consisted of a layer of topsoil (average thickness of about 130 mm) overlying firm to hard silty clay and silt and clay.

Groundwater measurements conducted in the open boreholes indicated that no groundwater was encountered in any of the boreholes upon completion of drilling. A piezometer was installed in one of the deep boreholes (BH 9), and on August 23, 2011 the water level was measured to be at 5.7 m below the existing grade (elevation of 117.35 m). Seasonal fluctuations in the groundwater levels should be expected.

Two representative soil samples were also selected by LVM and submitted for environmental analysis. The analysis did not indicate any exceedances for the parameters tested.

Geotechnical engineering recommendations have been developed by LVM for the design and construction of the proposed building and parking lots, including site preparation, the recommended foundation type, the Ultimate Limit States (ULS) and Serviceability Limit States (SLS) bearing pressures, slab-on-grade, site classification for seismic site response in accordance with Ontario Building Code, excavation and dewatering, backfilling and soil compaction criteria.

Concurrently with this investigation, a pavement design study has been conducted for this site by LVM and will be reported under a separate report.

INTRODUCTION

LVM inc. has completed a geotechnical investigation in order to provide geotechnical design parameters for a proposed Single/Two storey building to be constructed on Lot 181, York Road, in Niagara-On-The-Lake, Ontario. This work was carried out at the request of Jack To, P.Eng. of Public Works and Government Services Canada - Ontario Region, following the submission of a work program and fee proposal.

The proposed building is to be used by Royal Canadian Mounted Police (RCMP) and is designated as a post-disaster building (a building that is essential to the provision of services in the event of a disaster).

Lot 181 is currently active agricultural land with corn crops. It is our understanding that the project will include a single/Two storey building with slab-on-grade construction. The area of the proposed building is approximately 2386 m². As part of this project, adjacent parking lots and landscape areas will be also constructed around the proposed building. The area of the proposed parking lots and landscaping areas is 20,130 m² for a total site area of approximately 22,516 m².

The purpose of the geotechnical investigation was to determine the subsurface soil and groundwater conditions at the site and, based on that information, provide geotechnical engineering recommendations for the design and construction of the building foundation, including the recommended foundation type, the Ultimate Limit States (ULS) and Serviceability Limit States (SLS) bearing pressures, slab-on-grade, site classification for seismic site response in accordance with Ontario Building Code, and excavation and dewatering, backfilling and soil compaction criteria.

1 GEOTECHNICAL INVESTIGATION PROCEDURE

1.1 FIELD WORK

Subsequent to obtaining service clearances, the fieldwork for this investigation was carried out on August 15, 2011 and involved the drilling of fourteen boreholes (BH 1 to BH 14) to depths between approximately 1.5 m and 6 m below existing grade (to elevations ranging between 116.71 and 121.51 m) at the locations shown on the attached Borehole Location Drawing in Appendix 1.

The borehole locations were selected by LVM and established on the site by a surveying contractor working for the client. BH 6, BH 9 and BH 11 were placed within the potential footprint of the proposed building and drilled to 6 m depth, while the remainder of the boreholes were placed within the proposed parking lots and landscaping areas. BH 1, BH 3, BH 10, BH 12 and BH 14 were drilled to 3 m depth and BH 2, BH 4, BH 5, BH 6, BH 7, BH 8 and BH 13 were drilled to 1.5 m depth.

The boreholes were advanced using a track-mounted drill rig equipped with continuous flight solid stem augers supplied by Malone's Soil Samples Co. under continuous supervision of a LVM field technician.

Subsoil samples were recovered at regular intervals of depth using a 50 mm O.D. split-barrel sampler driven into the subsoil in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). The SPT N-values were recorded and plotted on the borehole logs in Appendix 2. Subsoil samples were recovered at 760 mm depth intervals above 3 m depth, and at 1.5 m intervals below this level. The recovered subsoil samples were visually examined in the field and then preserved and transported to our GTA laboratory for examination and testing.

Groundwater observations were carried out in the open boreholes upon completion of the field work and then promptly backfilled in accordance with Ontario Regulation 468/10. A piezometer, consisting of 19 mm I.D. solid plastic riser pipe covered by plastic caps, was installed BH 9 to permit monitoring of the 'stabilized' site water level. The bottom section of hole was screened and surrounded by filter sand. This was then followed by the installation of a bentonite plug, earth fill (auger spoil), and approximately a 0.5 m thick bentonite plug installed up to the ground surface to prevent surface water infiltration. The complete details of the measured groundwater levels are shown on the borehole logs in Appendix 2.

1.2 LABORATORY TESTING

All of the recovered soil samples were tested in the LVM GTA laboratory for moisture content. Two representative samples were selected by LVM and tested for grain size and hydrometer analysis. The moisture contents have been plotted on the borehole logs given in Appendix 2, and the grain size and hydrometer test results have been provided in Appendix 4.

In addition, two subsoil samples were selected by LVM and submitted to Exova Accutest for environmental analysis in accordance with Ontario Regulation 511/09 (metals and inorganics). The complete environmental testing results, including Exova Accutest Reports of Analysis are attached in Appendix 3.

The soil samples will be stored for a period of three months from the date of sampling. After this time, they will be discarded unless prior arrangements have been made for longer storage.

2 SUBSOIL CONDITIONS

The subsurface conditions at the site are described in detail on the borehole logs (provided in Appendix 2), with the general subsoil conditions summarized briefly below.

A topsoil layer (sand with some silt and trace roots) was encountered in all of the boreholes and ranged in thickness from approximately 100 to 150 mm. the topsoil was underlain by silty clay. In the 6 m deep boreholes, silt and clay was encountered below the silty clay at about 4.5 m depth.

The silty clay was firm to hard in relative consistency having Standard Penetration Test (SPT) 'N'-values ranging from 7 to 33 blows per 300 mm of penetration. The in-situ moisture content of this material ranged from about 15.8 (moist) to 28.6 (wet) percent.

The silt and clay was very stiff in relative consistency having SPT 'N'-values ranging from 15 to 22 blows per 300 mm of penetration. The in-situ moisture content of this material ranged from about 21.0 (very moist) to 28.1 (wet) percent.

The groundwater measurements conducted in the open boreholes upon completion of drilling indicated that the boreholes were dry. The water level in a piezometer (19 mm diameter), which was installed in BH 9; was measured 8 days following the completion of drilling and indicated a 'stabilized' water level of 5.7 m below existing grade (elevation of 117.35 m). Seasonal fluctuations in the groundwater levels should be expected.

3 DISCUSSION AND RECOMMENDATIONS

3.1 SITE PREPARATION

The topsoil encountered during the investigation should be subexcavated completely and properly disposed. After subexcavation, the exposed surface must be proof-rolled under the supervision of a geotechnical engineer and any soft or wet spots should be sub-excavated and properly replaced with approved compacted non-frost susceptible granular material.

3.2 FOUNDATIONS

3.2.1 Spread Footings

The investigation suggests that the proposed building may be supported on spread footings (piers and pads and exterior walls strip footing) founded on the native silty clay and/or silt and clay deposits, using an allowable safe net bearing pressure of 250 kPa (Serviceability Limit States). The factored bearing pressure at the Ultimate Limit States is 375 kPa.

A foundation constructed within native the silty clay and/or silt and clay deposits would be expected to undergo total and differential settlements less than 25 mm and 12 mm, respectively, depending on structure rigidity.

Prior to concreting, the foundation area should be inspected by a qualified geotechnical engineer to ensure that the soil conditions encountered at the time of construction are suitable to support the recommended design bearing pressure. Any disturbed or loose soil identified during the inspection should be removed from the footing areas and replaced with concrete.

Footings must also be protected from frost action by providing at least 1.2 m of earth cover or equivalent thermal insulation. If the construction is undertaken during winter, the footing base must be protected from freezing.

3.2.2 Cast-In-Place Concrete Caissons

If higher bearing capacities are desired, LVM recommends that the new building may be supported on cast-in-place caissons (drilled shafts), having a minimum depth-to-diameter ratio of 3 to 1, and founded on native native silty clay and/or silt and clay deposits at minimum 2.5 m depth below ground surface.

Cast-in-place caissons founded on the native silty clay and/or silt and clay deposits may be designed using a geotechnical resistance at SLS (Serviceability Limit States) of 400 kPa. The factored bearing pressured at the ULS (Ultimate Limit States) is 600 kPa.

A caisson foundation bearing within native the silty clay and/or silt and clay deposits would be expected to undergo total and differential settlements less than 25 mm and 12 mm, respectively, depending on structure rigidity.

It is recommended that full-time geotechnical monitoring be provided during the installation of the bored caissons so that an accurate record of drilled shaft size, alignment, location, length, cut-off elevation, and installation procedures can be kept. Cleaning by the contractor will be required to remove any loose material from the caisson base prior to concreting and inspection/testing of the base of the caisson is also required to confirm that the founding soils are suitable to support the

design loads and to ensure that any disturbed soils are removed from the bottom and sides of the caissons.

Caisson construction must be carried out in conformance with Ontario Occupational Health and Safety Act and Regulations for Construction projects, O.Reg. 213/91, s. 243 to 247.

3.2.3 Earthquake Design Considerations

A Site Classification D should be used for earthquake load and effects in accordance with Table 4.1.8.4.A. of the National Building Code of Canada (2005) and the Ontario Building Code (2006).

3.2.4 Slab-on-grade

The building slab-on-grade may be constructed using conventional concrete slab-on-grade techniques subject to the removal of the top soil and proofrolling the exposed native surface (any soft areas encountered during proof-rolling should be subexcavated and backfilled with approved compacted non-frost susceptible granular material).

Approved engineered fill could be considered (if required) for raising grades beneath slab-on-grade. The engineered fill should consist of OPSS 1010 Granular B Type 1 or SSM. The engineered fill should be placed in uniform layers not exceeding 150 mm in thickness and each layer should be compacted to at least 100 percent Standard Proctor Maximum Dry Density (SPMDD). The engineered fill layer should extend at least 1.0 m beyond the building envelope (footprint).

A minimum 150 mm thick layer of 19 mm clear crushed stone should be provided directly beneath the floor slab-on-grade.

If a moisture-sensitive floor finish is to be applied to the slab, then we recommend that a 15 mil polyethylene moisture vapour barrier be installed directly beneath the slab as per Section 9.13.2.7 of the Ontario Building Code (2006).

It is further recommended that subdrains be installed beneath the engineered fill and connected to a suitable positive outlet such as catchbasins or sump. The purpose of the subdrains is to remove excess subsurface water in order to mitigate the potential of wet soft subgrade. The subdrain shall be 150 mm diameter perforated pipe, wrapped with geotextile and surrounded with 100 mm concrete sand meeting the requirement of OPSS 1002.

Full-time compaction testing by experienced geotechnical personnel should be carried out during fill placement to examine and approve the fill material, and carefully monitor the placement and verify the compaction by insitu density testing using nuclear gauges.

3.2.5 Exterior Grades

The exterior of the building should be graded to prevent drainage towards the foundation after settling as per OBC 9.12.3.2. In this regard, it is recommended that exterior grades around the dwellings be sloped away at a minimum 2 percent gradient, for a distance of at least 1.2 m.

The finished grades around the building should be sealed (i.e. topsoiled and vegetated in the grass area and paved in the driveway area) as soon as possible to minimize water infiltration adjacent to the exterior walls. The minimum topsoil thickness should be 100 mm. In addition, the vegetation cover on the slope should be routinely maintained and encouraged to grow and under no circumstances should any concentrated runoff water be discharged directly beside the exterior walls.

3.3 EXCAVATION AND BACKFILLING

Excavation/drilling required for the construction of the foundation is expected to be relatively straight forward. The preliminary investigation results suggest that the excavation should be able to be carried out using conventional excavation equipment. Excavation side slopes in the upper subsoils are expected to remain relatively stable provided they are cut back and maintained at an angle not steeper than 45 degrees (1H:1V sloped from the base of the excavation). It should be noted that, if wet seams or zones are encountered, some sloughing to flatter slopes (as flat as 3H:1V) should be expected.

Regardless, all excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). The native subsoils encountered at the site as per OHSA criteria would typically be considered:

Moist to Very Moist, Very Stiff to Hard Silty Clay and Silt and Clay– Type 2

Very Moist to Wet, Firm Silty Clay – Type 3

Occasional boulders may be contacted during the drilling of caisson, and this should be recognized by prospective contractors when assessing equipment requirements and production rates. The concrete for the caisson should be placed immediately after drilling, cleaning and inspection.

3.4 DEWATERING

The groundwater measurements conducted upon completion of drilling indicated that no water was encountered in any of the boreholes. A groundwater measurement taken 8 days after completion of drilling indicated a groundwater level about 5.7 m below the existing grade at BH 9. It is not anticipated that a permit to take water (PTTW) will be required for this project.

In general, the subsoils excavated from the foundation location are not considered suitable for reuse as backfill. Imported granular material such as OPSS Granular B Type 1 is recommended. The backfill should be placed in 300 mm thick lifts and compacted to 100 % Standard Proctor Maximum Dry Density. The backfill must be brought up evenly on both sides of walls not designed to resist lateral earth pressures. The geotechnical soil parameters of Granular B Type 1 (for design purpose) would be a soil unit weight of 21 kN/m^3 and an at-rest earth pressure coefficient of 0.5.

3.5 ENVIRONMENTAL ANALYSIS RESULTS

Two subsoil samples were selected by LVM (BH3-SS3 and BH6-SS5) and submitted to Exova Accutest for environmental analysis in accordance with Ontario Regulation 511/09 (metals and inorganics). The environmental analysis results were then compared with O.Reg. 511/09 Table 1 criteria (Full Depth Background Site Condition Standards for All Other Types of Property Uses). The complete environmental testing results, including Exova Accutest Reports of Analysis are attached in Appendix 3. The analysis did not indicate any exceedances for the parameters tested.

4 CLOSING REMARKS

The comments provided in this report have been developed for the use of Public Works and Government Services Canada. It should be noted that on the borehole logs, the soil boundaries indicated are inferred from non-continuous sampling and observations during drilling and should not be interpreted as exact planes of geological change. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design. Also, the subsoil and groundwater conditions have been determined at the borehole locations only. Additional boreholes and/or test pits would be necessary to determine the localized conditions between boreholes. Contractors bidding on, or undertaking the work, must conduct their own investigations, and interpretations of the factual borehole data, and draw their own conclusions as to how the subsoil and groundwater conditions may affect their construction techniques, scheduling and costs.

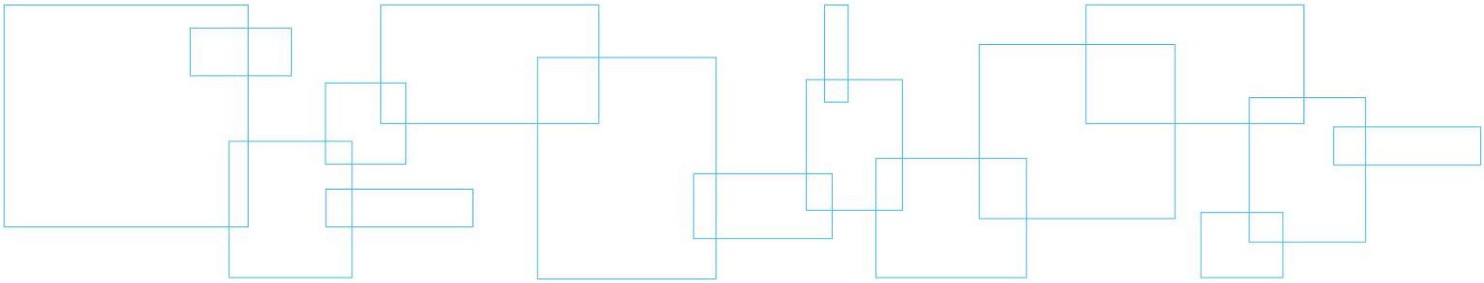
The recommended bearing capacity has been calculated by LVM from the information obtained from the borehole data. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes, when foundation construction is underway.

It is further noted that, depending on the time of year the fieldwork was completed, water levels should be expected to vary, perhaps significantly, from those observed at the time of this investigation.

During placement of concrete at the construction site, testing should be performed to determine the slump, temperature and air entrainment of the concrete, and concrete cylinders should be cast for compressive strength testing. Construction of concrete shall be in accordance with OPSS 904.

Sampling and testing of concrete compressive strength cylinders to the requirements of CSA A23.1 and A23.2 is recommended. At least one set of concrete cylinders should be taken for each day foundations are poured.

Appendix 1 Borehole Location Drawings



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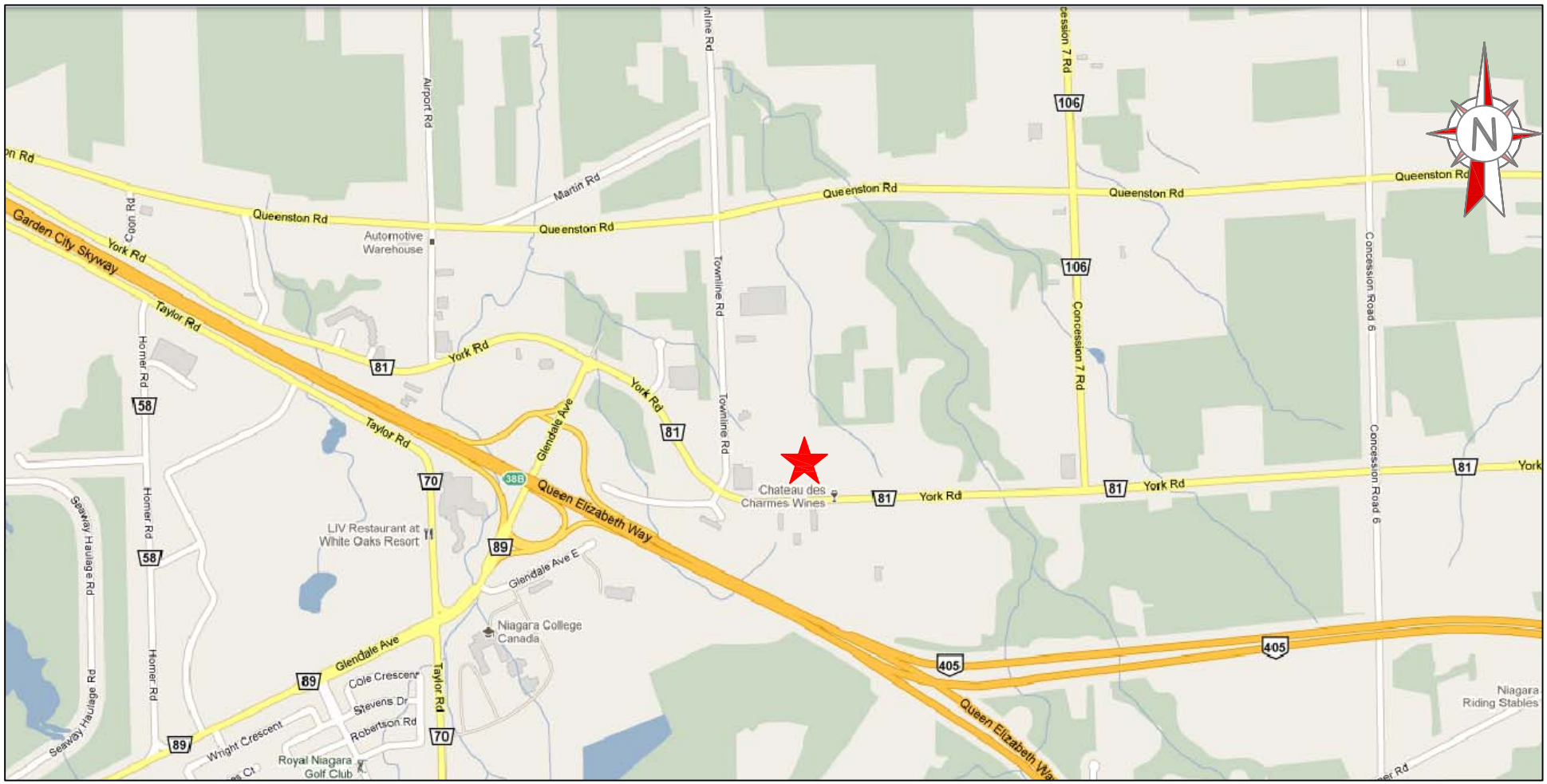

LEGEND :

SUBJECT SITE LOCATION

NOTES :
1-REFERENCES : GOOGLE MAP

Project

PROPOSED RCMP SINGLE / DOUBLE STOREY BUILDING

Lot 181 - York Road (Regional Road 81) and Townline Road, Niagara-on-the-Lake, Ontario

Title **SITE PLAN**

REV.			Prepared	Checked
1	2011-09-29	LOCATION MAP IS REMOVED TO A SEPARATE DRAWING AS PER CLIENT'S REQUEST	KL	AAO

ISSUES / REVISIONS

LVM inc.
1821, Albion Road, Unit 7
Toronto (Ontario) M9W 5W8
Telephone : 416.213.1060
Fax : 416.213.1070

Prepared	K.LO	Discipline	GE
Drawn	K.LO	Scale	N.T.S
Checked	A.A.OBEID	Date	2011-09-29

Project manager: A.A.OBEID
Sequence no.: 01 of 03

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
124	P041600	100		GE	01	01

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0 1 2 3 4 5 10 cm

LEGEND :

BOREHOLE LOCATION

NOTES :
1-REFERENCES : GOOGLE MAP

Project

PROPOSED RCMP SINGLE / DOUBLE STOREY BUILDING

Lot 181 - York Road (Regional Road 81) and Townline Road, Niagara-on-the-Lake, Ontario

Title **SITE PLAN**

REV.			Prepared	Checked
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ISSUES / REVISIONS

LVM inc.
1821, Albion Road, Unit 7
Toronto (Ontario) M9W 5W8
Telephone : 416.213.1060
Fax : 416.213.1070

Prepared	K.LO	Discipline	GE
Drawn	K.LO	Scale	N.T.S
Checked	A.A.OBEID	Date	2011-09-29

Project manager: A.A.OBEID
Sequence no.: 02 of 03

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
124	P041600	100		GE	02	01

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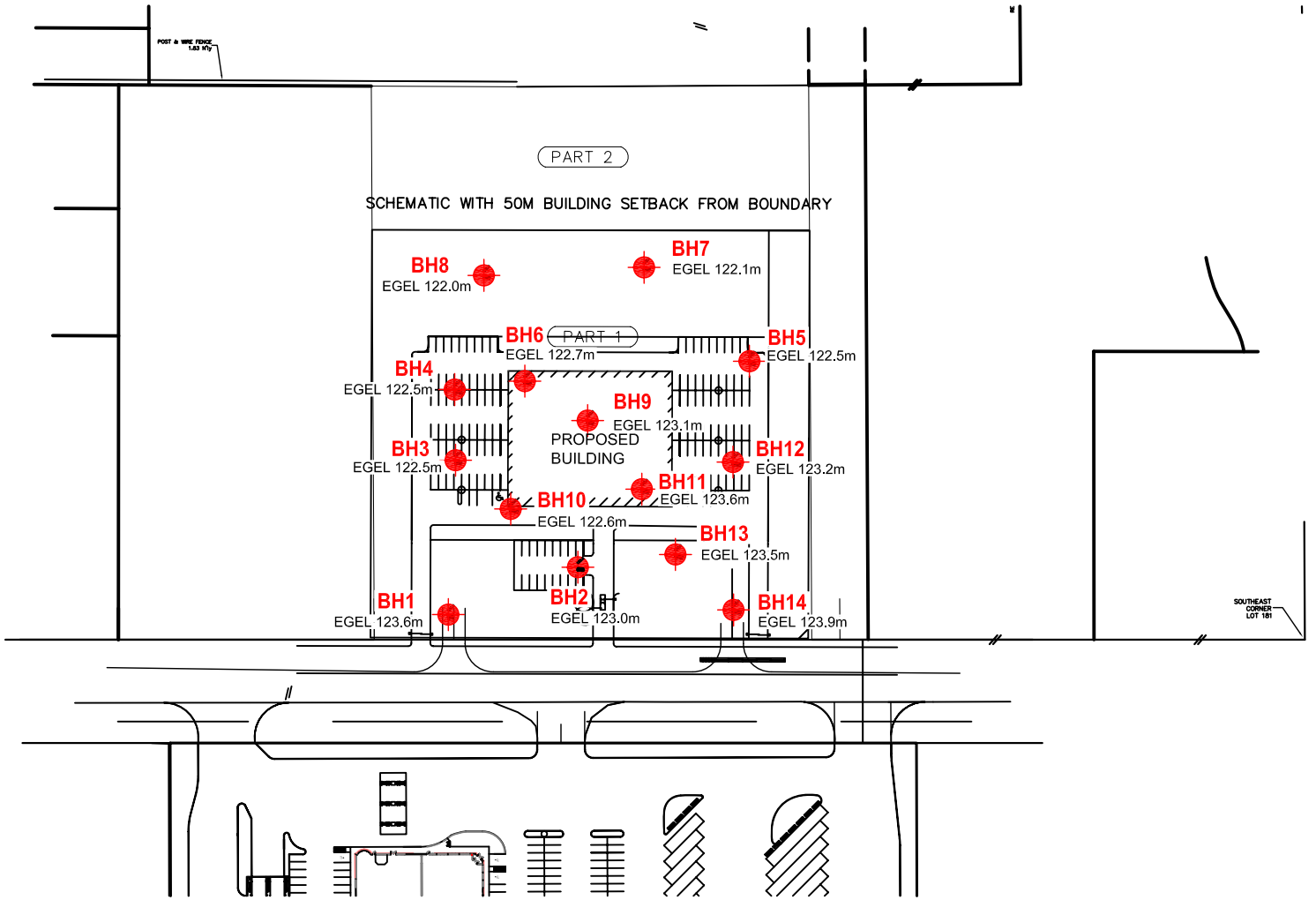


LEGEND :

BOREHOLE LOCATION

NOTES :
1-REFERENCES : GOOGLE MAP

Project

PROPOSED RCMP SINGLE / DOUBLE STOREY BUILDING

Lot 181 - York Road (Regional Road 81) and Townline Road, Niagara-on-the-Lake, Ontario

Title

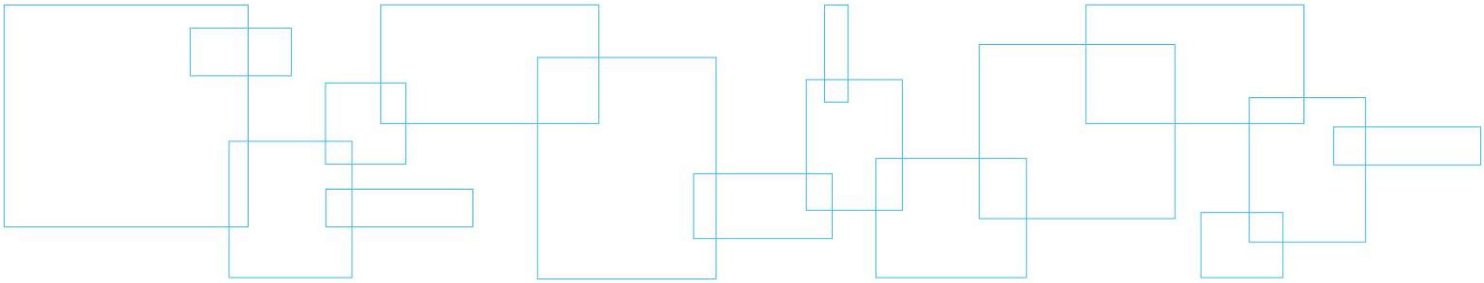
BOREHOLE LOCATION PLAN

LVM inc.
1821, Albion Road, Unit 7
Toronto (Ontario) M9W 5W8
Telephone : 416.213.1060
Fax : 416.213.1070

Prepared	K.LO	Discipline	GEOTECHNICAL	Project manager	A.A.OBEID
Drawn	K.LO	Scale	N.T.S.	Sequence no.	03 of 03
Checked	A.A.OBEID	Date	2011-09-29		

M. dept.	Project	Work pckg.	Sub-w.p.	Disc.	Drawing no.	Rev.
124	P041600	100		GE	100	00

Appendix 2 Borehole Logs



LVM inc.

LOG OF BOREHOLE No.1

Project No. P041600-100 DRAWING No. BH 1

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Natural Moisture Content ×
Atterberg Limits —○—
Undrained Triaxial at % Strain at Failure 0 / 5 / 10 / 15
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH	Standard Penetration Test N Value / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight g/cm³
			122.5		20 40 60 80 / 50 100 150 200	10 20 30		
		TOPSOIL (100 mm): sand, some silt, trace roots, brown	122.4	0				
		SILTY CLAY: trace sand, stiff to very stiff, brown and grey, moist to very moist		1				
		trace organic matter	120.7	2	450 kPa			
			119.4	3				
		Terminated at 3.1 m						

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650046.50 Y 4779893.48

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.2

Project No. P041600-100 DRAWING No. BH 2

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test +S

Natural Moisture Content ×
Atterberg Limits ⊢○⊣
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH	Standard Penetration Test N Value / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight g/cm³
			123.0	0	20 40 60 80 / 50 100 150 200	10 20 30		
		TOPSOIL (125 mm): sand, some silt, trace roots, brown	122.9					
		SILTY CLAY: trace sand, stiff to very stiff, brown and grey, very moist						
		trace gravel	122.3	1				
			121.5					
		Terminated at 1.5 m						

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650091.37 Y 4779912.85

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.3

Project No. P041600-100 DRAWING No. BH 3

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test S

Natural Moisture Content ×
Atterberg Limits ⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH
			122.5	0
		TOPSOIL (100 mm): sand, some silt, trace roots, brown	122.4	
		SILTY CLAY: trace sand, trace gravel, stiff to very stiff, brown and grey, moist to very moist		1
		becoming pink and grey	120.6	2
			119.4	3
		Terminated at 3.1 m		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight g/cm³

450 kPa
450 kPa

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650045.96 Y 4779948.19

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.4

Project No. P041600-100 DRAWING No. BH 4

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Natural Moisture Content ×
Atterberg Limits ⊢○⊣
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH	Standard Penetration Test N Value / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight g/cm³
			122.5	0	20 40 60 80 / 50 100 150 200	10 20 30		
		TOPSOIL (125 mm): sand, some silt, trace roots, brown	122.4					
		SILTY CLAY: trace sand, trace gravel, stiff to very stiff, brown and grey, very moist		1				
			121.0					
		Terminated at 1.5 m						

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650044.21 Y 4779973.17

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.5

Project No. P041600-100 DRAWING No. BH 5

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Natural Moisture Content ×
Atterberg Limits ⊢○⊣
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH	Standard Penetration Test N Value / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight g/cm³
			122.5	0	20 40 60 80 / 50 100 150 200	10 20 30		
		TOPSOIL (150 mm): sand, some silt, trace roots, brown	122.4					
		SILTY CLAY: trace sand, trace gravel, firm to very stiff, brown and grey, wet		1				
			121.0					
		Terminated at 1.5 m						
		Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.						
		Coordinates: X 650147.90 Y 4779989.12						

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.6

Project No. P041600-100 DRAWING No. BH 6

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH
			122.7	0
		TOPSOIL (125 mm): sand, some silt, trace roots, brown	122.6	
		SILTY CLAY: stiff to hard, brown and grey, moist to wet		
			122.0	
		trace sand, trace gravel		1
				2
			120.4	
		becoming pink and grey		
				3
				4
			118.1	
		SILT AND CLAY: trace sand, very stiff, pink, brown and grey, moist		5
			117.1	
		becoming brownish grey		
			116.6	6
		Terminated at 6.1 m		

Standard Penetration Test N Value: 20, 40, 60, 80
Shear Strength kPa: 50, 100, 150, 200
450 kPa
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10, 20, 30
SAMPLES
Natural Unit Weight g/cm³

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650068.87 Y 4779977.57

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.7

Project No. P041600-100 DRAWING No. BH 7

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test S

Natural Moisture Content ×
Atterberg Limits ⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH	Standard Penetration Test N Value / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight g/cm³
			122.1	0	20 40 60 80 / 50 100 150 200	10 20 30		
		TOPSOIL (125 mm): sand, some silt, trace roots, brown	122.0					
		SILTY CLAY: trace sand, stiff to very stiff, brown and grey, very moist			450 kPa			
		trace gravel	121.4	1				
			120.6					
		Terminated at 1.5 m						

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650108.77 Y 4780020.18

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.8

Project No. P041600-100 DRAWING No. BH 8

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test +S

Natural Moisture Content ×
Atterberg Limits ⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH	Standard Penetration Test N Value / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight g/cm³
			122.0	0	20 40 60 80 / 50 100 150 200	10 20 30		
		TOPSOIL (125 mm): sand, some silt, trace roots, brown	121.9					
		SILTY CLAY: trace sand, stiff to very stiff, brown and grey, very moist						
			121.2					
		trace gravel		1				
			120.5					
		Terminated at 1.5 m						

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650052.28 Y 4780014.13

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.9

Project No. P041600-100 DRAWING No. BH 9

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH
			123.1	0
		TOPSOIL (125 mm): sand, some silt, trace roots, brown	122.9	
		SILTY CLAY: stiff to hard, brown and grey, very moist		
			122.3	
		trace sand, trace gravel		1
			121.5	
		becoming pink and grey		2
			120.8	
		becoming brownish grey		3
				4
			118.5	
		SILT AND CLAY: trace sand, very stiff, brownish grey, wet		5
			117.4	
			117.0	6
		Terminated at 6.1 m		
		Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.		
		Coordinates: X 650091.86 Y 4779964.88		

Standard Penetration Test N Value
Shear Strength kPa: 20, 40, 60, 80; 50, 100, 150, 200
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10, 20, 30
SAMPLES
Natural Unit Weight g/cm³

300 kPa

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none
August 23, 2011	5.7 m	

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.10

Project No. P041600-100 DRAWING No. BH 10

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕ (0, 5, 10, 15)
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH
			122.6	
		TOPSOIL (150 mm): sand, some silt, trace roots, brown	122.4	0
		SILTY CLAY: trace sand, stiff to hard, brown and grey, very moist		
			121.5	1
		trace gravel		
				2
			120.0	
		with thin seam of gravel (20 mm)		
			119.5	3
		Terminated at 3.1 m		

Standard Penetration Test N Value
Shear Strength kPa: 20 40 60 80 | 50 100 150 200
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
450 kPa

SAMPLES

Natural Unit Weight g/cm³

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650066.42 Y 4779932.09

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.11

Project No. P041600-100 DRAWING No. BH 11

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test +S

Natural Moisture Content ×
Atterberg Limits ⊢○⊣
Undrained Triaxial at % Strain at Failure ⊕ (0, 5, 10, 15)
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH
			123.6	
		TOPSOIL (125 mm): sand, some silt, trace roots, brown	123.5	0
		SILTY CLAY: trace sand, stiff to hard, brown mottled, moist to very moist		
			122.8	
		trace gravel, brown and pink		1
			122.1	
		becoming brown and grey		2
			121.3	
		becoming brownish grey		3
				4
			119.0	
		SILT AND CLAY: trace sand, very stiff, brownish grey, very moist		5
			117.5	6
		Terminated at 6.1 m		

Standard Penetration Test N Value: 20, 40, 60, 80
Shear Strength kPa: 50, 100, 150, 200
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10, 20, 30
SAMPLES
Natural Unit Weight g/cm³

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650112.44 Y 4779941.73

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.12

Project No. P041600-100 DRAWING No. BH 12

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test S

Natural Moisture Content ×
Atterberg Limits ⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH
			123.2	0
		TOPSOIL (150 mm): sand, some silt, trace roots, brown	123.0	
		SILTY CLAY: trace sand, stiff to very stiff, brown and grey, very moist		1
		trace gravel	121.4	2
			120.1	3
		Terminated at 3.1 m		

Standard Penetration Test N Value
Shear Strength kPa: 20 40 60 80 / 50 100 150 200
450 kPa
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
SAMPLES
Natural Unit Weight g/cm³

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650144.10 Y 4779953.15

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.13

Project No. P041600-100 DRAWING No. BH 13

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S
Natural Moisture Content ×
Atterberg Limits ⊢○⊣
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH	Standard Penetration Test N Value / Shear Strength kPa	Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight g/cm³
			123.5	0	20 40 60 80 / 50 100 150 200	10 20 30		
		TOPSOIL (150 mm): sand, some silt, trace roots, brown	123.3					
		SILTY CLAY: some sand, trace gravel, stiff to very stiff, brown and grey, very moist		1	450 kPa ▲			
			121.9					
		Terminated at 1.5 m						

Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.

No water was encountered upon completion.

Coordinates: X 650125.63 Y 4779919.30

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

LVM inc.

LOG OF BOREHOLE No.14

Project No. P041600-100 DRAWING No. BH 14

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: Lot 181, York Road, Niagara On The Lake

Date Drilled: 8/15/2011

Drill Type: Solid Stem Augers

Datum: Geodetic-As provided by Client

Split Spoon Sample ☒
Auger Sample □
SPT (N) Value ●
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Natural Moisture Content ×
Atterberg Limits —○—
Undrained Triaxial at % Strain at Failure 0 / 5 / 10 / 15 ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	ELEV. m	DEPTH
			123.9	0
		TOPSOIL (150 mm): sand, some silt, trace roots, brown	123.7	
		SILTY CLAY: trace sand, stiff to very stiff, brown and grey, very moist		
		becoming pink and grey	122.8	1
				2
			120.8	3
		Terminated at 3.1 m		
		Borehole advanced uncased using continuous flight solid stem augering equipment on August 15, 2011 by Malone's Soil Samples Co. Ltd.		
		No water was encountered upon completion.		
		Coordinates: X 650147.28 Y 4779900.86		

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

450 kPa

Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

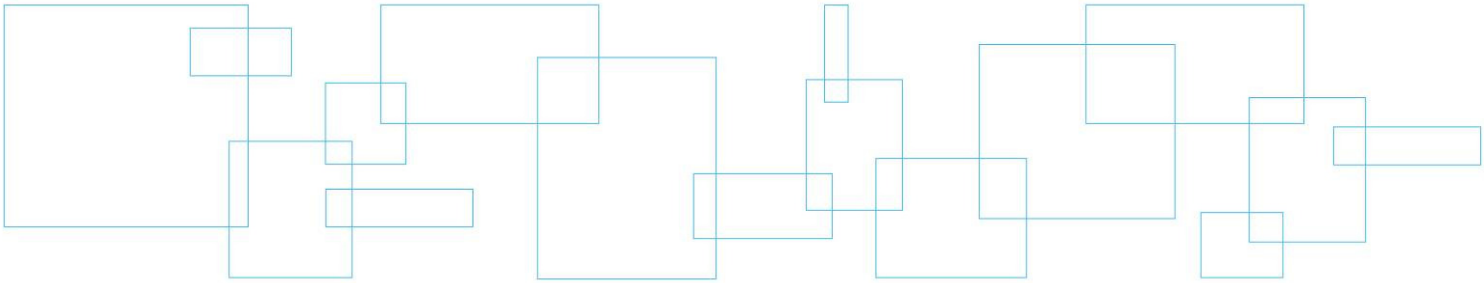
SAMPLES

Natural Unit Weight g/cm³

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	none	none

LOG A GWGL02 P041600_BOREHOLE LOGS.GPJ LOG A GWGL02.GDT 8/31/11

Appendix 3 Environmental Analysis Results



REPORT OF ANALYSIS

Client: **LVM inc.**
1821 Albion Road, Unit 7

Toronto, ON
M9W 5W8
Attention: **Ms. Karolina Konarski**

Niagara Report: N11-1553
Report Number: 1118917
Date: 2011-08-25
Date Submitted: 2011-08-16

Project: P041600

P.O. Number:
Matrix: Soil

Chain of Custody Number: **745652**

			LAB ID:	904048	904049				**GUIDELINE**		
			Sample Date:	2011-08-15	2011-08-15				O.Reg.511-Table1-Soil-Industrial/Commercial/Community Property Use		
			Sample ID:	BH6-SS5 (Niagara on the Lake)	BH3-SS3 (Niagara on the Lake)						
PARAMETER	**UNITS**	**MRL**							**TYPE**	**LIMIT**	**UNITS**
Cyanide (free)	ug/g	0.03		<0.03	<0.03				STD	0.051	ug/g
Electrical Conductivity	mS/cm	0.05		0.31	0.22				STD	0.57	mS/cm
pH				6.8	7.8				N/A	N/A	pH Units
Sodium Absorption Ratio (SAR)		0.01		1.10	0.45				STD	2.4	No Units
Antimony	ug/g	1		<1	<1				STD	1.3	ug/g
Arsenic	ug/g	1		5	5				STD	18	ug/g
Barium	ug/g	1		124	100				STD	220	ug/g
Beryllium	ug/g	1		<1	<1				STD	2.5	ug/g
Boron (hot water extract)	ug/g	0.5		<0.5	<0.5				N/A	N/A	N/A
Cadmium	ug/g	0.5		<0.5	<0.5				STD	1.2	ug/g
Chromium	ug/g	1		24	19				STD	70	ug/g
Cobalt	ug/g	1		12	13				STD	21	ug/g
Copper	ug/g	1		29	24				STD	92	ug/g
Hexavalent Chromium (Cr(VI))	ug/g	0.5		<0.50	<0.50				STD	0.66	ug/g
Lead	ug/g	1		10	12				STD	120	ug/g
Mercury	ug/g	0.1		<0.1	<0.1				STD	0.27	ug/g
Molybdenum	ug/g	1		<1	<1				STD	2	ug/g
Nickel	ug/g	1		29	28				STD	82	ug/g
Selenium	ug/g	1		<1	<1				STD	1.5	ug/g
Silver	ug/g	0.2		<0.2	<0.2				STD	0.5	ug/g
Thallium	ug/g	1		<1	<1				STD	1	ug/g
Vanadium	ug/g	2		33	28				STD	86	ug/g
Zinc	ug/g	2		62	51				STD	290	ug/g

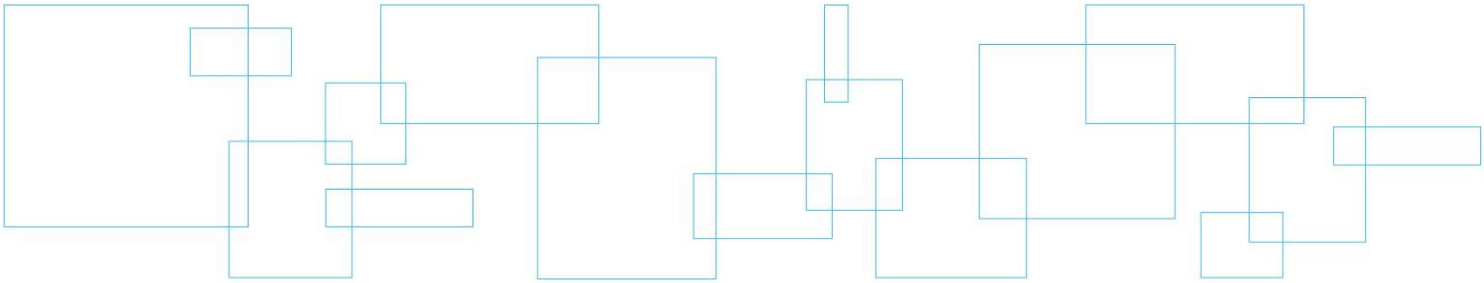
MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:
Samples were subcontracted for pH, conductivity, boron, CrVI and cyanide analysis.

APPROVAL: _____
Lorna Wilson
Inorganic Lab Supervisor

Methods references and/or additional QA/QC information available on request.

Appendix 4 Laboratory Testing Results



LVM inc.
1821 Albion Road, Unit 7, Toronto (Ontario) M9W 5W8
Telephone: (416) 213-1060 Facsimile: (416) 213-1070
E-Mail: toronto@lvm.ca Website: WWW.LVM.CA

GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT
MTO LS-602, 702, AND 703/704

JEGEL: P041600-100 CLIENT/JOB NAME: Public Works and Government Services Canada CONTRACT NUMBER: EQ467-120533/001/PWL

JEGEL ID: 32894 PROJECT/LOCATION: Nagara On The Lake

SAMPLING LOCATION:	BH6 SS6
SAMPLING DEPTH, m	4.57
SAMPLING METHOD:	Split Spoon
SAMPLED BY:	KK
SAMPLE DESCRIPTION:	Silt and Clay, trace Sand
SAMPLING DATE:	15/08/2011
SAMPLE RECEIVED DATE:	16/08/2011

GRAIN SIZE PROPORTIONS, %

% GRAVEL (> 4.75 mm):	0.0
% SAND (75 µm to 4.75 mm):	5.0
% Silt (5 µm to 75 µm):	40.9
% Clay (<5 µm):	54.2
SUSCEPTIBILITY TO FROST HEAVING:	Moderate

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	82.1
37.5	100.0	0.026	78.0
26.5	100.0	0.017	71.9
19.0	100.0	0.010	66.2
13.2	100.0	0.007	59.5
9.5	100.0	0.005	54.2
4.75	100.0	0.003	43.7
2.36	98.8	0.001	25.9
1.18	99.1	ATTERBERG LIMITS, %	
0.60	98.9		
0.30	98.1	Plastic Limit	
0.15	97.0	Liquid Limit	
0.075	95.0	Plastic Index	

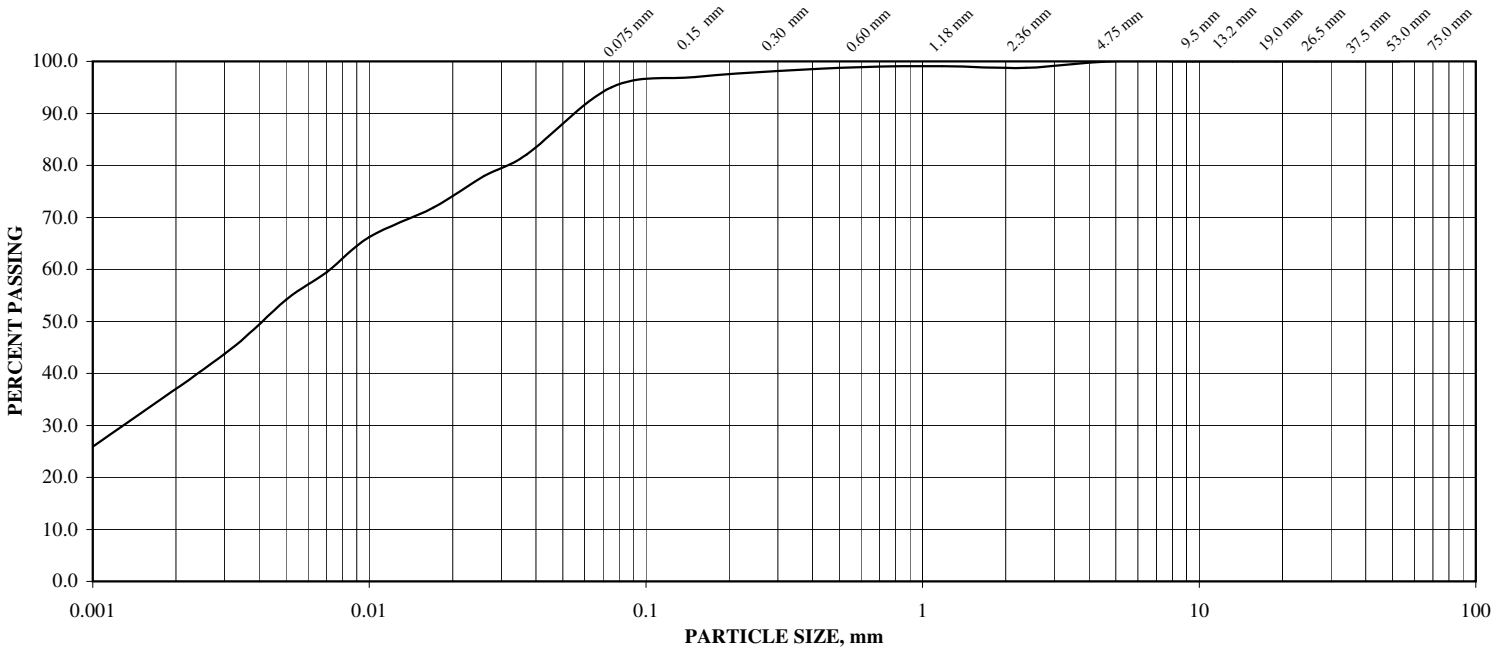
PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

FINES (SILT & CLAY)	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	COARSE GRAVEL



LVM inc.
1821 Albion Road, Unit 7, Toronto (Ontario) M9W 5W8
Telephone: (416) 213-1060 Facsimile: (416) 213-1070
E-Mail: toronto@lvm.ca Website: WWW.LVM.CA

GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT
MTO LS-602, 702, AND 703/704

JEGEL: P041600-100 CLIENT/JOB NAME: Public Works and Government Services Canada CONTRACT NUMBER: EQ467-120533/001/PWL

JEGEL ID: 32894 PROJECT/LOCATION: Nagara On The Lake

SAMPLING LOCATION:	BH13 SS2
SAMPLING DEPTH, m	1.07
SAMPLING METHOD:	Split Spoon
SAMPLED BY:	KK
SAMPLE DESCRIPTION:	Silty Clay with some Sand, trace Gravel
SAMPLING DATE:	15/08/2011
SAMPLE RECEIVED DATE:	16/08/2011

GRAIN SIZE PROPORTIONS, %

% GRAVEL (> 4.75 mm):	0.6
% SAND (75 µm to 4.75 mm):	12.6
% Silt (5 µm to 75 µm):	27.8
% Clay (<5 µm):	59.0
SUSCEPTIBILITY TO FROST HEAVING:	Low

GRAIN SIZE ANALYSIS		HYDROMETER ANALYSIS	
SIEVE SIZE mm	% PASSING	DIAMETER mm	% PASSING
53.0	100.0	0.037	80.5
37.5	100.0	0.026	76.0
26.5	100.0	0.017	72.7
19.0	100.0	0.010	66.6
13.2	100.0	0.007	63.9
9.5	100.0	0.005	59.0
4.75	99.4	0.003	52.7
2.36	97.6	0.001	36.6
1.18	94.0	ATTERBERG LIMITS, %	
0.60	91.3		
0.30	89.4	Plastic Limit	
0.15	88.1	Liquid Limit	
0.075	86.8	Plastic Index	

PARTICLE SIZE DISTRIBUTION, MTO LS-702

U.S. BUREAU OF SOILS CLASSIFICATION (AS USED IN MINISTRY OF TRANSPORTATION OF ONTARIO PAVEMENT DESIGNS)

CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL

UNIFIED SOILS CLASSIFICATION ASTM D 2487

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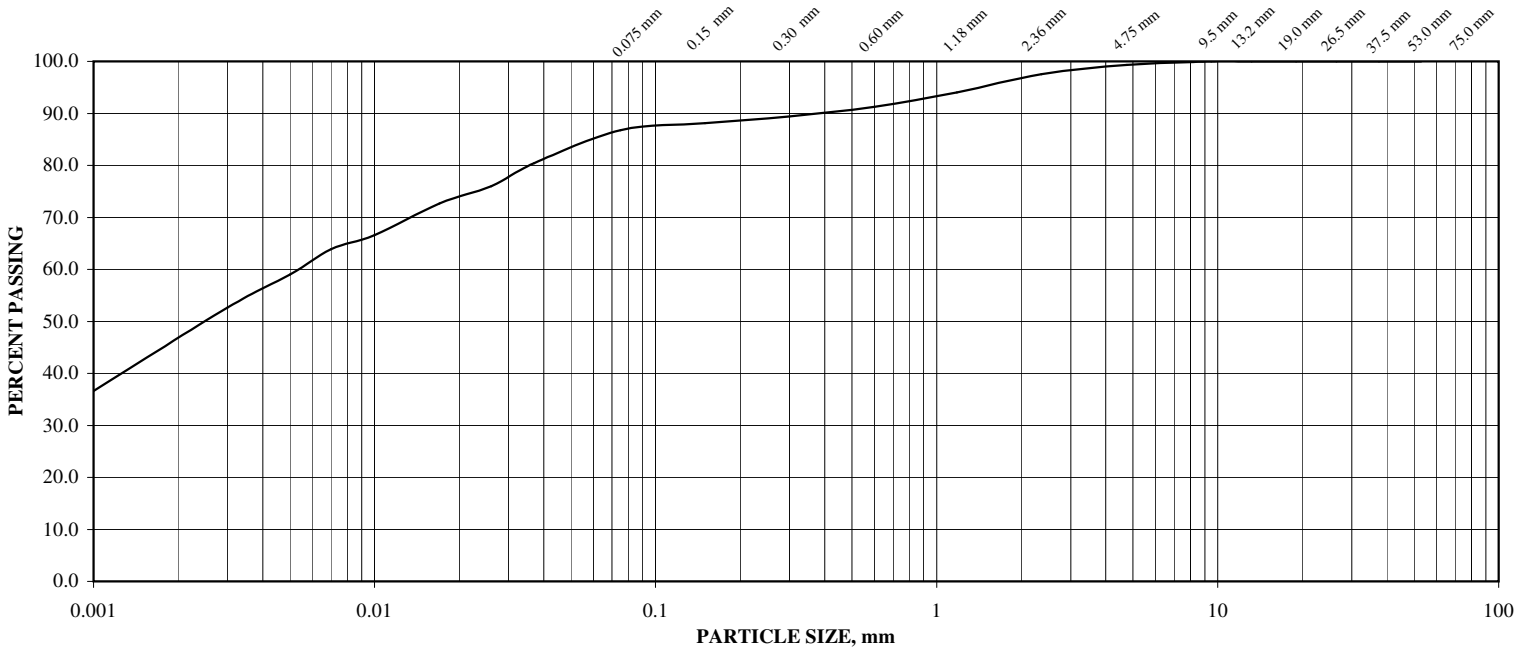


LVM inc.
1821 Albion Road, Unit 7
TORONTO (Ontario) Canada M9W 5W8
Telephone: 416.213.1060
Fax: 416.213.1070
toronto@lvm.ca
www.lvm.ca

TECHNICAL MEMORANDUM

DATE :	February 17, 2012
TO :	Peter Joice Project Manager RCMP National Project Management Office
FROM :	M.Ali Ahsan, M.Eng., P.Eng Michael H. MacKay, M.Eng., P.Eng. Principal Engineer and General Manager, GTA
SUBJECT :	Additional Pavement Recommendations for the Proposed RCMP Building, Lot 181 York Road, Niagara-On-The-Lake, Ontario.
O/Ref. :	P-0000031

LVM inc. has completed supplementary pavement recommendations for the proposed permeable paving (pedestrian areas) and the grass paving for emergency fire truck access at the south side of RCMP proposed development on Lot 181, York Road, Niagara-On-The-Lake, Ontario. The purpose of this Technical Memorandum is to provide the recommendations for the design and construction of the proposed special pavement types (grass and permeable paving), including the site preparation, the pavement drainage and the pavement structure (components) based on the anticipated usage.

Paving recommendations are based on the LVM geotechnical investigation report (124-P041600-0100-GE-0001-01, dated September 29, 2011) and pavement report (124-P041600-100-CH-0001-00, dated September 29, 2011), which was submitted to PWGSC in 2011 and should be read in conjunction with this Technical Memorandum. It is our understanding that two types of special pavements are being proposed for this RCMP Building, the first being a grass paving strip which will serve as fire lane and should be capable to accommodating fire trucks during an emergency, and permeable pavement areas for pedestrian traffic and occasional landscaping vehicles. Further the permeable pavement area will be used as a crossing for fire trucks in case of emergency in the area where grass paving strip crosses the permeable pavement structure.

Subsoil Conditions in the Supplementary Pavement Areas

The subgrade soil at the borehole locations (BH No. 2 and BH No. 10) near proposed grass paving (fire lane) and permeable paving areas (pedestrian areas) was observed to consist of stiff to hard silty clay, having Standard Penetration Test "N" values ranging from 9 to 32 blows per 300 mm of penetration. The in-situ moisture content of this material ranged from about 18 (moist) to 24 (very moist) percent.

Groundwater measurements conducted in the open boreholes upon completion of drilling indicated that the groundwater level was below the borehole termination depth in all boreholes.

Pavement Recommendations

Pavement design recommendations were developed by LVM in accordance with OPSS and ASTM Standards. Based on LVM previous experience, Unilock or equivalent concrete pavers are recommended for permeable pavement structure and Grasspave2 (Teraffix Geosynthetic Inc.) or an equivalent product is recommended for the grass paving structure. It is also strongly recommended that these pavement types be properly constructed in conformance with the specific product manufacturer guidelines.

Prior to undertaking any pavement construction work, the pavement drainage and/or sub-drainage should be assessed, noting that provision of proper drainage is fundamental to the performance of the pavement structure to mitigate optional frost-related movements and minimize seasonal loss of subgrade support (subgrade softening in spring).

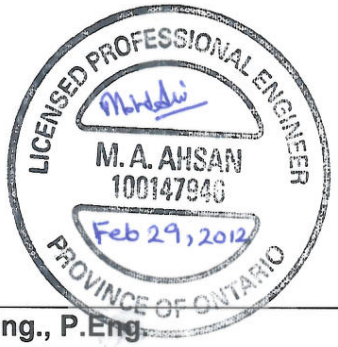
Permeable Paving (Pedestrian Area)

- Sub-excavate to the depth required for pavement installation, minimum 430 mm;
- The exposed subgrade should be carefully proof-rolled and any soft or wet spots properly repaired with approved material;
- Geotextile fabric should be provided between granular base and subgrade layer in accordance with OPSS 1860.
- Install PVC perforated drainage pipe of 100 mm diameter, wrapped in knitted sock geotextile and connect to nearest catch-basin. Seeing that subgrade soil is predominantly silty clay in this area and infiltration rate of this kind of soil is very low, hence it is recommended that the sub-drains be installed extending partially into the subgrade. Installation of sub-drains should be completed in accordance with OPSS 405.
- Construct the pavement base with 300 mm of open graded, crushed, angular granular material meeting ASTM C 33 requirements for No. 57 granular base or 300 mm of Open Graded Drainage Layer - OGDL (aggregate only) in accordance with OPSS 320 gradation requirements. Place in lifts not exceeding 150 mm loose thickness. Compact to 100 percent Standard Proctor Maximum Dry Density (SPMDD).
- Construct the paver bedding layer with 50 mm of crushed, angular, 6 mm nominal chip stone bedding material in accordance with ASTM C 33 requirements for No. 8 chip (or equivalent granular bedding material recommended by the manufacturer).
- Place 80 mm thick permeable paver with installation/construction in accordance with manufacturer's guidelines.

Grass Paving (Emergency Fire Access)

- Sub-excavate to the depth required for Grasspave2 system installation, approximately 300 mm;
- The exposed subgrade should be carefully proof-rolled and any soft or wet spots properly repaired with approved material;
- Geotextile fabric (Terrafix 270R or equivalent) should be provided between the granular base and subgrade layer in accordance with OPSS 1860.
- Construct the pavement base with 200 mm of OPSS 1010 Granular A base. It is recommended that Granular A be produced from pit run sand and gravel material. If crusher run limestone is proposed for use, it will require addition of sharp sand (up to 33% by volume) to ensure long-term porosity. Place in lifts not exceeding 150 mm loose thickness. Compact to 100 percent Standard Proctor Maximum Dry Density (SPMDD); and
- Install the Grasspave2 or equivalent pavement system as per manufacturer's requirements.

We trust that this Technical Memorandum is satisfactory for your purposes. Please do not hesitate to contact us with any questions or if you require more information.



Prepared by:

M. Ali Ahsan, M.Eng., P.Eng.
Pavement Engineer

Reviewed by:

Michael H. MacKay, M.Eng., P.Eng.
Principal Engineer and General Manager, GTA

TECHNICAL MEMORANDUM

Date: July 8th, 2014

To: James Lindsey, Aviation Director / Project Manager

From: Marc Labelle, PM Aviation

Project No.: 131-23055-00

Subject: RCMP Heliport, Niagara-on-the-Lake, Ontario
TLOF Pavement Design – Engineering Brief

A. OBJECTIVE

The purpose of this technical memorandum is to provide an engineering brief on the concrete pavement structure design of the proposed heliport TLOF and recommended construction methods and materials.

B. EXISTING SITE CONDITIONS

An investigation of geotechnical site conditions was carried out by LVM, as presented in their report N°: 124-P041600-0100-GE-0001-01 dated September 29, 2011. It should be noted that the investigation did not include any boreholes directly at the heliport location.

The BH7 located in the parking lot is the nearest to the heliport and is considered representative of the subsurface conditions at the heliport location. The general subsurface condition on the site and in BH7 is mostly topsoil over a deep layer of silty clay or silt and clay. One piezometer was installed in BH9 where the ground elevation is 123.1m ASL (Above Sea Level). The groundwater level lies about 5.7m (117.4m ASL) below the existing ground surface. The ground elevation of the bottom of the pond at the heliport is 120.5m ASL. However, groundwater level during spring season is expected to be higher since, per the report, the geotechnical investigations were taken in August.

C. TLOF CONCRETE PAVEMENT DESIGN RECOMMENDATIONS

Based on Table 6 of the Heliport Design Brief report (except below), the pavement design requirements shall be based on the Bell 412 as the critical design helicopter. The pertinent physical characteristics of the Bell 412 are detailed below:

TABLE 6
PAVEMENT DESIGN REQUIREMENTS

Criteria	Bell 412
Maximum Take-off Weight	5,080 kg
Main Gear Type	Skids
Nose Gear Pressure	N/A
Main Gear Pressure	N/A

Source: Heliport Design Brief

As the helicopter has a skid type landing gear, it is recommended that the FATO be constructed of a ridged pavement structure (i.e. concrete slabs). As requested and as indicated in Transport Canada's and the US Federal Aviation Administration pavement design standards, the TLOF shall be designed to withstand a dynamic load of 1.5x the maximum certified take-off weight transmitted through the contact areas of the skids of the critical helicopter.

Prior to granular pavement construction, as the helipad will be constructed in a dry pond, it is recommended that a compactable fill material should be placed under the pavement subgrade over the bottom of the pond. Since this terrain area will be a low point, where the moisture content of soil can be high, the fill material used should have a low frost susceptibility (including no more than 12% of fine particles passing N° 200 sieve or 80µm).

Any fill required for construction of the helipad should be approved on site and placed in thin lifts compacted to 95% MPMDD. The upper 300 mm of the pavement subgrade should be compacted to 98% MPMDD. It is not recommended to use the silty clay or silt and clay native soil for filling under the heliport pavements structures as it is very susceptible to frost heave and loss of bearing strength in spring conditions. On site excavated material should not be used for filling under the concrete slabs or under the grass paved area of the FATO.

The concrete pavement structure of the TLOF should consist of:

Recommended Pavement Design	
Depth	**Material**
200mm	Unreinforced concrete slabs (5m x 5m)
200mm	Granular A Base
300mm	Granular B Type I Subbase
Partial Frost Protection 700mm	

The Portland cement concrete as delivered to the site should be evaluated on the basis of flexural strength or compressive strength, slump, and air content and should meet the following conditions:

- An average flexural strength of not less than 4.0 MPa at 28 days, or an average compressive strength of not less than 32 MPa at 28 days
- A maximum water/cementing material ratio of 0.45
- An air content percent by volume of 4 to 7 for concrete with a maximum coarse aggregate size of 40 mm

The 10m TLOF area should be constructed with four (4) 5m x 5m slabs. The joints should be saw cut at 5m spacing for contraction joints. No load transfer devices are needed for the dimension of the proposed slabs.The concrete should be cured by protecting it against loss of moisture, rapid temperature change, and mechanical damage.

All joints must be saw cut at a minimum of 50 mm deep as soon as practical after placement. A 12mm wide (plus 5mm chamfered edges at 45°) by 22mm deep reservoir should be saw cut later for sealant. Prior to sealing the joints, a 12mm diameter backer rode should be placed at the bottom the reservoir. The joints could be filled with hot or cold joint-sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible.

The Granular A base meeting OPSS 1010 will have to be placed in two (2) 100mm thick lifts and compacted to a minimum 100% modified Proctor maximum dry density (MPMDD). The Granular B subbase meeting Type I Granular B per OPSS 1010 passing 100% 4.75mm sieve should be placed in maximum 150 mm thick lifts and compacted to a minimum 95% MPMDD.

D. OTHER RECOMMENDATIONS

The subgrade depth of the surrounding grass paved area should be harmonized with the subgrade for the proposed concrete pavement (700mm) of the TLOF to minimize differential behaviour at the junction between the two (2) different pavement types.

Perforated subdrains pipes should be placed in a trench just under the subgrade line in the fill material and surrounded by open graded stone wrapped in a geotextile filter. If the outlet of the subdrains in the pond is not above the 2 years water level, the design should include a flap gate.

Although the heliport is proposed to be constructed in a dry pond, where the water level in the pond could rise over the pavement subgrade and/or if the pond has a long discharge time, the silty clay soil excavated on site can be used for placing in a 300mm layer within the embankment slope underneath the topsoil where the surrounding water could be in contact with the heliport fill and granular structure. This will minimize the risk for subgrade soil saturation and frost heave effects during late autumn winter or early spring rainfall.

Frequent inspection, sampling and testing by a laboratory is recommended to approve the granular compaction and the concrete placement and curing procedure, and to verify that the specified compressive strength, slump and air content of the concrete are being achieved. During construction, testing should be conducted to confirm the gradation and compactibility characteristics of the fill, the granular base and subbase materials.

All construction materials proposed for this heliport project should conform to Transport Canada specifications. Inspection and testing of all pavement construction operations should be carried out on a continuous basis by experienced specialist geotechnical/materials quality assurance testing staff to ensure that appropriate materials, procedures and equipment are used to construct the work.

The pond entry will pass through a culvert underneath the road connecting the building parking lot and the heliport's FATO. The culvert and the ditch should be design at least for a 10 years rainfall without restriction to prevent water ponding against the road or the heliport embankment.

WSP Canada Inc.

Marc Labelle, eng.
Project Manager, Aviation