Servicing Report –100 Lusk Street

Prepared for:
N45 Architecture Inc.

Prepared by:
Stantec Consulting Ltd.

July 3, 2020

Revision	Description	Author		Quality Check	
1	Issued for Review	2020-06-20	TR	2020-07-02	KK

Sign-off Sheet

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Prepared by _____
(signature)

Thakshika Rathnasooriya, P.Eng.

Reviewed by _____
(signature)

Kris Kilborn

Stantec

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1.0 INTRODUCTION

Stantec Consulting Ltd. has been commissioned by N45 Architecture Inc. to prepare a servicing study in support of Site Plan Control submission of the proposed development located at 100 Lusk Street. The site is situated southwest of Lusk Street and O'Keefe Court intersection within the City of Ottawa. The proposed development would replace vacant land with a new three-storey commercial building and associated surface parking. The site location is shown as **Figure 1** below. The 0.40ha site is presently zoned IP(Business Park Industrial Zone), which permits the proposed development plan. The intent of this report is to provide a servicing scenario for the site that is free of conflicts, provides on-site servicing in accordance with City of Ottawa design guidelines, and utilizes the existing local infrastructure in accordance with the guidelines outlined per consultation with City of Ottawa staff.

Figure 1: Location Plan

2.0 BACKGROUND

Documents referenced in preparation of the design for the 159 Forward Avenue development include:

- Geotechnical Guidelines –Proposed Change of Use from Residential and Commercial Development to Business Park Industrial Zone O'Keefe Court and Fallowfield Road, Kollaard Associates., June 17, 2013.
- Design Brief – O'Keefe Court – 416 Lands, IBI Group, January 2018.
- City of Ottawa Design Guidelines – Water Distribution, Infrastructure Services Department, City of Ottawa, First Edition, July 2010
- City of Ottawa Sewer Design Guidelines, 2nd Ed., City of Ottawa, October 2012
- Technical Bulletin ISTB-2018-01 Revision to Ottawa Design Guidelines – Sewer, City of Ottawa, March 2018
- Technical Bulletin ISTB-2018-02 Revision to Ottawa Design Guidelines – Water Distribution, City of Ottawa, March 2018

3.0 WATER SUPPLY SERVICING

3.1 BACKGROUND

The proposed development comprises one three-storey commercial building, complete with associated infrastructure and parking. The site is located on the southwest side of the Lusk Street and O'Keefe Court intersection. The site will be serviced via a 50mm building service connection to the existing 200mm dia. watermain within the Lusk Street ROW at the southern boundary of the site. The property is located within the City's Pressure Zone BARR. Average ground elevations of the site are approximately 104.2m. Under normal operating conditions, hydraulic gradelines vary from approximately 147.4m to 151.7m as confirmed through boundary conditions as provided by the City of Ottawa (see **Appendix A.1**)

3.2 WATER DEMANDS

Water demands for the development were estimated using the Ministry of Environment's Design Guidelines for Drinking Water Systems (2008) and the Ottawa Design Guidelines – Water Distribution (2010). A rate of 28,000 L/gross ha/day of commercial space was used for the proposed site. See **Appendix A.2** for detailed domestic water demand estimates.

The average day demand (AVDY) for the entire site was determined to be 0.06 L/s. The maximum daily demand (MXDY) is 1.5 times the AVDY for residential areas, which sums to 0.09 L/s. The peak hour demand (PKHR) is 1.8 times the MXDY for residential areas totaling 0.17 L/s.

The Ontario Building Code (OBC) was used to determine the fire flow required for the proposed site given that the proposed development only involves a water service connection. The building was considered to be of combustible construction, and as a residential apartment, the building falls under occupancy class D. Based on calculations per the OBC guidelines (see **Appendix A.3**), the minimum required fire flows for this development are 150 L/s (9,000 L/min).

3.3 PROPOSED SERVICING

Domestic water supply pressures are required to range within the guidelines of 50-80 psi specified in the City of Ottawa Design Guidelines for Water Distribution. Maximum day demands rates must generate a residual pressure above the required minimum 140 kPa (20 psi).

Based on boundary conditions provided by the City of Ottawa and an approximate elevation of 104.2m, adequate domestic water supply is available for the subject site with pressures ranging from 43.5m (61.9psi) to 47.5m (67.5psi). This pressure range is within the guidelines of 50-80 psi specified in the City of Ottawa Design Guidelines for Water Distribution.

The boundary conditions provided for the proposed development under maximum day demands demonstrate that a maximum flowrate of 150 L/s is available in order to have a residual pressure above the required minimum 20 psi. This demonstrates that sufficient fire flow is available for the proposed development.

The closest hydrants are located on Lusk ROW at the southern and eastern boundaries of the subject property and is within 90m of the proposed building as per City of Ottawa Water Distribution Design Guidelines.

3.4 SUMMARY OF FINDINGS

The proposed development is serviced by the City of Ottawa's water distribution system. The available water supply is sufficient to meet both domestic and fire protection requirements.

4.0 WASTEWATER SERVICING

4.1 BACKGROUND

The site will be serviced via an existing 250 mm diameter sanitary sewer situated within the Lusk Street ROW at the southern boundary of the site (see **Drawing SSP-1**). It is proposed to connect a 150mm diameter sanitary service lateral directly to the existing sewer to service the proposed site.

4.2 DESIGN CRITERIA

As outlined in the City of Ottawa Sewer Design Guidelines and the MECP Design Guidelines for Sewage Works, the following criteria were used to calculate estimated wastewater flow rates and to size the sanitary sewers:

- Minimum Velocity – 0.6 m/s (0.8 m/s for upstream sections)
- Maximum Velocity – 3.0 m/s
- Manning roughness coefficient for all smooth wall pipes – 0.013
- Minimum size – 200mm dia. for residential areas, 250mm for commercial areas
- Average Wastewater Generation – 28,000L/ha/day
- Peak Factor – 1.5 (Commercial)
- Extraneous Flow Allowance – 0.33 l/s/ha (conservative value)
- Manhole Spacing – 120 m
- Minimum Cover – 2.5m

4.3 PROPOSED SERVICING

The proposed site will be serviced by gravity sewers which will direct the wastewater flows (approx. 0.33 L/s with allowance for infiltration) to the existing 250 mm diameter sanitary sewer. A sanitary sewer design sheet for the proposed service lateral is included in . Full port backwater valves are to be installed on all sanitary services within the site to prevent any surcharge from the downstream sewer main from impacting the proposed property.

5.0 STORMWATER MANAGEMENT

5.1 OBJECTIVES

The objective of this stormwater management plan is to determine the measures necessary to control the quantity/quality of stormwater released from the proposed development to criteria established during the pre-consultation/zoning process, and to provide sufficient detail for approval and construction.

5.2 SWM CRITERIA AND CONSTRAINTS

Criteria were established by combining current design practices outlined by the City of Ottawa Design Guidelines (2012), and through consultation with City of Ottawa staff. The following summarizes the criteria, with the source of each criterion indicated in brackets:

General

- Use of the dual drainage principle (City of Ottawa).
- Wherever feasible and practical, site-level measures should be used to reduce and control the volume and rate of runoff. (City of Ottawa)
- Assess impact of 100-year event outlined in the City of Ottawa Sewer Design Guidelines on major & minor drainage system (City of Ottawa)
- The proposed site is not subject to quality control criteria as it is captured downstream at the pond in Block 4 (City of Ottawa).

Storm Sewer & Inlet Controls

- Size storm sewers to convey 2-year storm event under free-flow conditions using City of Ottawa I-D-F parameters (City of Ottawa).
- Site discharge rates for each storm event to be restricted to 2-year storm event of 69 L/s based on rates calculated in the O'Keefe Court 416 Lands Design Brief by IBI Group.
- Proposed site to discharge the existing 600mm diameter storm sewer within the Lusk Street ROW at the boundary of the subject site (City of Ottawa).
- 100-year Storm HGL to be a minimum of 0.30 m below building foundation footing (City of Ottawa).

Surface Storage & Overland Flow

- Building openings to be a minimum of 0.30m above the 100-year water level (City of Ottawa)
- Rooftop and parking lot storage to be maximized where possible.
- Maximum depth of flow under either static or dynamic conditions shall be less than 0.30m (City of Ottawa)
- Provide adequate emergency overflow conveyance off-site (City of Ottawa)

5.3 STORMWATER MANAGEMENT

The Modified Rational Method was employed to assess the rate and volume of runoff generated during post-development conditions. The site was subdivided into subcatchments (subareas) tributary to stormwater controls as defined by the location of inlet control devices. A summary of subareas and runoff coefficients is provided in **Appendix C** and **Drawing SD-1** indicates the stormwater management subcatchments.

5.3.1 Allowable Release Rate

The overall approach for the storm servicing and stormwater management for the proposed site is outlined in the O'Keefe Court 416 Lands Design Brief by IBI Group, January 2018. The target release rate has been summarized based on results from subcatchment B12 in the overall O'Keefe Court 416 Lands Design Brief.

Based on the background report, the peak post-development discharge from the subject site is to be limited to that of the 2-year event and runoff volume from the proposed site up to the 100 year storm event is to be captured and stored on site. Minor and major system flows from the site are directed towards the stormwater management facility located at Block 4. The pond discharges to O'Keefe Drain and ultimately to the Jock River.

The target release rate for the site is summarized in **Table 1** below:

Table 1: Target Release Rates

Design Storm	Target Flow Rate (L/s)
All Events	69.0

5.3.2 Storage Requirements

The site requires quantity control measures to meet the restrictive stormwater release criteria. It is proposed that rooftop storage via restricted roof release in combination with surface parking storage with inlet control devices (ICDs) be used to reduce site peak outflow to target rates.

5.3.2.1 Rooftop Storage

It is proposed to retain stormwater on the building rooftop by installing restricted flow roof drains. The following calculations assume the roof will be equipped with standard Watts Model R1100 Accuflow Roof Drains.

Watts Drainage "Accutrol" roof drain weir data has been used to calculate a practical roof release rate and detention storage volume for the rooftops. It should be noted that the "Accutrol" weir has been used as an example only, and that other products may be specified for use, provided that the total roof drain release rate is restricted to match the maximum rate of release indicated in **Table 2**, and that sufficient roof storage is provided to meet (or exceed) the resulting volume of detained stormwater. Proposed drain release rates have been calculated based on the Accutrol weir setting at 50% open. Storage volume and controlled release rate are summarized in **Table 2**:

Table 2: Roof Control Area (BLDG)

Design Storm	Depth (mm)	Discharge (L/s)	Volume Stored (m^3)
2-Year	99.35	2.83	9.34
100-Year	148.85	3.76	31.38

Drainage from the roof will directly discharge to the proposed 300mm storm sewer, slightly upstream of the existing 375mm storm sewer stub for the proposed site.

5.3.2.2 Surface Storage

Per the modified rational method calculations included as part of **Appendix C.2**, the remainder of the site is to be directed towards three catch basins (CB101A-1, CB101B-1, CB101C-1)complete with IPEX Tempest HF or LMF Orifice ICD to meet the target peak discharge rate for the during the 100-year event.

In order to control peak discharge from the subject site to within target levels, available surface storage in parking areas in the amount of approximately 65.1m^3 was provided. Storage volumes and controlled release rates are summarized in **Table 3.**

Table 3: Surface Storage Areas (L101A, L101B, L101C)

Tributary Area	Design Storm	Design Head (m)	Discharge (L/s)	Orifice Type	$V_{required}$ (m^3)	$V_{available}$ (m^3)
L101A	2-Year	1.48	17.79	IPEX Tempest HF 83mm Orifice	0.00	3.80
	100-Year	1.48	17.79		1.24	
L101B	2-Year	1.58	10.25	IPEX Tempest LMF 105	0.00	21.10
	100-Year	1.58	12.31		10.49	
L101C	2-Year	1.58	12.31	IPEX Tempest LMF 105	4.45	40.20
	100-Year	1.58	12.31		31.45	

5.3.2.3 Uncontrolled Areas

Due to grading restrictions, one subcatchment area has been designed without a storage component. The catchment area discharges off-site uncontrolled to the adjacent Lusk Street and O'Keefe Court. Peak discharges from uncontrolled areas have been considered in the overall SWM plan and have been balanced through overcontrolling proposed site discharge rates to meet target levels.

Table 4: Uncontrolled Non-Tributary Area (UNC-1)

Design Storm	Discharge (L/s)
2-Year	6.83
100-Year	19.86

5.3.3 Results

Table 5 demonstrates the proposed stormwater management plan and demonstrates adherence to target peak outflow rates for the site.

Table 5: Summary of Total 2 and 100 Year Event Release Rates

	2-Year Peak Discharge (L/s)	100-Year Peak Discharge (L/s)
Uncontrolled – Surface	6.83	19.86
Controlled – Surface	40.35	42.41
Controlled – Roof	2.83	3.76

Total	**50.01**	**66.03**
Target	**69.00**	**69.00**

6.0 GRADING AND DRAINAGE

The proposed development site measures approximately 0.40ha in area. The topography across the site is relatively flat, and currently drains from to both the northwest and southeastern boundary, with overland flow generally being directed to the adjacent Lusk Street ROW. A detailed grading plan (see **Drawing GP-1**) has been provided to satisfy the stormwater management requirements, adhere to any geotechnical restrictions (see **Section 10.0**) for the site, and provide for minimum cover requirements for storm and sanitary sewers where possible. Site grading has been established to provide emergency overland flow routes required for stormwater management in accordance with City of Ottawa requirements.

The subject site is graded to provide an emergency overland flow route to Lusk Street for storm flows exceeding those generated by the 100-year design storm.

7.0 UTILITIES

Hydro, Bell, Gas and Cable servicing for the proposed development should be readily available within subsurface plant and adjacent overhead utility lines within the Lusk Street ROW. Exact size, location and routing of utilities, along with determination of any off-site works required for redevelopment, will be finalized after design circulation.

8.0 APPROVALS

Pre-consultation with Ontario Ministry of Environment, Conservation and Parks (MECP) staff concerning Environmental Compliance Approvals (ECAs, formerly Certificates of Approval (CofA)) under the Ontario Water Resources Act is not expected to be a requirement for the development.

Requirement for a MECP Permit to Take Water (PTTW) for sewer construction dewatering and building footing excavation will be confirmed by the geotechnical consultant.

9.0 EROSION CONTROL DURING CONSTRUCTION

Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.

1. Implement best management practices to provide appropriate protection of the existing and proposed drainage system and the receiving water course(s).
2. Limit extent of exposed soils at any given time.
3. Re-vegetate exposed areas as soon as possible.
4. Minimize the area to be cleared and grubbed.
5. Protect exposed slopes with plastic or synthetic mulches.
6. Provide sediment traps and basins during dewatering.
7. Install sediment traps (such as SiltSack® by Terrafix) between catch basins and frames.
8. Plan construction at proper time to avoid flooding.

The contractor will, at every rainfall, complete inspections and guarantee proper performance. The inspection is to include:

9. Verification that water is not flowing under silt barriers.
10. Clean and change silt traps at catch basins.

Refer to **Drawing ECDS-1** for the proposed location of silt fences and other erosion control structures.

10.0 GEOTECHNICAL INVESTIGATION AND ENVIRONMENTAL ASSESSMENT

A geotechnical review was prepared by Kollaard Associates Engineers on June 17, 2013. The report summarizes the geotechnical design parameters and construction recommendations prior to completion of full geotechnical investigation. For details which are not summarized below, please see the original Kollaard Associates Engineers report.

Subsurface soil conditions were based on existing subsurface information in the vicinity from previous geotechnical investigations. The soil stratigraphy for the overall O'Keefe Court development is expected to consist of shallow bedrock, glacial till and silty clay. The proposed site was measured by test pit 7 which indicated a layer of topsoil, underlaid by red brown fine sand and trace gravel, followed by grey brown silty sand and a refusal on a large boulder or bedrock at 2.7m below ground surface.

Table 6: Recommended Pavement Structure – Car Only Parking Areas

Thickness (mm)	Material Description
80	Asphaltic Concrete, 40mm of HL3 over 40mm of HL8
150	OPSS Granular A
300	OPSS Granular B Type II subbase

11.0 CONCLUSIONS

11.1 WATER SERVICING

Based on the supplied boundary conditions from the City for existing watermains and estimated domestic and fire flow demands for the subject site, it is anticipated that the proposed servicing in this development will provide sufficient capacity to sustain both the required domestic demands and emergency fire flow demands of the proposed site.

11.2 SANITARY SERVICING

The proposed sanitary sewer network is sufficiently sized to provide gravity drainage of the site. The proposed site will be serviced by a gravity sewer service lateral which will direct wastewater flows to the existing 250 mm diameter sanitary sewer within the Forward Avenue ROW at the western boundary of the property. The proposed drainage outlet has sufficient capacity to receive sanitary discharge from the site.

11.3 STORMWATER SERVICING

The proposed stormwater management plan is in compliance with the goals specified through consultation with the City of Ottawa. Rooftop storage and controlled roof release, and subsurface storage via a large diameter storage pipe has been proposed to limit peak storm sewer inflows to downstream storm sewers to predevelopment levels as determined by City of Ottawa staff. The storm flows from the site will be controlled to less than the 5-year storm event. The downstream receiving sewer has sufficient capacity to receive runoff volumes from the site based on pre-consultation through City of Ottawa staff.

11.4 GRADING

Grading for the site has been designed to provide an emergency overland flow route as per City requirements and reflects the recommendations in the Geotechnical Review prepared by Paterson Group. Erosion and sediment control measures will be implemented during construction to reduce the impact on existing facilities.

11.5 UTILITIES

Utility infrastructure exists within overhead lines and subsurface plant within the Forward Avenue ROW at the western boundary of the proposed site. It is anticipated that existing infrastructure will be sufficient to provide a means of distribution for the proposed site. Exact size, location and routing of utilities will be finalized after design circulation.

11.6 APPROVALS/PERMITS

An MECP Environmental Compliance Approval is not expected to be required for the subject site. Requirements for a Permit to Take Water (PTTW) are not anticipated. Need for a PTTW for sewer construction dewatering and building footing excavation will be confirmed by the geotechnical consultant. The Rideau Valley Conservation Authority will need to be consulted in order to obtain municipal approval for site development. No other approval requirements from other regulatory agencies are anticipated.

Appendix A WATER SUPPLY SERVICING

A.1 BOUNDARY CONDITIONS

Boundary Conditions
100 Lusk St.

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	3.6	0.06
Maximum Daily Demand	5.4	0.09
Peak Hour	10.2	0.17
Fire Flow Demand	9000	150

Location

Connection 1 – Lusk St.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	151.7	67.4
Peak Hour	147.4	61.2
Max Day plus Fire	144.3	56.8

[1] Ground Elevation = 104.4 m

Notes:

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

From:	Rathnasooriya, Thakshika
To:	Johnson, Warren
Subject:	FW: Boundary Conditions - 100 Lusk St
Date:	Wednesday, June 10, 2020 8:29:44 AM
Attachments:	100 Lusk St_Boundary Conditions_28May2020.docx

Shika Rathnasooriya , P.Eng.

Direct: 613 724-4081
Thakshika.Rathnasooriya@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Baker, Adam <adam.baker@ottawa.ca>
Sent: Wednesday, June 03, 2020 2:05 PM
To: Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Subject: RE: Boundary Conditions - 100 Lusk St

Hi Shika,

Please find attached the water boundary conditions for this property. If there are new private watermains or hydrants that will be proposed as part of this development, we will need to circle back and get the FUS calculations to determine required fire flow at the property.

Thank you,
Adam

Adam Baker, EIT
Engineering Intern
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - South Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2424 ext./poste 26552, Adam.Baker@ottawa.ca

From: Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Sent: May 28, 2020 11:51 AM
To: Baker, Adam <adam.baker@ottawa.ca>
Subject: FW: Boundary Conditions - 100 Lusk St

Hi Adam,

Is it possible to get a statues update on the boundary condition request?

Thanks,

Shika Rathnasooriya , P.Eng.

Direct: 613 724-4081
Thakshika.Rathnasooriya@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Hodgins, Cameron <cameron.hodgins@ottawa.ca>
Sent: Wednesday, May 13, 2020 3:22 PM
To: Baker, Adam <adam.baker@ottawa.ca>
Cc: Kilborn, Kris <kris.kilborn@stantec.com>; Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Subject: RE: Boundary Conditions - 100 Lusk St

Hi Adam,

This is related to the Pre-consult held for 100 Lusk Street a few months ago. When you can, can you please take a look at the email below and provide the requested information if possible. Thank you!

Sincerely,

Cameron Hodgins
Planner I
Development Review (South Services) | Examen des projets d'aménagement (services sud)
Planning, Infrastructure and Economic Development | Services de planification, d'infrastructure et de développement économique

City of Ottawa | Ville d'Ottawa
☎ 613.580.2424 ext./poste 15788

From: Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Sent: May 13, 2020 2:50 PM
To: Hodgins, Cameron <cameron.hodgins@ottawa.ca>
Cc: Baker, Adam <adam.baker@ottawa.ca>; Kilborn, Kris <kris.kilborn@stantec.com>
Subject: Boundary Conditions - 100 Lusk St

Hi Cameron,

I am looking for watermain hydraulic boundary conditions for 100 Lusk Street. The proposed commercial site consists of one three storey building . We anticipate connecting to the existing 300mm diameter watermain on Lusk Street. (please see attached figure).

Please send the revised estimated domestic demands and fire flow requirements for the site as mentioned below:
Average Day Demand – 0.06 L/s
Max Day Demand - 0.09 L/s
Peak Hour Demand - 0.17 L/s
Fire Flow Requirement per OBC for townhome and back-to-back units - 150 L/s (9,000 L/min)

Thank you,

Shika Rathnasooriya , P.Eng.

Direct: 613 724-4081
Thakshika.Rathnasooriya@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

A.2 DOMESTIC WATER DEMAND ESTIMATE

Fire Flow Calculations as per Ontario Building Code 2006 (Appendix A)

Job#	160401505	Designed by:	TKR
Date	2-Jul-20	Checked by:	
		Description:	3-Storey Commercial

$Q = KVS_{tot}$

Q = Volume of water required (L)
V = Total building volume (m3)
K = Water supply coefficient from Table 1
S_{tot} = Sotal of spatial coefficeint values from property line exposures on all sides as obtained from the formula

$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + S_{side4}]$

1	Type of construction	Building Classification		Water Supply Coefficient
	combustible without Fire-Resistance Ratings	A-2, B-1, B-2, B-3, C, D		23

2	Area of one floor (m^2)	number of floors	Avg. height of ceiling (m)	Total Building Volume (m^3)
	780.5	3	3.70	8,664

3	Side	Exposure Distance (m)	Spatial Coefficient	Total Spatial Coeffiecient
	North	20	0	1.75
	East	12	0	
	South	7	0.3	
	West	5.5	0.45	

4	Established Fire Safety Plan?	Reduction in Volume (%)		Total Volume Reduction
	no	0%		0%

5		**Total Volume 'Q' (L)**
		348,726
		Minimum Required Fire Flow (L/min)
		9,000

A.3 FIRE FLOW REQUIREMENTS

100 Lusk Street - Domestic Water Demand Estimates

- Based on N45 Architecture Inc. Site Plan (Feb 2020)

Demand conversion factors as per City Guidelines:

Commercial 28,000 L/ha-day

Building ID	Area (m^2)	Population	Daily Rate of Demand	Avg Day Demand		Max Day Demand [1]		Peak Hour Demand [2]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Commercial	1,895	-	2.8	3.7	0.06	5.5	0.09	9.9	0.17
Total Site :				**3.7**	**0.06**	**5.5**	**0.09**	**9.9**	**0.17**

For the purpose of this study it is predicted that retail and office facilities will be operated 12 hours per day.

Water demand criteria used to estimate peak demand rates for commercial areas are as follows:

1 maximum day demand rate = 1.5 x average day demand rate

2 peak hour demand rate = 1.8 x maximum day demand rate

Appendix B WASTEWATER SERVICING

B.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION:

Bluesky Medical Centre
100 Lusk

DATE: 7/2/2020
REVISION: 1
DESIGNED BY: WAJ
CHECKED BY: TKR

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401505

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	280 l/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	28,000 l/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 l/ha/day	MANNINGS n	0.013
PEAKING FACTOR (ICI >20%):	1.5	INDUSTRIAL (LIGHT)	35,000 l/ha/day	BEDDING CLASS	B
PERSONS / SINGLE	3.4	INSTITUTIONAL	28,000 l/ha/day	MINIMUM COVER	2.50 m
PERSONS / TOWNHOME	2.7	INFILTRATION	0.33 l/s/Ha	HARMON CORRECTION FACTOR	0.8
PERSONS / APARTMENT	1.8				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA	SINGLE	UNITS TOWN	APT	POP.	CUMULATIVE AREA	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	PEAK FLOW	TOTAL AREA	ACCU. AREA	INFILT. FLOW	FLOW	LENGTH	DIA	MATERIAL	CLASS	SLOPE	CAP. (FULL)	CAP. V PEAK FLOW	VEL. (FULL)	VEL. (ACT.)
			(ha)					(ha)			(l/s)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(l/s)	(ha)	(ha)	(l/s)	(l/s)	(m)	(mm)			(%)	(l/s)	(%)	(m/s)	(m/s)
C1A	BLDG	EX SAN	0.00	0	0	0	0	0.00	0	3.80	0.0	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2	0.40	0.40	0.13	0.33	8.2	100	PVC	DR 28	1.00	5.3	**6.13%**	0.67	0.30
	EX SAN	EX SAN	0.00	0	0	0	0	0.00	0	3.80	0.0	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2	0.00	0.40	0.13	0.33	11.7	250	PVC	SDR 35	0.25	30.3	**1.08%**	0.61	0.16
																												250							

Appendix C STORMWATER MANAGEMENT

C.1 STORM SEWER DESIGN SHEET

Stantec

Bluesky Medical Centre
100 Lusk

DATE: 2020-07-02
REVISION: 1
DESIGNED BY: WAJ
CHECKED BY: TKR

FILE NUMBER: **160401505**

STORM SEWER DESIGN SHEET
(City of Ottawa)

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
a =	732.951	998.071	1174.184	1735.688
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

MANNING'S n = 0.013 BEDDING CLASS = B
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min

LOCATION			DRAINAGE AREA																						PIPE SELECTION										
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETE (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
L101A, L101B, L101C	101	100	0.22	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.176	0.176	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	37.6	39.6	300	300	CIRCULAR	PVC	-	0.40	60.8	**61.89%**	0.86	0.79	0.83
																				10.83																		
BLDG	BLDG	100	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	3.8	3.8	3.8	5.8	150	150	CIRCULAR	PVC	-	1.00	15.3	**24.56%**	0.86	0.60	0.16
																				10.16																		
	100	EX STM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	10.83	73.74	99.98	117.18	171.27	0.0	3.8	39.9	17.0	300	300	CIRCULAR	PVC	-	0.40	60.8	**65.60%**	0.86	0.80	0.35
	EX STM	EX STM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	11.19	72.53	98.31	115.22	168.39	0.0	3.8	39.3	14.2	375	375	CIRCULAR	PVC	-	0.25	82.4	**47.68%**	0.78	0.66	0.36
																				11.55									375	375								

C.2 RATIONAL METHOD CALCULATIONS

Stormwater Management Calculations

File No: **160401505**
Project: **Bluesky Medical Centre**
Date: **12-May-20**

SWM Approach:
Post-development flows as per O'Keefe Court - 416 Lands Design Brief prepared by IBI dated January 2018

Post-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table

Catchment Type	Sub-catchment Area ID / Description		Area (ha) "A"		Runoff Coefficient "C"	"A x C"		Overall Runoff Coefficient
Roof	BLDG	Hard	0.080		0.9	0.072		
		Soft	0.000		0.2	0.000		
		Subtotal		0.08			0.072	0.900
Controlled - Tributary	L101C	Hard	0.098		0.9	0.088		
		Soft	0.022		0.2	0.004		
		Subtotal		0.12			0.0924	0.770
Controlled - Tributary	L101B	Hard	0.051		0.9	0.046		
		Soft	0.009		0.2	0.002		
		Subtotal		0.06			0.048	0.800
Controlled - Tributary	L101A	Hard	0.040		0.9	0.036		
		Soft	0.000		0.2	0.000		
		Subtotal		0.04			0.036	0.900
Uncontrolled - Non-Tributary	UNC-1	Hard	0.017		0.9	0.015		
		Soft	0.083		0.2	0.017		
		Subtotal		0.1			0.032	0.320
Total				**0.400**			**0.280**	
Overall Runoff Coefficient= C:								**0.70**

Total Roof Areas	**0.080 ha**
Total Tributary Surface Areas (Controlled and Uncontrolled)	**0.220 ha**
Total Tributary Area to Outlet	**0.300 ha**
Total Uncontrolled Areas (Non-Tributary)	**0.100 ha**
Total Site	**0.400 ha**

Stormwater Management Calculations

Project #160401505, Bluesky Medical Centre
Modified Rational Method Calculatons for Storage

2 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	732.951
b =	6.199
c =	0.81

t (min)	I (mm/hr)
10	76.81
20	52.03
30	40.04
40	32.86
50	28.04
60	24.56
70	21.91
80	19.83
90	18.14
100	16.75
110	15.57
120	14.56

2 YEAR Predevelopment Target Release from Portion of Site

Subdrainage Area: Tributary Area to Outlet
Area (ha): 0.4000
C: 0.80

Typical Time of Concentration

tc (min)	I (2 yr) (mm/hr)	Qtarget (L/s)
10	76.81	**68.33**

2 Year Release Rate Based on O'Keefe Court 416 Lands Design Brief by IBI Group, January 2018	= 69.0 L/s

2 YEAR Modified Rational Method for Entire Site

Subdrainage Area: BLDG
Area (ha): 0.08
C: 0.90

Maximum Storage Depth: Roof 150 mm

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	76.81	15.37	2.68	12.70	7.62	91.5	0.00
20	52.03	10.41	2.81	7.61	9.13	98.4	0.00
30	40.04	8.02	2.83	5.19	**9.34**	99.4	0.00
40	32.86	6.58	2.80	3.78	9.06	98.1	0.00
50	28.04	5.61	2.76	2.85	8.56	95.8	0.00
60	24.56	4.92	2.71	2.21	7.95	93.0	0.00
70	21.91	4.39	2.65	1.74	7.29	90.0	0.00
80	19.83	3.97	2.59	1.38	6.61	86.9	0.00
90	18.14	3.63	2.53	1.10	5.93	83.8	0.00
100	16.75	3.35	2.47	0.88	5.26	80.8	0.00
110	15.57	3.12	2.42	0.70	4.61	77.8	0.00
120	14.56	2.91	2.36	0.55	3.98	74.8	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	99.35	0.10	2.83	9.34	32.00	0.00

Subdrainage Area: L101C
Area (ha): 0.12
C: 0.77

Controlled - Tributary

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	19.73	12.31	7.42	**4.45**
20	52.03	13.37	12.31	1.06	1.27
30	40.04	10.29	10.29	0.00	0.00
40	32.86	8.44	8.44	0.00	0.00
50	28.04	7.20	7.20	0.00	0.00
60	24.56	6.31	6.31	0.00	0.00
70	21.91	5.63	5.63	0.00	0.00
80	19.83	5.09	5.09	0.00	0.00
90	18.14	4.66	4.66	0.00	0.00
100	16.75	4.30	4.30	0.00	0.00
110	15.57	4.00	4.00	0.00	0.00
120	14.56	3.74	3.74	0.00	0.00

Storage: Surface Storage Above CB

Orifice Size: LMF105
Invert Elevation 102.37 m
T/G Elevation 103.75 m
Max Ponding Depth 0.20 m
Downstream W/L 101.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Level	103.95	1.58	12.31	4.45	40.20	OK

Subdrainage Area: L101B
Area (ha): 0.06
C: 0.80

Controlled - Tributary

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	10.25	10.25	0.00	**0.00**
20	52.03	6.94	6.94	0.00	**0.00**
30	40.04	5.34	5.34	0.00	**0.00**
40	32.86	4.39	4.39	0.00	**0.00**
50	28.04	3.74	3.74	0.00	**0.00**
60	24.56	3.28	3.28	0.00	**0.00**
70	21.91	2.92	2.92	0.00	**0.00**
80	19.83	2.65	2.65	0.00	**0.00**
90	18.14	2.42	2.42	0.00	**0.00**
100	16.75	2.23	2.23	0.00	**0.00**
110	15.57	2.08	2.08	0.00	**0.00**
120	14.56	1.94	1.94	0.00	**0.00**

Project #160401505, Bluesky Medical Centre
Modified Rational Method Calculatons for Storage

100 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	1735.688
b =	6.014
c =	0.820

t (min)	I (mm/hr)
10	178.56
20	119.95
30	91.87
40	75.15
50	63.95
60	55.89
70	49.79
80	44.99
90	41.11
100	37.90
110	35.20
120	32.89

100 Year Target Release Rate = 69.0 L/s

100 YEAR Modified Rational Method for Entire Site

Subdrainage Area: BLDG
Area (ha): 0.08
C: 1.00

Maximum Storage Depth: Roof 150 mm

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	39.71	3.43	36.29	21.77	131.0	0.00
20	119.95	26.68	3.63	23.04	27.65	141.9	0.00
30	91.87	20.43	3.72	16.71	30.08	146.4	0.00
40	75.15	16.71	3.75	12.96	31.10	148.3	0.00
50	63.95	14.22	3.76	10.46	**31.38**	148.8	0.00
60	55.89	12.43	3.76	8.67	31.22	148.6	0.00
70	49.79	11.07	3.74	7.33	30.79	147.8	0.00
80	44.99	10.01	3.72	6.28	30.17	146.6	0.00
90	41.11	9.14	3.69	5.45	29.42	145.2	0.00
100	37.90	8.43	3.67	4.76	28.58	143.7	0.00
110	35.20	7.83	3.63	4.19	27.69	142.0	0.00
120	32.89	7.32	3.60	3.71	26.75	140.3	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	148.85	0.15	3.76	31.38	32.00	0.00

Subdrainage Area: L101C
Area (ha): 0.12
C: 0.96

Controlled - Tributary

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	57.33	12.31	45.03	27.02
20	119.95	38.51	12.31	26.21	**31.45**
30	91.87	29.50	12.31	17.19	30.94
40	75.15	24.13	12.31	11.82	28.37
50	63.95	20.54	12.31	8.23	24.68
60	55.89	17.95	12.31	5.64	20.30
70	49.79	15.99	12.31	3.68	15.45
80	44.99	14.45	12.31	2.14	10.26
90	41.11	13.20	12.31	0.89	4.82
100	37.90	12.17	12.17	0.00	0.00
110	35.20	11.30	11.30	0.00	0.00
120	32.89	10.56	10.56	0.00	0.00

Storage: Surface Storage Above CB

Orifice Size: LMF105
Invert Elevation 102.37 m
T/G Elevation 103.75 m
Max Ponding Depth 0.20 m
Downstream W/L 101.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Level	103.95	1.58	12.31	31.45	40.20	OK
					8.75	

Subdrainage Area: L101B
Area (ha): 0.06
C: 1.00

Controlled - Tributary

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	29.78	12.31	17.48	**10.49**
20	119.95	20.01	12.31	7.70	9.24
30	91.87	15.32	12.31	3.02	5.43
40	75.15	12.53	12.31	0.23	0.54
50	63.95	10.67	10.67	0.00	0.00
60	55.89	9.32	9.32	0.00	0.00
70	49.79	8.30	8.30	0.00	0.00
80	44.99	7.50	7.50	0.00	0.00
90	41.11	6.86	6.86	0.00	0.00
100	37.90	6.32	6.32	0.00	0.00
110	35.20	5.87	5.87	0.00	0.00
120	32.89	5.49	5.49	0.00	0.00

Stormwater Management Calculations

Project #160401505, Bluesky Medical Centre
Modified Rational Method Calculatons for Storage

Storage: Surface Storage Above CB

Orifice Size: LMF105
Invert Elevation 102.37 m
T/G Elevation 103.75 m
Max Ponding Depth 0.20 m
Downstream W/L 101.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Level	103.95	1.58	10.25	0.00	21.10	OK

Subdrainage Area: L101A — Controlled - Tributary
Area (ha): 0.04
C: 0.90

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	7.69	7.69	0.00	**0.00**
20	52.03	5.21	5.21	0.00	**0.00**
30	40.04	4.01	4.01	0.00	**0.00**
40	32.86	3.29	3.29	0.00	**0.00**
50	28.04	2.81	2.81	0.00	**0.00**
60	24.56	2.46	2.46	0.00	**0.00**
70	21.91	2.19	2.19	0.00	**0.00**
80	19.83	1.98	1.98	0.00	**0.00**
90	18.14	1.82	1.82	0.00	**0.00**
100	16.75	1.68	1.68	0.00	**0.00**
110	15.57	1.56	1.56	0.00	**0.00**
120	14.56	1.46	1.46	0.00	**0.00**

Storage: Surface Storage Above CB

Orifice Equation: Q = CdA(2gh)^0.5 — Where C = 0.61
Orifice Diameter: 83.00 mm
Invert Elevation 102.44 m
T/G Elevation 103.82 m
Max Ponding Depth 0.10 m
Downstream W/L 101.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Level	103.92	1.48	17.79	0.00	3.80	OK

Subdrainage Area: UNC-1 — Uncontrolled - Non-Tributary
Area (ha): 0.10
C: 0.32

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	76.81	6.83	6.83		
20	52.03	4.63	4.63		
30	40.04	3.56	3.56		
40	32.86	2.92	2.92		
50	28.04	2.49	2.49		
60	24.56	2.18	2.18		
70	21.91	1.95	1.95		
80	19.83	1.76	1.76		
90	18.14	1.61	1.61		
100	16.75	1.49	1.49		
110	15.57	1.39	1.39		
120	14.56	1.30	1.30		

SUMMARY TO OUTLET

Tributary Area	0.300	ha
Total 2yr Flow to Sewer	43.17	L/s
Non-Tributary Area	0.100	ha
Total 2yr Flow Uncontrolled	6.83	L/s
Total Area	0.400	ha
Total 2yr Flow	50.00	L/s
Target	69.00	L/s

Project #160401505, Bluesky Medical Centre
Modified Rational Method Calculatons for Storage

Storage: Surface Storage Above CB

Orifice Size: LMF105
Invert Elevation 102.37 m
T/G Elevation 103.75 m
Max Ponding Depth 0.20 m
Downstream W/L 101.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Level	103.95	1.58	12.31	10.49	21.10	OK
					10.61	

Subdrainage Area: L101A — Controlled - Tributary
Area (ha): 0.04
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	19.86	17.79	2.07	**1.24**
20	119.95	13.34	13.34	0.00	0.00
30	91.87	10.22	10.22	0.00	0.00
40	75.15	8.36	8.36	0.00	0.00
50	63.95	7.11	7.11	0.00	0.00
60	55.89	6.22	6.22	0.00	0.00
70	49.79	5.54	5.54	0.00	0.00
80	44.99	5.00	5.00	0.00	0.00
90	41.11	4.57	4.57	0.00	0.00
100	37.90	4.21	4.21	0.00	0.00
110	35.20	3.91	3.91	0.00	0.00
120	32.89	3.66	3.66	0.00	0.00

Storage: Surface Storage Above CB

Orifice Equation: Q = CdA(2gh)^0.5 — Where C = 0.61
Orifice Diameter: 83.00 mm
Invert Elevation 102.44 m
T/G Elevation 103.82 m
Max Ponding Depth 0.10 m
Downstream W/L 101.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Level	103.92	1.48	17.79	1.24	3.80	OK
					2.56	

Subdrainage Area: UNC-1 — Uncontrolled - Non-Tributary
Area (ha): 0.10
C: 0.40

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	19.86	19.86		
20	119.95	13.34	13.34		
30	91.87	10.22	10.22		
40	75.15	8.36	8.36		
50	63.95	7.11	7.11		
60	55.89	6.22	6.22		
70	49.79	5.54	5.54		
80	44.99	5.00	5.00		
90	41.11	4.57	4.57		
100	37.90	4.21	4.21		
110	35.20	3.91	3.91		
120	32.89	3.66	3.66		

SUMMARY TO OUTLET

Tributary Area	0.300	ha
Total 100yr Flow to Sewer	46.16	L/s
Non-Tributary Area	0.100	ha
Total 100yr Flow Uncontrolled	19.86	L/s
Total Area	0.400	ha
Total 100yr Flow	66.02	L/s
Target	69.00	L/s

Project #160401505, Bluesky Medical Centre
Roof Drain Design Sheet, Area BLDG
Standard Watts Model R1100 Accutrol Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0009	0	0.025	18	0	0	0.025
0.050	0.0006	0.0019	1	0.050	71	1	1	0.050
0.075	0.0008	0.0024	4	0.075	160	3	4	0.075
0.100	0.0009	0.0028	9	0.100	284	5	9	0.100
0.125	0.0011	0.0033	19	0.125	444	9	19	0.125
0.150	0.0013	0.0038	32	0.150	640	13	32	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
1.0	547.9	1.0	0.1522
3.9	1189.8	2.8	0.48268
9.3	1930.7	5.5	1.019
18.4	2728.4	9.0	1.77688
31.9	3561.4	13.5	2.76617

Rooftop Storage Summary

Total Building Area (sq.m)		800
Assume Available Roof Area (sq.	80%	640
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		3
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		32
Estimated 100 Year Drawdown Time (h)		2.7

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

From Watts Drain Catalogue

Head (m)	L/s Open	75%	**50%**	25%	Closed
0.025	0.3155	0.3155	**0.3155**	0.3155	0.3155
0.050	0.6309	0.6309	**0.6309**	0.6309	0.6309
0.075	0.9464	0.8675	**0.7886**	0.7098	0.6309
0.100	1.2618	1.1041	**0.9464**	0.7886	0.6309
0.125	1.5773	1.3407	**1.1041**	0.8675	0.6309
0.150	1.8927	1.5773	**1.2618**	0.9464	0.6309

* Note: Number of drains can be reduced if multiple-notch drain used.

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.003	0.004	-
Depth (m)	0.099	0.149	0.150
Volume (cu.m)	9.3	31.4	32.0
Draintime (hrs)	1.0	2.7	

Appendix D GEOTECHNICAL INVESTIGATION

Kollaard Associates
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June 17, 2013 130399

DCR Phoenix Homes
18 Bentley Avenue
Nepean, Ontario
K0A 2Z0

Attention: Mr. Mike Boucher

RE: ADDITIONAL GEOTECHNICAL GUIDELINES
PROPOSED CHANGE OF USE FROM RESIDENTIAL AND COMMERCIAL DEVELOPMENT TO BUSINESS PARK INDUSTRIAL ZONE
O'KEEFE COURT AND FALLOWFIELD ROAD
OTTAWA, ONTARIO

Dear Sirs:

This letter is intended to provide additional guidelines for the proposed development at the site between O'Keefe Court and Fallowfield Road in the City of Ottawa, Ontario further to the preliminary subsurface investigation in August 2006 and additional subsurface investigation in March 2008. Based on information provided by Ms. Meredith Lynes, a planner for MMM Group Limited, the proposed development for the site will change from residential and commercial development to commercial/business park development.

Kollaard Associates previously completed the preliminary subsurface investigation report and additional subsurface investigation letter for a development at the above location consisting of proposed residential and commercial development. Since the preparation of that report and letter, it is understood that revised plans for development have been made to consist of Commercial / Business Park Development, including office uses, hotel and associated secondary uses, and a place of worship. The proposed developments seek to include building structures between 4 to 12 storeys in height. In view of the proposed development changes, the City of Ottawa requested that a review of the geotechnical investigations provided by Kollaard Associates be carried out to verify if the proposed development changes might influence the conclusions of the geotechnical reports.

Soil Background Information

The results of the above mentioned preliminary subsurface investigation and additional subsurface investigation letter are provided in the Kollaard Associates Inc. Report No. 060445, entitled "Preliminary Subsurface Investigation, Proposed Residential and Commercial Development, O'Keefe Court and Fallowfield Road, Ottawa, Ontario", dated August 2006 and Additional Subsurface Investigation, Report No. 080069, Proposed Residential and Commercial Development, O'Keefe Court and Fallowfield Road, Ottawa, Ontario, dated March 5, 2008 should be read in conjunction with this present letter. That report and letter indicate, in general, the site is underlain by shallow bedrock, glacial till and silty clay. Based on the results of the test pits and boreholes put down at the site for the investigations, the silty clay is stiff to very stiff in consistency. Beneath the silty clay, both boreholes encountered a deposit of glacial till. The glacial till is in a loose to compact state of packing. Refusal to auger advancement and/or practical refusal was encountered on the surface of bedrock or on large boulders within the boreholes and test pits at depths ranging between about 1.3 to 5.5 metres below the existing ground surface.

Geotechnical Considerations

A review of a planning rationale for this project was provided by Ms. Meredith Lynes, planner for MMM Group Limited. The planning rationale illustrated a proposed plan of subdivision along with a height strategy figure that identifies proposed building heights within each proposed lot within the business park. The review of the planning rationale provided general development information that could influence design considerations from a geotechnical point of view.

As such, Kollaard Associates considers that the following letter provide supplemental Geotechnical Guidelines for the proposed changes to the development at the above noted site.

Proposed Commercial / Business Park Development

Foundations for Proposed Commercial Buildings

From a geotechnical point of view, with the exception of the fill materials and topsoil, the subsurface conditions, in general, encountered at the test pits and boreholes advanced during the investigations are suitable for the support of the proposed commercial buildings on conventional spread footing foundations bearing on either the overburden or the underlying bedrock. It is considered that the excavations for the foundations should be taken down through any surficial fill, topsoil or otherwise deleterious material to expose the undisturbed silty clay, glacial till and/or bedrock.

For the proposed commercial buildings founded beneath the fill and topsoil on the undisturbed native silty clay or glacial till a maximum allowable bearing pressure of 150 kilopascals for serviceability limit states and 350 kilopascals for the factored ultimate bearing resistance.

For the proposed commercial buildings founded beneath the fill and topsoil on the undisturbed bedrock or on engineered fill placed on bedrock an allowable bearing pressure of 500 to 800 kilopascals for serviceability limit states and 1500 kilopascals for the factored ultimate bearing resistance may be used for both strip and pad footings.

As the types of developments and foundation requirements have not been determined at this stage, These preliminary allowable bearing pressures and factored ultimate bearing resistances are subject to changed with more detailed, site specific geotechnical investigations for site specific design purposes.

Seismic Design for the Proposed Commercial Buildings

Based on the limited information from the test pits and the boreholes put down at the site and from information obtained from adjacent sites, for seismic design purposes, in accordance with the 2006 OBC Section 4.1.8.4, Table 4.1.8.4.A., the site classification for seismic site response is Site Class A or B. For building permit application purposes, site specific investigations should be carried out to confirm the seismic site response for each lot.

Site Services
No changes

Roadways
No changes

Construction Considerations
No changes

Conclusions

In summary, Kollaard Associates has considered the proposed changes to the development as indicated by MMM Group Limited from a geotechnical point of view. Kollaard Associates considers the proposed Commercial / Business Park Development is feasible from a geotechnical point of view. Kollaard Associates strongly suggests that additional subsurface investigations be carried out on a site per site basis for the final design of each of the proposed buildings.

We trust this letter provides sufficient information for your purposes. If you have any questions concerning this letter please do not hesitate to contact our office.

Yours truly,

Kollaard Associates Inc.

Dean Tataryn, B.E.S, EP.

Reviewed by Steve deWit, P. Eng.

14712 3.9

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August 10, 2006

060445

Phoenix Homes
18 Bentley Avenue
Nepean, Ontario
K2E 6T8

Attention: Mr. Bill Buchanan

RE: PRELIMINARY SUBSURFACE INVESTIGATION
PROPOSED RESIDENTIAL AND
COMMERCIAL DEVELOPMENT
O'KEEFE COURT AND FALLOWFIELD ROAD
OTTAWA, ONTARIO

Dear Sirs:

This report presents the results of a preliminary subsurface investigation carried out at the site of the proposed residential and commercial development between O'Keefe Court and Fallowfield Road in the City of Ottawa, Ontario. The purpose of the investigation was to determine the general subsurface conditions at the site by means of a limited number of test pits and, based on the factual information obtained, to provide engineering guidelines on the geotechnical aspects of the preliminary design of the project, including construction considerations, which could influence design decisions.

PROJECT DESCRIPTION AND SITE

The development site in question consists of about a 10 hectare, triangular shaped property located on the south side of O'Keefe Court and bordered on the southeast and southwest by Fallowfield

Road, in the City of Ottawa, Ontario (see Key Plan, Figure 1). It is understood that a yet determined portion of the site will be developed for the construction of single family dwellings and/or rowhouses with the remaining portion used for commercial development. The dwellings are likely to be of wood frame construction with full depth conventional concrete foundations. Details regarding the proposed commercial development at the site was not available at the time of this report. The development will be provided with full municipal services and local roadways.

The ground surface across the site is relatively flat with most of the site being open grassed fields with scattered young trees and shrubs. Wooded areas exist at the west end of the site and in the central portion of the site near the south property line. A water course runs north/south through about the middle of the site

Based on a review of the surficial geology map for the site area and the results of previous geotechnical investigations carried out in proximity of the site, it is expected that the site is underlain by glacial till deposits in the east portion and marine deposited sensitive silty clay over glacial till in the west.

SUBSURFACE INVESTIGATION

The fieldwork for this investigation was carried out on July 7, 2006 at which time twenty test pits were put down across the site. The test pits were advanced to depths of some 0.6 to 3.8 metres below the existing ground surface. The subsurface conditions encountered in the test pits were classified based on visual and tactile examination of the materials exposed on the sides and bottom of the test pits. In situ vane shear testing was carried out within the softer portions of silty clay material encountered to measure the undrained shear strength of that material. The groundwater conditions were observed in the open test pits at the time of excavating.

The field work was supervised throughout by a member of our field engineering staff who directed the test pitting operation, cared for the samples obtained and logged the test pits.

A detailed account of the subsurface conditions encountered at each of the test pits is provided in the attached Table I Record of Test Pits following the text of this report. The approximate locations of the test pits are shown on the Site Plan, Figure 2.

SUBSURFACE CONDITIONS

General

As previously indicated, the soil and groundwater conditions encountered at the test pits put down for this investigation are given in Table 1 Record of Test Pits following the text of this report. The test pit logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. Subsurface conditions at other than the test pit locations may vary from the conditions encountered in the test pits. In addition to soil and bedrock variability, fill of variable physical and chemical composition may be present over portions of the site.

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

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

The following presents an overview of the subsurface conditions encountered in the test holes advanced during this investigation.

Fill

Test pits 8 to 20 inclusive encountered a layer of fill from the surface. At the test pit locations the fill is some 0.3 to 2.7 metres in thickness and in general consists of grey brown silty clay, sand, gravel, and cobbles with topsoil, concrete, asphaltic concrete, bricks and wire.

Topsoil

From the surface or beneath the fill materials all of the test pits except test pits 8 and 9 encountered a layer of topsoil. The topsoil thickness varies across the site and ranges in thickness from about 0.1 to 0.5 metres at the test pit locations. The material was classified as topsoil based on colour and the presence of organic materials and is intended as identification for geotechnical purposes only and does not constitute a statement as to the suitability of this layer for cultivation and sustaining plant growth.

Sand/Silty Sand

Beneath the fill materials or topsoil, test pits 4, 5, 6, 7 and 14 encountered a layer of red brown to yellow brown sand to silty sand. The sand/silty sand layer is some 0.4 to 0.7 metres in thickness at the test pits. The sand/silty sand layer was full penetrated at the test pit locations at depths of some 0.7 to 1.8 metres below the existing ground surface.

Silty Clay

A deposit of grey brown to grey silty clay was encountered beneath the fill, topsoil, sand and/or silty sand at test pits 2, 3 and 9 to 19 inclusive. Where fully penetrated at test pits 2, 3, 10 and 19 the silty clay deposit is some 0.2 to 1.5 metres in thickness. Test pits 9 and 11 to 18 were terminated in the silty

clay material at depths of some 3.2 to 3.8 metres below the existing ground surface. In situ vane shear tests were carried out in the softer silty clay material encountered and gave undrained shear strength values ranging from 52 to 110 kilopascals indicating a stiff to very stiff consistency.

Glacial Till

Beneath the fill, topsoil, sands and/or silty clay test pits 1 to 8 inclusive and 10, 19 and 20 encountered a deposit of yellow brown to grey brown glacial till. The glacial till consists of gravel, cobbles and

boulders in a matrix of silty sand with a trace to some clay. All of the test pits, except test pit 8, were terminated in the glacial till at depths of some 1.3 to 3.3 metres below the existing ground surface. Based on tactile examination of the glacial till in the walls and bottom of the test pits and on the difficulty to advance the test pits in the glacial till it is considered that the glacial till is in a compact to dense state of packing.

Bedrock

Bedrock was encountered beneath the glacial till at test pit 8 at a depth of about 0.6 metres below the existing ground surface.

Groundwater

Seepage was encountered into most of the test pits during excavating on July 7, 2006 at depths of about 1.4 to 3.3 metres below the existing ground surface. It should be noted that the groundwater levels may be higher during wet periods of the year such as the early spring.

PROPOSED RESIDENTIAL AND COMMERCIAL DEVELOPMENT

General

This section of the report provides engineering guidelines on the geotechnical aspects of the project based on our interpretation of the test hole information and project requirements. It is stressed that the information in the following sections is provided for the guidance of the designers for the preliminary design of the project and is intended for this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface

contamination resulting from previous uses or activities at this site or adjacent properties, and/or resulting from the introduction onto the site from materials from off site sources are outside the terms of reference for this report and have not been investigated or addressed.

Foundations for Proposed Rowhouses, Single Family Dwellings and Commercial Buildings

From a geotechnical point of view with regards to preliminary foundation design, the site can be divided into three areas: east, central and west, respectively. The east and west areas are represented by test pits 1 to 8 , 10, 19 and 20. The east and west areas are underlain by native materials consisting of relatively thin layers of sands and silty clay overlying glacial till or bedrock. The central area is represented by test pits 9 and 11 to 18. The central area is underlain by a significant layer of fill materials together with a deposit of silty clay. Due to the combined thickness of the fill materials and silty clay deposit the total thickness of the silty clay was not penetrated at the test pits in the central area.

East and West Areas

For the proposed rowhouses, single family dwellings and light commercial buildings founded beneath the fill and topsoil in the undisturbed, sands, silty clay, glacial till or bedrock, or on engineered fill used to replace existing fill materials, a maximum allowable bearing pressure of 150 kilopascals may be used for preliminary design of footings using the total dead and live loads which will be carried by the footings. Provided that any loose and disturbed soil is removed from the bearing surfaces prior to pouring concrete, the settlement of the footings should be less than 25 millimetres.

No grade raise restrictions adjacent to foundations or limit for footing size are necessary for the east and west areas from a geotechnical point of view.

For seismic design purposes for the east and west areas a foundation factor, F, of 1.0 should be used in accordance with the 1997 OBC Section 4.1.9.1, Table 4.1.9.1.C.

Central Area

The central area is characterized by a surficial layer of fill materials typically some 1.0 to 2.7 metres in thickness and an underlying deposit of silty clay of unknown total thickness. For areas underlain by silty clay it is usual that footing size and the height of landscape fill adjacent to foundations would be restricted and that the allowable bearing pressure for foundation design would be limited. The limited information obtained from the test pits indicate that the silty clay deposit within the central area is stiff to very stiff in consistency and based on that information the design of foundations would be similar as indicated above for the east and west areas. However, in view of the unknown depth of the silty clay deposit and that silty clay deposits typically decrease in strength with depth, it is possible that firm to soft silty clay exists within the central area. Should soft to firm silty clay exist, it will likely have a restrictive affect on the design of foundations and allowable landscape grade raises adjacent to foundations within the central area Accordingly, it is considered that information on the

thickness and consistency of the silty clay deposit within the central area should be determined prior to final design planning.

All exterior footings and those in any unheated parts of the structures at this site should be provided with at least 1.5 metres of earth cover for normal frost protection purposes. Where it is not possible to provide at least 1.5 metres of earth cover, frost protection should be provided with the use of a suitable rigid insulation. All structures with a basement should be provided with a conventional, perforated perimeter exterior drain within a 150 millimetre thick surround of 20 millimetre minus crushed stone installed at founding level and positively drained to a storm sewer.

For predictable performance of concrete floor slabs on grade all exiting fill and topsoil and any deleterious materials should be removed from within the proposed building areas. The subgrade should then be inspected by geotechnical personnel and any soft of loose areas observed should be subexcavated and replaced with suitable granular materials. Material used to raise the approved subgrade to within 150 millimetres of the underside of the concrete slab should consist of sand or sand and gravel meeting the Ontario Provincial Standards Specifications (OPSS) for Granular B Type I or crushed stone meeting OPSS grading requirements for Granular B Type II. A 150 millimetre base course of OPSS Granular A should be provided immediately beneath the floor slab. All of the granular materials should be placed in maximum 250 millimetre thick loose lifts and be compacted to at least 95 percent of the standard Proctor maximum dry density for the materials used.

The native soils at this site are considered to be highly frost susceptible. As such, to prevent possible foundation frost jacking, the backfill against unheated walls or isolated walls or piers should consist of free draining, non-frost susceptible material such as sand or sand and gravel meeting OPSS

Granular B Type I grading requirements. Alternatively, foundations could be backfilled with native material in conjunction with the use of an approved proprietary drainage layer system against the foundation wall. It is pointed out that there is potential for possible frost jacking of the upper portion of some types of these drainage layer systems if frost susceptible material is used as backfill. This

could be mitigated by using non-frost susceptible granular material for the upper about 0.6 metre portion of backfill.

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

In view of the substantial thickness of the existing fill materials at the site, it is expected that engineered fill will be required to replace the existing fill and raise the subgrade to proposed footing founding levels. In preparation for engineered fill construction all of the existing fill and topsoil, and any alluvium (in the area of the existing water course), should be removed to expose the underlying undisturbed native sand, silty clay or glacial. The engineered fill should consist of crushed stone meeting OPSS requirements for Granular A or Granular B Type II and should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. To allow the spread of load beneath the footings, the engineered fill should extend down and out from the edges of the footings at 1 horizontal to 1 vertical, or flatter. The excavations for the structures should be sized to accommodate this fill placement. Currently, OPSS documents allow recycled asphaltic concrete to be used in Granular A and Granular B Type II materials. Since the source of recycled material cannot be determined, it is suggested that any granular materials used below founding level be composed of virgin material only.

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

SITE SERVICES

Excavation

The excavations for the site services will be carried out through fill, topsoil, sands, silty clay, glacial till and depending on depths, possibly bedrock. The sides of the excavations in overburden materials

should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Ontario Occupational Health and Safety Act. That is, open cut excavations within overburden deposits should be carried out with side slopes of 1 horizontal to 1 vertical, or flatter. Where space constraints dictate, the excavation and backfilling operations should be carried out within a tightly fitting, braced steel trench box. If excavations extend below the water table in silty sand or sandy soil, some loss of ground and groundwater inflow may occur, requiring flatter side slopes to be used. Cobbles and boulders, some of which could be large may exist within the glacial till.

Bedrock was encountered in test pit 8 at about 0.6 metres depth and practical refusal was encountered in most of the test pits in the east area of the site at depths of about 2.6 to 3.1 metres below the existing ground surface. As such, it is expected that bedrock may be encountered during excavating for site services. Small amounts of bedrock removal, if required, can most likely be carried out by hoe ramming. If larger amounts of bedrock removal are required it may be more economically feasible to use drill and blasting techniques and should be carried out under the supervision of a blasting specialist engineer. Monitoring of the blasting should be carried out throughout the blasting period to ensure that the blasting meets the limiting vibration criteria established by the specialist engineer. Pre-blast condition surveys of nearby structures and existing utilities are essential.

Groundwater seepage into the excavations, if any, should be handled by pumping from sumps in the excavation.

Pipe Bedding and Cover Materials

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

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of granular material, such as OPSS Granular A or Granular B Type I (with a maximum particle size of 25 millimetres).

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

Trench Backfill

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

In areas where the service trench will be located below or in close proximity to existing or future roadway areas, acceptable native materials should be used as backfill between the roadway subgrade level and the depth of seasonal frost penetration (i.e., 1.8 metres below finished grade) in order to reduce the potential for differential frost heaving between the area over the trench and the adjacent section of roadway. Where native backfill is used, it should match the native materials exposed on the trench walls. Backfill below the zone of seasonal frost penetration could consist of either acceptable native material or imported granular material conforming to OPSS Granular B Type I. In general, the existing fill materials could be used as trench backfill provided all deleterious materials such as any soft clay, topsoil, large boulders, asphaltic concrete , wood, wire, styrofoam, etc. are culled prior to use.

The silty clay and glacial till overburden deposits at this site are sensitive to changes in moisture content. In addition, some of the native materials from the lower part of the trench excavations may be wet of optimum for compaction. Depending on the weather conditions encountered during construction, some drying of materials and/or recompaction may be required. Any wet materials

that cannot be compacted to the required density should either be wasted from the site or should be used outside of existing or future roadway areas.

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

The permanent lowering of the groundwater level at the site can be caused by drainage through the granular bedding/backfill within the sewer trenches. Groundwater lowering can cause stress within any softer silty clay materials which may underlie a portion of the site and in turn result in settlement of underlying footings/foundations. To minimize the possibility of groundwater lowering at this site due to the presence of the proposed sewers, it is considered that clay dykes should be provided within sewer trenches at about 150 metre spacing. Details for construction of the proposed clay dykes are shown in the attached Figure 3.

ROADWAYS

Subgrade Preparation

In preparation for roadway construction, the topsoil and any soft, wet or deleterious material should be removed from the roadway area. It may be possible to leave in place any existing fill materials provided that they do not contain significant amounts of organic or deleterious materials and that the materials have been inspected and approved by the geotechnical engineer. The subgrade surface should then be proof rolled with a large steel drum roller and inspected and approved by geotechnical personnel. Any soft areas evident from the proof rolling should be subexcavated and replaced with suitable earth borrow material.

Fill sections along the proposed roadway should be brought up to proposed roadway subgrade level using acceptable earth borrow material. The earth borrow 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 subgrade surface should be shaped and crowned to promote drainage of the roadway granulars.

Pavement Structure

It is suggested that provision be made for the following minimum pavement structure for local residential roadways:

80 millimetres of Asphaltic Concrete
(40 millimetres of HL3 over 40 millimetre of HL8), over

150 millimetres of OPSS Granular A base, over

300 millimetres of OPSS Granular B Type II subbase
(50 or 100 millimetre minus crushed stone)

Where the pavement structure will carry buses or heavy truck traffic, the subbase thickness should be increased to 450 millimetres and the asphaltic concrete thickness increased to 100 millimetres.

The pavement granular materials should be compacted in maximum 300 millimetre thick lifts to at least 100 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment.

In areas where the new pavement will abut existing pavement, the depths of the granular materials should taper up or down at 5 horizontal to 1 vertical, or flatter, to match the depths of the granular material(s) exposed in the existing pavement.

The above pavement structure assumes that the trench backfill is adequately compacted and that the roadway subgrade surface is prepared as described in this report. If the roadway subgrade surface is disturbed or wetted due to construction operations or precipitation, the granular thicknesses given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type II subbase and/or to incorporate a non-woven geotextile separator between the roadway subgrade surface and the granular subbase material. The adequacy of the design pavement thickness should be assessed by geotechnical personnel at the time of construction.

TREE PLANTING

It should be noted that any soft silty clay soils at the site are highly sensitive to water depletion by trees of high water demand during periods of dry weather. When trees draw water from the silty clay, the silty clay undergoes shrinkage which can result in settlement of adjacent structures. The zone of influence of a tree is considered to be approximately equal to the mature height of the tree. Therefore trees, which have a high water demand, should not be planted closer to structures than the ultimate height of the trees. Table II provides a list of the common trees in decreasing order of water demand and, accordingly, decreasing risk of potential effects on structures.

WATER COURSE SLOPE STABILITY EVALUATION

As mentioned above a water course exists running north/south through about the centre of the site. A reconnaissance of the slopes of the water course was carried out to observe the general condition of the slopes. At the time of the reconnaissance visit the height and inclination of the water course slopes were measured using a hand clinometre and level and the degree of erosion of the water course channel was observed. The results of the measurements indicate that the water course slopes are typically some 3.5 metres high and inclined at about 10 to 15 degrees to the horizontal on the east side and some 2. metres high and inclined at about 10 to 12 degrees to the horizontal on the west side The water course channel walls are near vertical and some 1 to 1.5 metres high. A relatively wide flood plain exists between the water course channel and the toe of the slopes. The slopes

including the relatively steep water course channel walls are well vegetated. Some minor localized erosion of the water course channel walls was observed.

Based on the results of the slope reconnaissance it is considered that the water course side slopes are stable and have a factor of safety greater than 1.5. In view of the stable condition of the slopes and the minor erosion conditions, no construction set back from the crest of the existing water course slopes is considered necessary for the design of the proposed development.

ADDITIONAL INVESTIGATION AND CONSTRUCTION OBSERVATIONS

As indicated above it is considered that the central portion of the site may be underlain by softer silty clay materials. Accordingly, prior to final design planning it is strongly suggested that additional subsurface investigation be carried out by means of a series of boreholes to determine if any soft or firm silty clay exists at depth in the central area of the site.

In view of the relatively wide spacing between test pits and the substantial thickness of fill encountered at the site, it is suggested that additional site specific investigations be carried out for the final design of each of the proposed commercial buildings.

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

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

The subgrade surfaces for the site services and roadways should be inspected by geotechnical personnel. In situ density testing should be carried out on the service pipe bedding and backfill and the roadway granular materials.

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

We trust that this report provides sufficient information for your present purposes. If you have any questions concerning this information or if we can be of further assistance to you for the final design investigations at this site, please do not hesitate to contact our office.

Yours truly,

KOLLAARD ASSOCIATES INC.

REGISTERED PROFESSIONAL ENGINEER
C. R. MOREY
PROVINCE OF ONTARIO

C.R. Morey, P. Eng.

Attachments: Table I, Record of Test pits
Table II, Order of Water Demand for Common Trees
Figures 1 to 3

TABLE I

RECORD OF TEST PITS
PRELIMINARY GEOTECHNICAL INVESTIGATION
O'KEEFE COURT
CITY OF OTTAWA, ONTARIO

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP1	0.00 – 0.30	TOPSOIL
	0.30 – 1.32	Grey brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)
	1.32	End of test pit
Test pit dry, July 7, 2006.		
TP2	0.00 – 0.33	TOPSOIL
	0.33 – 0.76	Very stiff grey brown SILTY CLAY
	0.76 – 2.80	Grey brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)
	2.80	End of test pit, refusal on large boulder or bedrock
Water observed in test pit at about 2.8 metres below existing ground surface, July 7, 2006.		
TP3	0.00 – 0.38	TOPSOIL
	0.38 – 0.69	Very stiff grey brown SILTY CLAY
	0.69 – 2.60	Grey brown silty sand, gravel, cobbles, trace clay (GLACIAL TILL)
	2.60	End of test pit, refusal on large boulder or bedrock
Water observed in test pit at about 2.0 metres below existing ground surface, July 7, 2006.		

TABLE I (CONTINUED)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP4	0.00 – 0.33	TOPSOIL
	0.33 – 0.74	Red brown SILTY SAND, some gravel, trace clay
	0.74 – 3.10	Grey brown silty sand, some gravel, cobbles, trace clay (GLACIAL TILL)
	3.10	End of test pit, refusal on large boulder or bedrock

Water observed in test pit at about 2.1 metres below existing ground surface, July 7, 2006.

TP5	0.00 – 0.30	TOPSOIL
	0.30 – 1.02	Red brown to yellow brown SILTY SAND, trace gravel
	1.02 – 3.00	Grey brown silty sand, some gravel, cobbles, boulders, trace clay (GLACIAL TILL)
	3.00	End of test pit, refusal on large boulder or bedrock

Water observed in test pit at about 1.4 metres below existing ground surface, July 7, 2006.

TP6	0.00 – 0.30	TOPSOIL
	0.30 – 1.00	Red brown fine SAND, trace silt, some gravel
	1.00 – 2.80	Grey brown silty sand, some gravel, cobbles (GLACIAL TILL)
	2.80	End of test pit, refusal on large boulder or bedrock

Test pit dry, July 7, 2006.

TABLE I (CONTINUED)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP7	0.00 – 0.36	TOPSOIL
	0.36 – 0.79	Red brown fine SAND, trace gravel
	0.79 – 2.70	Grey brown silty sand, some gravel (GLACIAL TILL)
	2.70	End of test pit, refusal on large boulder or bedrock
Test pit dry, July 7, 2006.		
TP8	0.00 – 0.61	Topsoil, gravel, wire, asphaltic concrete (FILL)
	0.61	Refusal, BEDROCK
Test pit dry, July 7, 2006.		
TP9	0.00 – 0.28	Topsoil, gravel, cobbles, styrofoam, wood, clay tile, brick, asphaltic concrete, boulders (FILL)
	0.28 – 3.60	Very stiff grey brown SILTY CLAY
	3.60	End of test pit
Test pit dry, July 7, 2006.		

TABLE I (CONTINUED)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP10	0.00 – 2.30	Grey brown silty clay, some topsoil, gravel, boulders, concrete, asphaltic concrete (FILL)
	2.30 – 2.40	TOPSOIL
	2.40 – 2.60	Very stiff grey brown SILTY CLAY
	2.60 – 3.30	Grey brown silty clay, some gravel, boulders (GLACIAL TILL)
	3.30	End of test pit

Test pit dry, July 7, 2006.

TP11	0.00 – 1.80	Grey brown silty clay, gravel, cobbles (FILL)
	1.80 – 1.90	TOPSOIL
	1.90 – 3.60	Very stiff grey brown SILTY CLAY
	3.60	End of test pit

Water observed in test pit at about 3.3 metres below existing ground surface, July 7, 2006.

TP12	0.00 – 2.74	Topsoil, clay, gravel, asphaltic concrete (FILL)
	2.74 – 2.90	TOPSOIL
	2.90 – 3.80	Stiff grey SILTY CLAY
	3.80	End of test pit

In Situ Undrained Shear Strength Test Results

Depth (metres)	Cu (kilopascals)
2.90	52

Water observed in test pit at about 3.5 metres below existing ground surface, July 7, 2006.

TABLE I (CONTINUED)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP16	0.00 – 2.13	Topsoil, sand, clay, gravel, asphaltic concrete (FILL)
	2.13 – 2.44	TOPSOIL
	2.44 – 3.30	Stiff grey SILTY CLAY
	3.30	End of test pit

In Situ Undrained Shear Strength Test Results

Depth (metres)	Cu (kilopascals)
2.44	90

Water observed in test pit at about 2.7 metres below existing ground surface, July 7, 2006.

TP17	0.00 – 2.13	Grey brown silty sand, topsoil, cobbles, asphaltic concrete, wire, concrete, glass (FILL)
	2.13 – 2.44	TOPSOIL
	2.44 – 3.20	Grey SILTY CLAY
	3.20	End of test pit

Water observed in test pit at about 2.7 metres below existing ground surface, July 7, 2006.

TP18	0.00 – 2.13	Topsoil, clay, gravel, cobbles, boulders (FILL)
	2.13 – 2.60	TOPSOIL
	2.60 – 3.40	Grey SILTY CLAY
	3.40	End of test pit

Water observed in test pit at about 2.4 metres below existing ground surface, July 7, 2006.

TABLE I (CONTINUED)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP13	0.00 – 1.90	Grey brown silty clay, topsoil, asphaltic concrete, brick (FILL)
	1.90 – 2.20	TOPSOIL
	2.20 – 3.50	Very stiff grey brown SILTY CLAY
	3.50	End of test pit

Water observed in test pit at about 2.6 metres below existing ground surface, July 7, 2006.

TP14	0.00 – 1.02	Topsoil, gravel, clay, asphaltic concrete, wood, brick (FILL)
	1.02 – 1.22	TOPSOIL
	1.22 – 1.83	Grey brown fine to medium SAND
	1.83 – 3.30	Very stiff grey brown SILTY CLAY
	3.30	End of test pit

Water observed in test pit at about 1.5 metres below existing ground surface, July 7, 2006.

TP15	0.00 – 2.10	Topsoil, clay, gravel, boulders, brick (FILL)
	2.10 – 2.20	TOPSOIL
	2.20 – 3.40	Very stiff grey SILTY CLAY
	3.40	End of test pit

In Situ Undrained Shear Strength Test Results

Depth (metres)	Cu (kilopascals)
3.40	110

Water observed in test pit at about 3.0 metres below existing ground surface, July 7, 2006.

TABLE I (CONTINUED)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP19	0.00 – 1.22	Topsoil, sand, clay, gravel, boulders, wood (FILL)
	1.22 – 1.52	TOPSOIL
	1.52 – 2.01	Very stiff grey brown SILTY CLAY
	2.01 – 3.30	Grey brown silty sand, some clay, gravel, cobbles, boulders (GLACIAL TILL)
	3.30	End of test pit

Water observed in test pit at about 2.1 metres below existing ground surface, July 7, 2006.

TP20	0.00 – 0.48	Topsoil, gravel (FILL)
	0.48 – 0.79	TOPSOIL
	0.79 – 2.40	Yellow brown to grey brown silty sand, gravel, cobbles, trace clay (GLACIAL TILL)
	2.40	End of test pit

Test pit dry, July 7, 2006.

TABLE II

ORDER OF WATER DEMAND FOR COMMON TREES

Some common trees in decreasing order of water demand:

Broad Leaved Deciduous

Poplar
Alder
Aspen
Willow
Elm
Maple
Birch
Ash
Beech
Oak

Deciduous Conifer

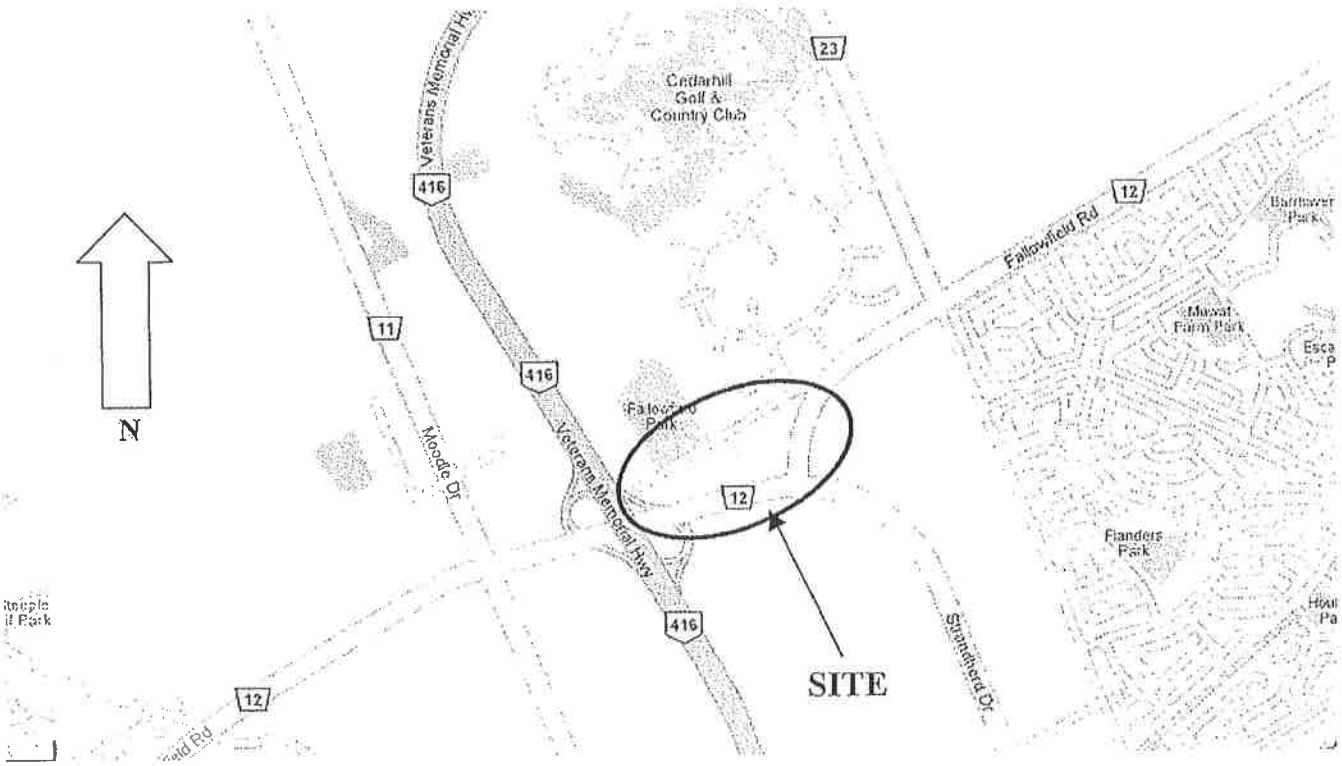
Larch

Evergreen Conifers

Spruce
Fir
Pine

KEY PLAN

FIGURE 1



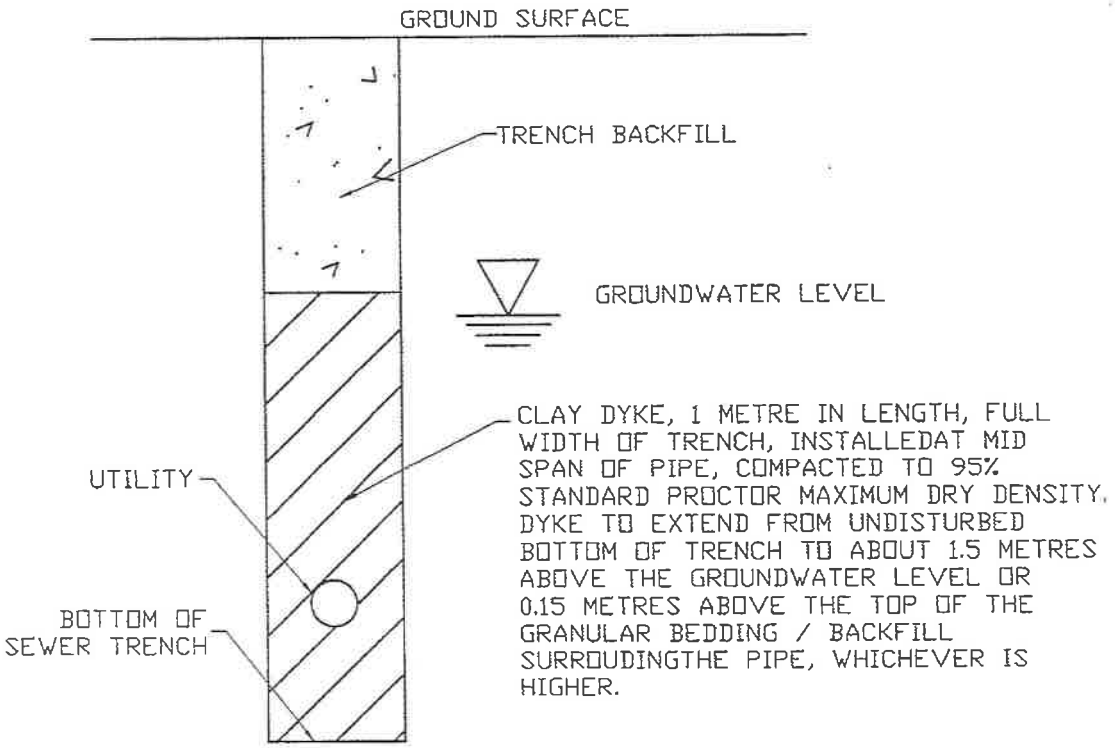
NOT TO SCALE

Kollaard Associates
Engineers

Project No. 060445

Date August 2006

FIGURE 3



REV.	NAME	DATE	DESCRIPTION

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K0G 1J0 FAX (613) 258-0475
http://www.kollaard.ca
(613) 860-0923
info@kollaard.ca

CLIENT: PHOENIX HOMES

PROJECT: GEOTECHNICAL INVESTIGATION

LOCATION: O'KEEFE COURT AND FALLOWFIELD ROAD OTTAWA, ONTARIO

DESIGNED BY:	DATE:
DM	AUGUST 2006
DRAWN BY:	SCALE:
DM	NTS

KOLLAARD FILE NUMBER: 060445

FIGURE 2

LEGEND

Approximate Test Pit Location

Plan supplied by City of Ottawa mapping website.

REV.	NAME	DATE	DESCRIPTION

Kollaard Associates Engineers

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CLIENT: PHOENIX HOMES

PROJECT: PRELIMINARY GEOTECHNICAL INVESTIGATION

LOCATION: O'KEEFE COURT CITY OF OTTAWA ONTARIO

DESIGNED BY:	DATE:
DT	JULY 28, 2005
DRAWN BY:	SCALE:
DM	1:2500

KOLLAARD FILE NUMBER: 050445

Kollaard Associates
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215 Sanders Street, Unit 1
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Civil • Geotechnical •
Structural • Environmental •
Industrial Health & Safety
(613) 860-0923
FAX: (613) 258-0475

March 5, 2008

080069

Phoenix Homes
18 Bentley Avenue
Nepean, Ontario
K2E 6T8

Attention: Mr. Bill Buchanan

RE: ADDITIONAL SUBSURFACE INVESTIGATION
PROPOSED RESIDENTIAL AND
COMMERCIAL DEVELOPMENT
O'KEEFE COURT AND FALLOWFIELD ROAD
OTTAWA, ONTARIO

Dear Sirs:

This letter presents the results of an additional subsurface investigation carried out at the site of the proposed residential and commercial development between O'Keefe Court and Fallowfield Road in the City of Ottawa, Ontario further to the preliminary subsurface investigation carried out at the site by Kollaard Associates Inc. in August 2006. The purpose of this present investigation was to check for the presence of any firm to soft silty clay in the area of the site identified during the preliminary subsurface investigation as underlain by a silty clay deposit.

BACKGROUND

The results of the above mentioned preliminary subsurface investigation are provided in the Kollaard Associates Inc. Report No. 060445, entitled "Preliminary Subsurface Investigation, Proposed Residential and Commercial Development, O'Keefe Court and Fallowfield Road, Ottawa, Ontario" dated August 2006. That report should be read in conjunction with this present letter.

A series of some 20 test pits were put down at the site for the previous subsurface investigation. Nine of those test pits, numbered 9 and 11 to 18, put down within the "central" portion of the site encountered silty clay material and were terminated in the silty clay at depths of some 3.2 to 3.8 metres below the existing ground surface. Although, the silty clay material is stiff in consistency to the depth encountered at the test pits, in view that the full depth of the silty clay was not penetrated and that silty clay deposits typically decrease in strength with depth, it was considered possible that firm to soft clay exits within the "central" area of the site.

PROCEDURE

To check for the presence of any firm to soft silty clay material within the "central portion" of the site, two boreholes were put down at the site on February 15, 2008, using a truck mounted drill rig supplied and operated by OGS Inc. of Almonte, Ontario. The boreholes, numbered 1 and 2, were advance to some 5.5 and 4.4 metres, respectively, below the existing ground surface. Borehole 1 was put down in close proximity of previous test pit 12 and borehole 2 was put down in close proximity of previous test pit 15, as shown on the attached site plan, Figure 1.

The boreholes were detailed sampled and tested below the level at which the adjacent previous test pits had been terminated, using a conventional 50 millimetre OD split spoon sampler in conjunction with standard penetration testing. A standpipe was installed in each of the boreholes for subsequent water level measuring and sampling.

Water levels were measured and water samples obtained at the standpipes on February 27, 2008. A water sample from each standpipe was delivered to Accutest Laboratories Ltd. in Ottawa, Ontario for sulphate testing.

A detailed account of the subsurface conditions encountered at the boreholes is provided in the attached Record of Borehole sheets.

SUBSURFACE CONDITIONS

General

As previously indicated, the soil and groundwater conditions encountered at the boreholes put down for this investigation are given on the attached Record of Borehole Sheets. The borehole logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted.

Silty Clay

As indicated above the boreholes were sampled and tested below about the level at which the adjacent previous test pits were terminated. Accordingly, borehole 1 was sampled and tested below about 4.0 metres depth and borehole 2 was sampled and tested below about 2.4 metres depth. Boreholes 1 and 2 encountered stiff to very stiff, grey brown to grey silty clay to depths of some 4.0 to 5.0 metres and 2.4 to 3.4 metres, respectively below the existing ground surface.

Glacial Till

Beneath the silty clay both of the boreholes encountered a deposit of glacial till. The glacial till consist of gravel, cobbles and boulders in a matrix of silty sand with a trace of clay. Standard penetration tests carried out in the glacial till material gave values of 8 and 37 blows for 0.3 metres, indicating a loose to compact state of packing.

Borehole 2 was terminated in the glacial till at depth of about 4.4 metres below the existing ground surface. Borehole 1 was terminated at a depth of about 5.5 metres below the existing ground surface on refusal to auger advancement on a large boulder or the upper surface of the bedrock.

Groundwater

The water level was measured at the borehole standpipes on February 19, 2008. At that time the water level at borehole 1 was measured at about 2.7 metres below the existing ground surface and at borehole 2 at about 1.0 metre below the existing ground surface.

The results of the laboratory testing of the water samples obtained from the standpipes gave values of 88 and 169 milligrams per litre for sulphate. Based on the above test results a negligible to mild attack of groundwater on concrete can be expected. Accordingly, normal Portland cement in a ratio of 0.5 water to cement may be used for buried concrete elements.

DISCUSSION

Based on the results of this additional investigation no presence of soft or firm silty clay material is indicated for the site, and no laboratory consolidation testing of the silty clay material is considered warranted. Accordingly, it is considered that the guidelines for foundation design for the "east and west areas" of the site outlined in our preliminary subsurface investigation report mentioned above can also be used for foundation design for rowhouses, single family dwellings and light commercial buildings within the "central area" of the site.

As suggested in the preliminary subsurface investigation report, for final design of any proposed commercial buildings, site/building specific subsurface investigation should be considered in view of the potential for substantial fill thicknesses within proposed building areas.

We trust this letter provides sufficient information for your present purposes. If you have any questions concerning this letter please do not hesitate to contact our office.

Yours truly,

Kollaard Associates Inc.

C. R. Morey, P.Eng.

Attachments: Record of Borehole Sheets
Figure 1

File 080069

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RECORD OF BOREHOLE BH1

CLIENT: PHOENIX HOMES

ADDITIONAL SUBSURFACE INVESTIGATION
PROPOSED DEVELOPMENT
FALLOWFIELD ROAD AND O'KEEFE COURT, OTTAWA, ON.

PROJECT No.: 080069
DATE OF DRILLING
FEBRUARY 15, 2008

LOCATION: SEE FIGURE 1

DEPTH (m) / WATER LEVEL	STRATA DESCRIPTION	STRATA PLOT	ELEV. / DEPTH	MOISTURE CONTENT (%) 20 40 60 80	SAMPLE & TEST DEPTH	N-VALUE BLOWS/0.3m	SHEAR VANE kPa	VANE REMOLD kPa	COMMENTS
0	Probably topsoil, clay, gravel, asphaltic concrete (FILL)		0.00						Auger cuttings
1									
2									
	Probably TOPSOIL								
3	Probably stiff grey brown SILTY CLAY								
4	Stiff grey SILTY CLAY, trace sand and gravel		3.96		3.96-4.56	7			
5	Compact, grey silty sand, some gravel, cobbles and boulders, trace clay (GLACIAL TILL)		5.02		5.20-5.50	16 / 0.15m 50 / 0.15m			
6	**End of Borehole** -Refusal to advance in glacial till or bedrock at about 5.5 metres below existing ground surface, backfilled with auger cuttings.		5.50						
7									
8									

Water level in standpipe at about 2.7 metres depth, February 15, 2008.

DRILL RIG: TRACK MOUNTED CME 55 AUGER: 200 mm HOLLOW STEM

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RECORD OF BOREHOLE BH2

CLIENT: PHOENIX HOMES

ADDITIONAL SUBSURFACE INVESTIGATION
PROPOSED DEVELOPMENT
FALLOWFIELD ROAD AND O'KEEFE COURT, OTTAWA, ON.

PROJECT No.: 080069
DATE OF DRILLING
FEBRUARY 15, 2008

LOCATION: SEE FIGURE 1

DEPTH (m) / WATER LEVEL	STRATA DESCRIPTION	STRATA PLOT	ELEV. / DEPTH
	Probably topsoil, clay, gravel, boulders and brick (FILL)		0.00
	Probably TOPSOIL		2.20
	Probably very stiff grey brown SILTY CLAY		2.30
	Very stiff grey brown SILTY CLAY (WEATHERED CRUST)		2.44
	Compact, grey silty sand, some gravel, cobbles and boulders, trace clay (GLACIAL TILL)		3.35
	End of Borehole -backfilled with auger cuttings.		4.42

MOISTURE CONTENT (%): 20 40 60 80

SAMPLE / TEST DEPTH	N-VALUE BLOWS/0.3m	SHEAR VANE kPa	VANE REMOLD kPa
2.44 -3.05	13		
3.05 -3.65	8		
3.81 -4.42	37		

COMMENTS

Auger cuttings

Water level in standpipe at about 1.8 metre depth, February 19, 2008.

DRILL RIG: TRACK MOUNTED CME 55 AUGER: 200 mm HOLLOW STEM.

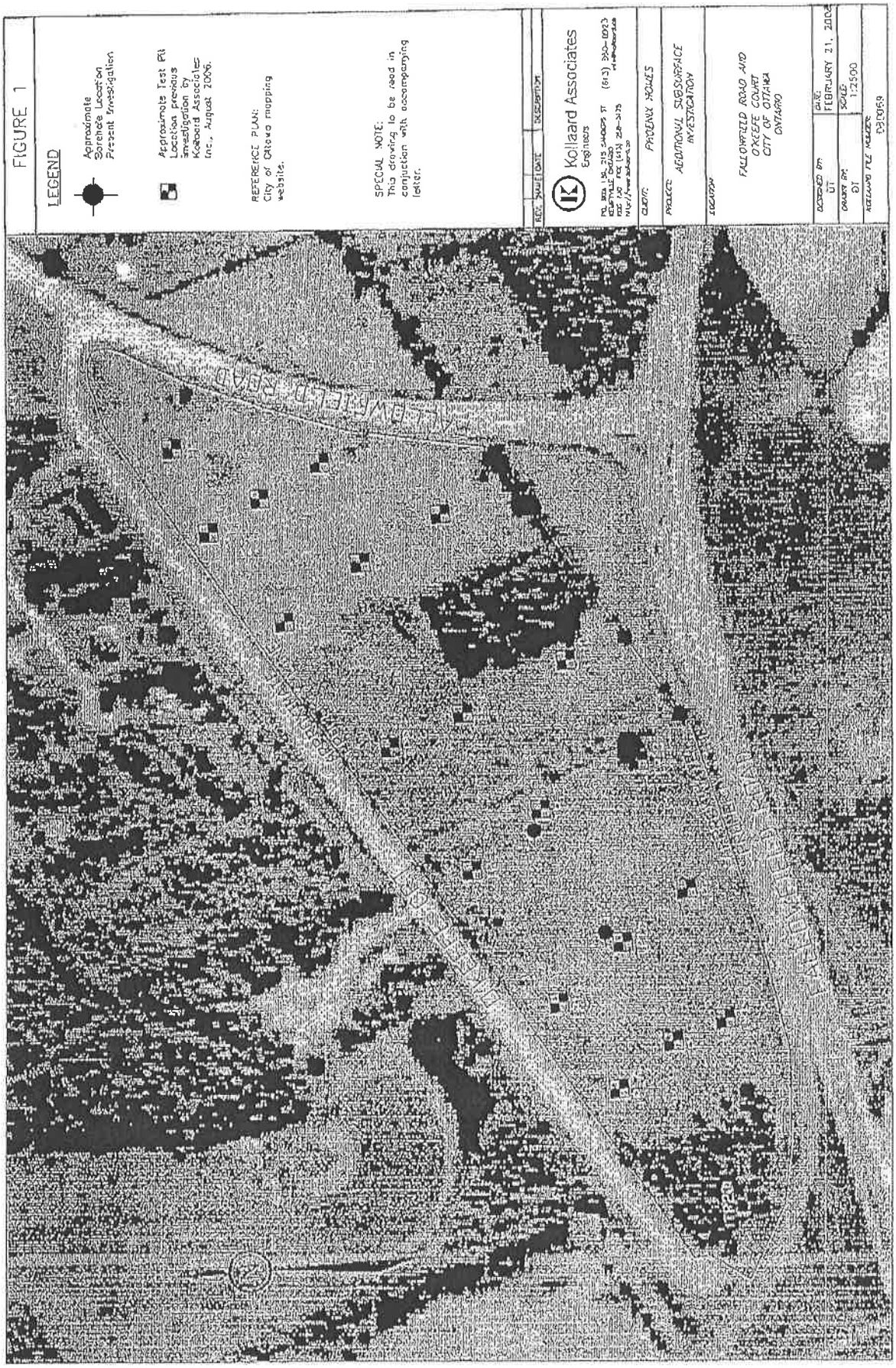
FIGURE 1
LEGEND
Approximate Borehole Location Present Investigation
Approximate Test Pit Location previous investigation by Kollaard Associates Inc., August 2006.
REFERENCE PLAN:
City of Ottawa mapping website.
SPECIAL NOTE:
This drawing to be read in conjunction with accompanying letter.
REV. NO. DATE DESCRIPTION
Kollaard Associates
Engineers
CLIENT: PHOENIX HOMES
PROJECT: ADDITIONAL SUBSURFACE INVESTIGATION
LOCATION: FALLOWFIELD ROAD AND O'KEEFE COURT CITY OF OTTAWA ONTARIO
DESIGNED BY: UT
DRAWN BY: DT
DATE: FEBRUARY 21, 2008
SCALE: 1:2500
REFERENCE NUMBER: OTT-08-0059

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Hydrogeology
Geological Engineering
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Building Science
Archaeological Services

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November 27, 2015
File: PE3696-LET.01

DCR / Phoenix Development Corp. Ltd.
c/o IBI Group Inc.
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

Attention: **Mr. Demetrius Yannoulopoulos**

Subject: **Limited Fill Environmental Testing Program**
Proposed Commercial Development
Vacant Land - O'Keefe Court
Ottawa - Ontario

Dear Sir,

Further to your request and authorization, Paterson Group (Paterson) analysed four (4) fill samples obtained from the aforementioned site. It is our understanding that the on-site fill material at the above noted site is to be transferred off-site and used to fill in a temporary pond, which will then be converted to a City of Ottawa park. This letter contains a summary of our findings with regard to the analytical test results obtained of the above noted fill material.

Previous Engineering Report

Prior to conducting our field program, the following report was reviewed:

- "Preliminary Subsurface Investigation, Proposed Residential and Commercial Development, O'Keefe Court and Fallowfield Road, Ottawa, Ontario", prepared by Kollaard Associates Inc., dated August 10, 2006.

At the time of the above noted investigation, a total of twenty (20) test pits to a maximum depth of 3.8 m below ground surface were excavated on the subject property for geotechnical purposes. Thirteen (13) of the above noted test pits identified a fill layer ranging in thickness from 0.3 to 2.7 m below existing ground surface. This fill material was noted to consist of the following: grey brown silty clay, sand, gravel, cobbles and topsoil. Concrete, asphalt, bricks and wire were also noted in some of the test pits.

Field Findings/Observations

Paterson field program was carried out on November 16, 2015. As part of our field program, four (4) test pits (TP1 to TP4) were excavated to a maximum depth of 0.6 m into the fill by hand. The test hole locations were chosen by IBI Group Inc. however, TP 1 and TP2 were moved slightly on account of the presence of trees at the original selected locations. The approximate test hole locations can be seen on the attached Test Hole Location Plan.

The fill material observed in TP1, TP2 and TP3 consisted predominantly of a grey silty clay with some gravel and organic material. The fill material in TP4 consisted of sand/gravel material with a mixture of some silty clay. One fill sample was obtained from each test hole.

No deleterious materials, odours or staining were observed in the fill material encountered at any of the four (4) test hole locations. It should be noted that the origin of the fill material is unknown.

Analytical Test Results and Conclusion

Four (4) fill samples, one from each test hole, were submitted to Paracel Laboratories of Ottawa for metals, PHCs (Fractions 1 to 4) and benzene, toluene, ethylbenzene and xylenes (BTEX) analyses.

The analytical test results were compared to the 2011 Ontario Ministry of Environment and Climate Change (MOECC) Table 1 standards (background). The City of Ottawa requires imported fill material to comply with the MOECC Table 1 criteria at proposed municipal park locations. A copy of the laboratory reports are appended to this letter.

No detectable BTEX parameters were identified in the soil samples analysed. The detected PHC (F3 and F4) concentrations identified in the fill samples obtained from TP2, TP3 and TP4 comply with the MOECC Table 1 standards.

All of metals parameters identified in the soil samples analysed were in compliance with the MOECC Table 1 standard with the following exceptions. The antimony concentrations identified in the fill samples analysed from TP1, TP3 and TP4 exceed the MOECC Table 1 standard. The antimony concentrations in these fill samples were 1.4, 1.6 and 1.4 µg/g, versus the Table 1 standard of 1.3 µg/g.

The soil analytical test results were also compared to the MOECC Table 3 (coarse grain soil condition) standards. All of the analytical test results comply with the MOECC Table 3 standards.

Based on our most recent analytical test results, three (3) of the fill samples analysed identified antimony concentrations in excess of the MOECC Table 1 (background) standards. However, the antimony concentrations identified in these fill samples comply with the MOECC Table 3 standards. As a result, a soil remediation program does not need to be completed at this time.

It is our understanding that the subject site is to undergo future site re-development. As a result, any soil which contains contaminant concentrations that meet the subject property standards (MOECC Table 3) but exceed the MOECC Table 1 (background) standards has to be removed from the site for construction purposes, it will have to be disposed of at an approved waste disposal facility at a premium.

As previously noted, four (4) samples were analysed as part of the current fill testing program. Consideration should be given to conducting additional analytical testing of the fill material prior to future site re-development, in order to better qualify the on-site fill material.

Statement of Limitations

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request that we be notified immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than IBI Group Inc. and DCR/Phoenix Development Corp. Ltd., without review by this firm for the applicability of our recommendations to the altered use of the report is prohibited.

Paterson Group Inc.

Eric Leveque, B.A.

Attachments

- ❏ Laboratory Certificate of Analysis
- ❏ Test Hole Location Plan

Report Distribution

- ❏ DCR/Phoenix Development Corp. Ltd. (2 hard copies and 1 electronic copy)
- ❏ IBI Group Inc. (1 electronic copy)
- ❏ Paterson Group (1 copy)

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154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Eric Leveque

Client PO: 18969
Project: PE3696
Custody: 106249

Report Date: 20-Nov-2015
Order Date: 16-Nov-2015

Order #: 1547080

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1547080-01	TP1
1547080-02	TP2
1547080-03	TP3
1547080-04	TP4

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Report Date: 20-Nov-2015
Client: **Paterson Group Consulting Engineers**
Order Date:16-Nov-2015
Client PO: 18969
Project Description: PE3696

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	17-Nov-15	20-Nov-15
PHC F1	CWS Tier 1 - P&T GC-FID	17-Nov-15	20-Nov-15
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	18-Nov-15	19-Nov-15
REG 153: Metals by ICP/OES, soil	based on MOE E3470, ICP-OES	20-Nov-15	20-Nov-15
Solids, %	Gravimetric, calculation	17-Nov-15	17-Nov-15

Certificate of Analysis

Report Date: 20-Nov-2015

Client: **Paterson Group Consulting Engineers**

Order Date:16-Nov-2015

Client PO: 18969

Project Description: PE3696

	Client ID:	TP1	TP2	TP3	TP4
	Sample Date:	16-Nov-15	16-Nov-15	16-Nov-15	16-Nov-15
	Sample ID:	1547080-01	1547080-02	1547080-03	1547080-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	77.0	81.1	86.4	85.7
Metals					
Antimony	1.0 ug/g dry	1.4	1.1	1.6	1.4
Arsenic	1.0 ug/g dry	2.3	1.6	2.2	1.2
Barium	1.0 ug/g dry	202	196	157	153
Beryllium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Boron	1.0 ug/g dry	5.6	4.9	6.4	7.9
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	37.9	37.2	29.7	22.8
Cobalt	1.0 ug/g dry	10.0	10.1	8.1	6.1
Copper	1.0 ug/g dry	20.8	20.3	17.0	13.8
Lead	1.0 ug/g dry	13.5	12.2	10.4	14.5
Molybdenum	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Nickel	1.0 ug/g dry	21.2	20.6	17.9	14.0
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Silver	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Uranium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Vanadium	1.0 ug/g dry	48.5	48.2	38.6	28.4
Zinc	1.0 ug/g dry	62.2	109	45.1	41.2
Volatiles					
Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Toluene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
o-Xylene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Toluene-d8	Surrogate	107%	109%	108%	103%
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	<7	<7
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	35	36	31
F4 PHCs (C34-C50)	6 ug/g dry	<6	48	92	118

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	1.0	ug/g						
Boron	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	1.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.5	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						
Volatiles									
Benzene	ND	0.02	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
m,p-Xylenes	ND	0.05	ug/g						
o-Xylene	ND	0.05	ug/g						
Xylenes, total	ND	0.05	ug/g						
Surrogate: Toluene-d8	*2.86*		*ug/g*		*89.4*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND				30	
F3 PHCs (C16-C34)	191	8	ug/g dry	225			16.1	30	
F4 PHCs (C34-C50)	193	6	ug/g dry	179			8.0	30	
Metals									
Antimony	ND	1.0	ug/g dry	ND			0.0	30	
Arsenic	4.79	1.0	ug/g dry	5.18			8.0	30	
Barium	9.69	1.0	ug/g dry	10.4			6.7	30	
Beryllium	ND	1.0	ug/g dry	ND			0.0	30	
Boron	3.39	1.0	ug/g dry	3.55			4.7	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	5.25	1.0	ug/g dry	5.73			8.7	30	
Cobalt	2.59	1.0	ug/g dry	2.66			2.5	30	
Copper	10.7	1.0	ug/g dry	11.2			5.3	30	
Lead	6.81	1.0	ug/g dry	7.13			4.5	30	
Molybdenum	1.70	1.0	ug/g dry	1.74			1.8	30	
Nickel	6.39	1.0	ug/g dry	7.24			12.5	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.5	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND				30	
Vanadium	11.9	1.0	ug/g dry	12.7			6.6	30	
Zinc	33.0	1.0	ug/g dry	34.7			4.9	30	
Physical Characteristics									
% Solids	83.9	0.1	% by Wt.	85.0			1.3	25	
Volatiles									
Benzene	ND	0.02	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
m,p-Xylenes	ND	0.05	ug/g dry	ND				50	
o-Xylene	ND	0.05	ug/g dry	ND				50	
Surrogate: Toluene-d8	*1.81*		*ug/g dry*	*ND*	*76.4*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	204	7	ug/g	ND	102	80-120			
F2 PHCs (C10-C16)	111	4	ug/g	ND	107	60-140			
F3 PHCs (C16-C34)	289	8	ug/g	36	117	60-140			
F4 PHCs (C34-C50)	286	6	ug/g	92	135	60-140			
Metals									
Antimony	257		ug/L	17.3	96.0	70-130			
Arsenic	336		ug/L	104	92.9	70-130			
Barium	448		ug/L	207	96.4	70-130			
Beryllium	253		ug/L	ND	101	70-130			
Boron	318		ug/L	71.1	98.8	70-130			
Cadmium	248		ug/L	4.15	97.6	70-130			
Chromium	338		ug/L	115	89.4	70-130			
Cobalt	275		ug/L	53.2	88.7	70-130			
Copper	463		ug/L	225	95.3	70-130			
Lead	383		ug/L	143	96.0	70-130			
Molybdenum	271		ug/L	34.7	94.7	70-130			
Nickel	360		ug/L	145	86.2	70-130			
Selenium	206		ug/L	ND	84.4	70-130			
Silver	241		ug/L	0.23	96.5	70-130			
Thallium	231		ug/L	ND	92.3	70-130			
Uranium	258		ug/L	ND	103	70-130			
Vanadium	472		ug/L	255	86.8	70-130			
Zinc	869		ug/L	693	70.3	70-130			
Volatiles									
Benzene	3.79	0.02	ug/g	ND	94.7	60-130			
Ethylbenzene	3.45	0.05	ug/g	ND	86.3	60-130			
Toluene	3.72	0.05	ug/g	ND	93.0	60-130			
m,p-Xylenes	7.53	0.05	ug/g	ND	94.1	60-130			
o-Xylene	3.20	0.05	ug/g	ND	79.9	60-130			
Surrogate: Toluene-d8	*2.56*		*ug/g*		*79.9*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

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Chain of Custody
(Lab Use Only)
№ 106249

Page __ of __

Client Name: Paterson Group	Project Reference: PE3696	TAT: [X] Regular [ ] 3 Day	
Contact Name: Eric Levesque	Quote #	[ ] 2 Day [ ] 1 Day	
Address: 154 Colonnade Rd	PO # 18969	Date Required:	
Telephone: 613-226-7381	Email Address: elevesque@patersongroup.ca		

Criteria: [X] O. Reg. 153/04 (As Amended) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [ ] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: _____ [ ] Other: _____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Paracel Order Number: 1547080

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)							
1	TP1	S		2	Nov 16/15	Am	X			X							-250ml+1vial-			X
2	TP2	S		2	↓	↓	X			X							↓			X
3	TP3	S		2			X			X										X
4	TP4	S		2	↓	↓	X			X							↓			X
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): Mik B.	Received by Driver/Depot: T Trouse	Received at Lab: Sumeyra Dokmeci	Verified By: SCUZ
Relinquished By (Print):	Date/Time: Nov 16/15 4:15pm	Date/Time: Nov 16, 2015 05:12	Date/Time: Nov 17/15 7:55a
Date/Time:	Temperature: ____ °C	Temperature: 12.9 °C	pH Verified [ ] By: N/A

patersongroup
consulting engineers

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NO.	REVISIONS	DATE	INITIAL
0			

IBI GROUP

FILL QUALITY ASSESSMENT
VACANT PROPERTY - O'KEEFE COURT

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2500	Date: 11/2015
Drawn by: MPG	Report No.: PE3696-1
Checked by: EJL	Dwg. No.: PE3696-1
Approved by: MSD	Revision No.:

Appendix E DRAWINGS