

Prepared for:

**BGIS GLOBAL INTEGRATED SOLUTIONS CANADA LP**  
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Markham, ON  
L3R 0J2

Prepared by:

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Tower 2, Suite 1000, 10th Floor,  
Ottawa, Ontario,  
K1S 1N4

# Site Servicing Report

## Hydro One Operations Centre

3440 Frank Kenny Road, Orléans ON

**Site Servicing Report**  
**Hydro One Operations Centre**  
**3440 Frank Kenny Road, Orléans ON**

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**Table of Contents**

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1.0	Introduction.....	1
1.1	General .....	1
1.2	Site Description and Proposed Development .....	1
2.0	Water Servicing .....	3
2.1	Domestic Water Demands .....	3
2.2	Water Supplied - Well Water Quality .....	4
2.3	Well Water Supplied Quantity .....	5
2.4	Decommissioning of the Existing Residential Water Well.....	5
2.5	Fire Protection Water Demand .....	5
3.0	Septic System & Raised Leach Bed (Design by Golder) .....	6
3.1	Sewage System Design Flows .....	6
3.2	Treatment Units .....	6
3.3	Leaching Bed.....	7
4.0	Summary of Servicing .....	7

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**List of Figures**

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Figure 1 – Key Location Plan.....	2
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**List of Appendices**

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- Appendix A: Site Plan & Civil Plans (Under Separate Cover)
- Appendix B: Domestic Well Water Supply
- Appendix C: WSP Technical Memorandum - Resampling Results, Well, PW11-1, and Updated Terrain Analysis
- Appendix D: Fire Protection Water Demand
- Appendix E: Dry Hydrant Storage Tanks and Dry Hydrant Specifications
- Appendix F: Consultation Record with Local Fire Chief
- Appendix G: WSP Technical Memorandum - New Septic System

# Site Servicing Report

## Hydro One Operations Centre

### 3440 Frank Kenny Road, Orléans ON

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## 1.0 Introduction

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### 1.1 General

This Site Servicing Report has been prepared by J.L. Richards and Associates Limited (JLR) on behalf of Brookfield Global Integrated Solutions Canada LP (BGIS) to support the Site Plan Control application of Hydro One Network Inc. (HONI) new Operations Centre (OC), at 3440 Frank Kenny Road, Ottawa, Ontario.

BGIS is a privately owned property management company acting as the construction manager for HONI's proposed OC development. The new building will service HONI's Business Line Operations. The facility will meet today's safety, regulatory, and industry operation standards. As well as HONI's stakeholder requirements.

In 2012 an interim development (Phase 1) was constructed on part (1.08 ha) of the site. It consisted of a modular office, gravel parking lot, storage building, maintenance yard, and a stormwater management facility (SWMF).

In 2021, BGIS retained JLR to provide professional planning, architectural, and engineering services for the development (Phase 2) of the remaining portion (1.56 ha) of the site. Works consisting of a one-storey permanent office building with attached maintenance garage, asphalted employee parking lot, expanded operations yard and new SWMF.

This report summarizes the development's private servicing (well and septic system) needs for water and septic. Note, that WSP Golder (Golder) was subcontracted to analyze the existing onsite well (PW11-1); and were also tasked with the design of the proposed septic system. The proposed septic system design by Golder is submitted under separate cover.

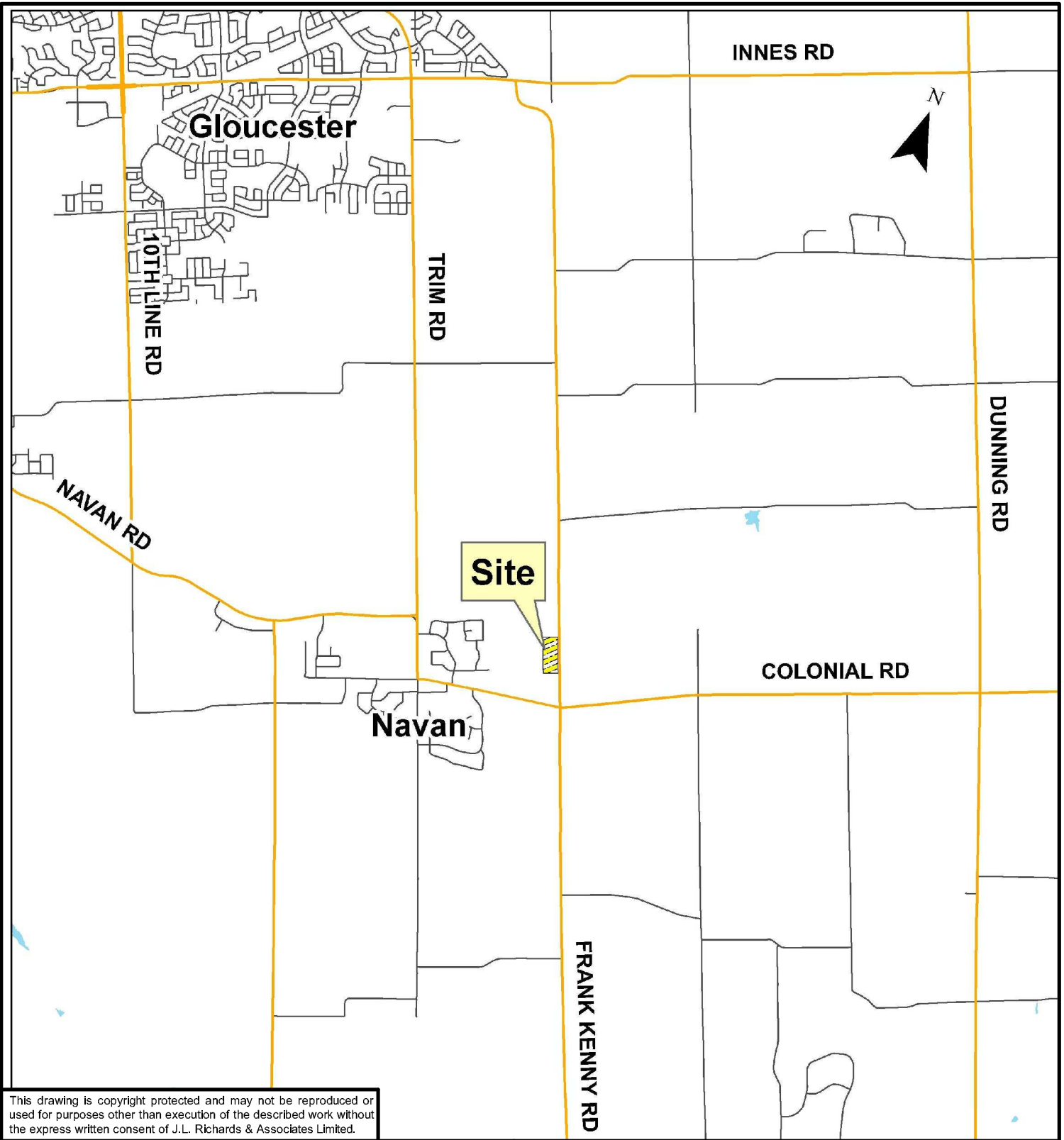
### 1.2 Site Description and Proposed Development

The total site area of HONI's permanent operations center is 2.65 ha. The site at 3440 Frank Kenny Road is Part of Lot 10, Concession 8, located within the City of Ottawa. The land is bounded by Frank Kenny Road to the east, a school bus storage yard to the north and farmlands, zoned General Agricultural (AG), to the south and west. Per the City of Ottawa Comprehensive Zoning By-law 2008-250, the site is within a Rural Heavy Industrial, Rural Exception Zone 35, RH [35r] zone, which permits the operations center's proposed development. Refer to **Figure 1** (below).

The site's topography is relatively flat. The front yard slopes east towards the existing City's right-of-way (ROW) ditch that spans along Frank Kenny Road. The Phase I developed area slopes southwest towards an existing SWMF. The undeveloped (farmland) portion of the site surface drains southwest and outlets to an existing open ditch.

Per the Phase 1 works the site was partially developed with: an interim modular office, gravel parking lot, storage building (two-story), and a maintenance yard. Per the proposed works the existing interim office, gravel lot, SWMF, and temporary septic holding tank will be removed. The proposed development to consist of: permanent building (one-story office with workshop and covered vehicle storage), asphalted employee parking lot, and an expanded gravel maintenance yard; also, including various outdoor surface storage areas and a new SWMF.

File Location: P:\31000\31500-000 - HONI Orleans OPC\3-Production\1-Civil\31500-000 C KEY LOCATION PLAN.dwg



This drawing is copyright protected and may not be reproduced or used for purposes other than execution of the described work without the express written consent of J.L. Richards & Associates Limited.

PROJECT:  
**HYDRO ONE - ORLEANS OPERATIONS CENTER**  
 3440 FRANK KENNY ROAD

DRAWING:  
**KEY LOCATION PLAN**



**J.L. Richards**  
 ENGINEERS ARCHITECTS PLANNERS

**J.L. Richards & Associates Limited**  
 864 Lady Ellen Place  
 Ottawa, ON Canada  
 K1Z 5M2  
 Tel: 613 728 3571  
 Fax: 613 728 6012

DESIGN: MD  
 DRAWN: GC  
 CHECKED: DU  
 PLOTTED: Mar 29, 2022

DRAWING NO.:  
**FIGURE 1**

JLR NO:  
 31500-000



**Site Servicing Report**  
**Hydro One Operations Centre**  
**3440 Frank Kenny Road, Orléans ON**

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## **2.0 Water Servicing**

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### **2.1 Domestic Water Demands**

Domestic water demand is to be met by the existing water supply well (currently servicing the interim office). The well will be disconnected from the temporary office and reconnected to the new building. Based on the Well records (well tag: A116305), included in Appendix B, the available maximum flow rate supplied from the well is 15 GPM (0.95 L/sec). The calculated domestic water demand is 45.1 GPM (2.84 L/sec). This flow was determined per the OBC requirements and the type and quantity of installed building fixtures. The building's domestic water distribution system was sized to supply water to fixtures per the estimated rate.

The cold-water storage tank will provide a volume buffer between the incidental draw flow and well pumping rate.

The cold-water storage tank (located in the building's mechanical room) was sized based on the maximum coincidental water flow rate of 17.7 GPM (1.1 L/sec) - simultaneous use of three showers, one service sink and one hose bib. Required water storage has been calculated based on the net peak flow required from storage at maximum coincidental system flowrate, and at maximum pumping flowrate from the well, for a period of 20 minutes (2 successive shower uses in every stall).

A safety margin of 20% to tank volume has been applied. The required water storage volume is 64.8 gals (245 L). The final domestic cold-water tank selection considered that a portion of the tank could be effectively used in the system pressure band of 30 to 50 psi. The selected tank has a volume of 264 gals (1,000 L), 30% of which can provide water within the design system pressure band. Therefore, the total usable domestic cold-water storage is 79.2 gals (300 L).

The actual safety factor for this tank installation is 47% or an additional 9 minutes at the maximum coincidental water flow. This conservative calculation approach assumes only cold-water will be used during the coincident peak demand. The available 250 gals (945 L) of hot-water storage are in addition to the cold-water storage discussed.

According to WSP's report, the required daily water demand to supply the building is approximately 5,000 L/day. WSP concluded that PW11-1 could deliver at least 11.3 L/min (16,350 L/day) based on the data obtained during the pumping test. During the six-hour pumping test period, about 31 percent of the available drawdown was utilized while pumping at an average rate of 11.3 L/min. As such, the yield of PW11-1 exceeds the assumed water usage for the new operations facility of 5,000L/day.

Refer to Appendix A for the location of the existing supply well.

# Site Servicing Report

## Hydro One Operations Centre

### 3440 Frank Kenny Road, Orléans ON

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## 2.2 Water Supplied - Well Water Quality

As stated in Section 2.1, the existing onsite water supply well currently serves the domestic water needs of the interim office. The well will be disconnected from the current building and used to service the proposed OC building. WSP recently resampled the onsite water supplied by the well (PW11-1) and revised their 2012 terrain analysis to today's City of Ottawa's - *Terrain Analysis and Hydrogeological Assessment* outlined standards.

The water supplied by the well was resampled in September 2022, a copy of the below listed analyses are provided in Appendix C:

- WSP (P/N Project No. 21493887) – *Resampling Results, Well PW11-1, and Updated Terrain Analysis, Hydro One Orleans OC, Phase 2 - 3440 Frank Kenny Road, Ottawa, Ontario - Technical Memorandum* (May 2, 2023).

The following report summaries are provided:

- Water quality meets applicable standards or objectives for the analyzed parameters.
- Treatment may be necessary to reduce the levels of colour, hydrogen sulphide, turbidity, iron, and manganese below the AOs. Common techniques for treating hydrogen sulphide, iron and manganese include water softeners, manganese greensand filters or other oxidizing media.
- Water colour from the well was field described as clear and colourless
- The measured (September 2022) colour was below 5 TCU, minimum level that can be measured using the Hach 900 colour meter).
- Water supplied in the well (PW11-1) is below to AO for colour and below the treatability limit of 7 TCU under Procedure D-5-5.

# Site Servicing Report

## Hydro One Operations Centre

### 3440 Frank Kenny Road, Orléans ON

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#### **2.3 Well Water Supplied Quantity**

As stated in WSP's technical memo dated May 3, 2023:

*"Golder's 2012 report concluded that well PW11-1 was capable of supplying at least 16,350 L/day (i.e., more than the current estimated daily water demand for Phase 2 of the site). This capacity remains sufficient to provide water supply to Phase 2 of the development."*

For full well water quantities, refer to WSP's technical memorandum in Appendix C.

#### **2.4 Decommissioning of the Existing Residential Water Well**

The site housed a residential home serviced by a supply well in the preexisting condition. During the construction of the Phase I development site, the home was demolished. However, the well was not removed. This existing well that serviced the previous residential building will need to be decommissioned during the construction works of the Phase II site. Per Golder's report (included within the May 5, 2023 Technical Memorandum), the decommissioning of this well is to be in accordance with Ontario Regulation 903.

#### **2.5 Fire Protection Water Demand**

Fire water supply and storage on site is a requirement under Part 3 of the Ontario Building Code (OBC). Since the proposed building footprint is over 600 square meters and the building is not a Part 9 Building with respect to the Ontario Building Code, onsite fire water supply and storage is required for this building. Fire protection for the proposed building was designed according to the OBC design methodology. The supply well and pressurized storage tanks stated in Section 2.1 will not be supplying any water for fire protection. The required fire flow will be provided solely from underground storage tanks and a dry hydrant. The mechanical engineer calculated the required fire flow rate to be 5,400 l/min (90 l/s). A total capacity of 183,110 L is required on site. Refer to Appendix A for the proposed locations and Appendix D for the fire protection design calculations prepared by JLR. Detailed specifications of the storage tanks and hydrants are provided in Appendix E. A total of three (3) fire storage tanks will be installed on site with a total working capacity of 183,110 L.

Consultation with the local fire chief was held to confirm fire flow requirements and a copy is provided in Appendix F.

**Site Servicing Report**  
**Hydro One Operations Centre**  
**3440 Frank Kenny Road, Orléans ON**

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### **3.0 Septic System & Raised Leach Bed (Design by Golder)**

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As no municipal sanitary services are available at this site, the sewage flows from the proposed development will be managed via a New Septic System, consisting of treatment units and a raised leaching bed. Refer to WSP's Technical Memorandum (P/N 21493887), New Septic System, Hydro One Operations Centre, Phase 2, 3440 Frank Kenny Road, Ottawa Ontario, dated May 5, 2023 – Appendix G.

The proposed footprint locations of the septic system's tanks and raised leach bed are shown on the Civil Site Plans, under Appendix B of this Technical Memorandum.

#### **3.1 Sewage System Design Flows**

Per WSP's Technical Memoranda

*"The total daily design sanitary sewage flow has been calculated to be 6,329 L/d for both normal and emergency operations as the floor area of the office governs the calculations, and also since the staffing for field staff has not been included directly, but instead assessed based on the warehouse facilities."*

Detail calculations are provided in WSP's Technical Memorandum included as Appendix G.

#### **3.2 Treatment Units**

Per WSP's Technical Memoranda

*"A Class 4 Sewage System, as per Section 8.6 of the OBC, is proposed to service the new building and will consist of the Waterloo Biofilter basket tank system, model BT-15500. The system will also consist of an anaerobic digester (septic tank) with a volume of 13,625 L (model number 13625AD), followed by separate 6,000 L pump tank that will be used to dose the final 15,500 L Biofilter basket tank. Refer to Sewage System Plan and Detail Sheet, Figure 2 in Appendix B."*

*"Due to the anticipated elevations of the tanks and leaching bed, a second alternating duplex pump system will be required to dose the leaching bed. Waterloo Biofilter has confirmed that these pumps can be installed with the Biofilter basket tank" (WSP Golder, 2022)*

*"... the treatment unit will be constructed as a double-pass system for denitrification, which requires recirculation to the anaerobic digester."*

*"The 32 mm diameter recirculation forcemain will provide approximately 50% recirculation of treated effluent back to the anaerobic digester..."*

*"The treatment units have been located on the site to conform with the minimum clearance distance as set out in Table 8.2.1.6.A of the OBC."*

Treatment unit details are provided in WSP's Technical Memoranda included as Appendix G.

# Site Servicing Report

## Hydro One Operations Centre

### 3440 Frank Kenny Road, Orléans ON

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#### 3.3 Leaching Bed

As part of the new septic system a mounded leaching bed will be built. Detail design of the system was conducted by WSP. Reference the Technical Memoranda in Appendix G.

In summary per WSP Golder's Technical Memoranda

*"... the system will require a contact area of 791 m<sup>2</sup>. A contact area measuring 25.0 m x 31.7 m has been provided, which provides a contact area of 792.5 m<sup>2</sup>. Refer to Sewage System Plan, Figure 1 in Appendix B."*

*"... the system will require a stone area of 127 m<sup>2</sup>. A stone area measuring 6 m x 21.2 m has been provided, which provides a contact area of 127 m<sup>2</sup>. Refer to Sewage System Plan, Figure 1 in Appendix B."*

*"The leaching bed is proposed over the existing gravel parking lot for the Phase 1 building. Therefore, the gravel for the parking lot is proposed to be removed down to the native soils."*

For further details of the proposed leaching bed reference WSPs Technical Memoranda included as Appendix G.

#### 4.0 Summary of Servicing

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This Site Servicing Report associated site plans and technical memos describe the proposed servicing solutions for HONI's permanent operations center. A summary of the servicing details is described below:

- Domestic water demands for the New Facility to be supplied by the existing onsite supply well (which is currently servicing the interim office), including a new onsite pressurized storage tank.
- Fire protection will be provided by underground water storage tanks and a dry hydrant. Water supply for the tanks is anticipated to be trucked to the site.
- Sanitary sewage from the proposed building to be treated via a new septic system The Septic System is designed by WSP, design calculations and plans are included.
- Natural Gas is proposed to service the new OC Facility. Refer to Appendix A for proposed locations.
- The existing transformer servicing the interim office and existing storage shed will be relocated to provide electricity to the new OC Facility. Refer to Appendix A for proposed locations and Electrical Plans (under separate cover).

# Site Servicing Report

## Hydro One Operations Centre

### 3440 Frank Kenny Road, Orléans ON

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This report has been prepared for the exclusive use of BGIS, for the stated purpose, for the named facility. Its discussions and conclusions are summary in nature and cannot be properly used, interpreted, or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report was prepared for the sole benefit and use of BGIS and may not be used or relied on by any other party without the express written consent of J.L. Richards & Associates Limited.

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J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

Reviewed by:

Lee Jablonski, P. Eng.  
Senior Civil Engineer

Marc Rivet, MCIP, RPP.  
Senior Planner

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# Appendix A

Plans

Under separate cover

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## **Appendix B**

Domestic Well Water Supply



Measurements recorded in:  Metric  Imperial

Page \_\_\_\_\_ of \_\_\_\_\_

A 116305

**Well Owner's Information**

First Name: Golden Last Name / Organization: Associates Ltd. E-mail Address: N/A  Well Constructed by Well Owner

Mailing Address (Street Number/Name): 32 Steacie Drive Municipality: Kanata Province: ON Postal Code: K2K2A9 Telephone No. (inc. area code): 613592916010

**Well Location**

Address of Well Location (Street Number/Name): 3450 Frank Kenny St. Township: Cumberland Lot: 10 Concession: 8

County/District/Municipality: Ottawa City/Town/Village: Ottawa Province: Ontario Postal Code: \_\_\_\_\_

UTM Coordinates: Zone: 18 Easting: 467827 Northing: 5030370 Municipal Plan and Sublot Number: \_\_\_\_\_ Other: \_\_\_\_\_

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	clay	Silt	Hard	0	3.1
Grey	clay	Silt	Hard	3.1	8.9
Grey	limestone		layered	8.9	24.3

**Annular Space**

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	10.9	Cement grout	0.4 m³

**Results of Well Yield Testing**

After test of well yield, water was:  Clear and sand free  Other, specify \_\_\_\_\_

If pumping discontinued, give reason: \_\_\_\_\_

Pump intake set at (m/ft): 20

Pumping rate (l/min / GPM): 56

Duration of pumping: 1 hrs + \_\_\_\_\_ min

Final water level end of pumping (m/ft): 1.87

If flowing give rate (l/min / GPM): \_\_\_\_\_

Time (min)	Draw Down		Recovery	
	Water Level (m/ft)	Time (min)	Water Level (m/ft)	Time (min)
Static Level	1.04		1.87	
1		1	1.17	
2		2	1.10	
3		3	1.08	
4		4	1.08	
5	1.69	5	2.06	
10	1.85	10	1.05	
15	1.85	15	1.04	
20	1.85	20	1.04	
25	1.87	25	1.04	
30	1.87	30	1.04	
40	1.88	40	1.04	
50	1.88	50	1.04	
60	1.87	60		

**Method of Construction**

Cable Tool  Diamond  Public  Commercial  Not used

Rotary (Conventional)  Jetting  Domestic  Municipal  Dewatering

Rotary (Reverse)  Driving  Livestock  Test Hole  Monitoring

Boring  Digging  Irrigation  Cooling & Air Conditioning

Air percussion  Industrial  Other, specify \_\_\_\_\_

Other, specify Air Rotary

**Construction Record - Casing**

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
15.55	Steel	0.48	4.6	10.9	<input checked="" type="checkbox"/> Water Supply
15.55	Open Hole		10.9	23.4	<input type="checkbox"/> Replacement Well

**Construction Record - Screen**

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)		Status of Well
			From	To	
					<input type="checkbox"/> Test Hole

**Water Details**

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested	Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
13	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	0	10.9	24.7
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	10.9	24.3	15.55

**Well Contractor and Well Technician Information**

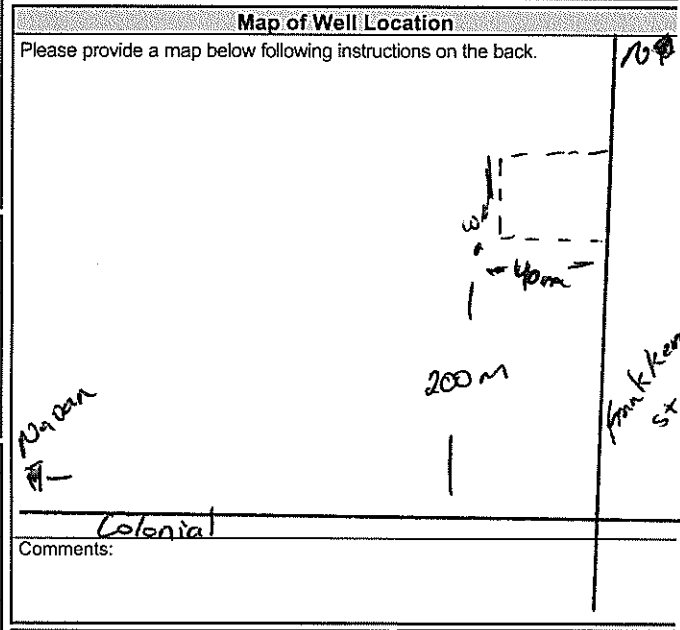
Business Name of Well Contractor: Bowagoois Well Drilling Ltd. Well Contractor's Licence No.: 741117

Business Address (Street Number/Name): 151 Montee D'Aoust Municipality: Nation

Province: ON Postal Code: K0A3C0 Business E-mail Address: N/A

Bus. Telephone No. (inc. area code): 613 828 7529 Name of Well Technician (Last Name, First Name): GENIER, MICHAEL

Well Technician's Licence No.: 31493 Signature of Technician and/or Contractor: \_\_\_\_\_ Date Submitted: 2011/11/23



**Ministry Use Only**

Well owner's information package delivered:  Yes  No

Date Package Delivered: 2011/11/13

Date Work Completed: \_\_\_\_\_

Audit No.: Z140701

Received: JAN 17 2012



Ministry of the Environment

Well Tag No. (Place Str)

A116305

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in:  Metric  Imperial

Page of

A 116305

Well Owner's Information

First Name: **ML Brady Ltd** Last Name / Organization: **ML** E-mail Address: **N/A**  Well Constructed by Well Owner

Mailing Address (Street Number/Name): **PO BOX 70 Napan** Municipality: **Napan** Province: **ON** Postal Code: **K0B1G3** Telephone No. (inc. area code): **613-835-2480**

Well Location

Address of Well Location (Street Number/Name): **3450 Frank Kenny St.** Township: **Cumberland** Lot: **10** Concession: **8**

County/District/Municipality: **Ottawa** City/Town/Village: **Ottawa** Province: **Ontario** Postal Code:

UTM Coordinates: Zone **18Q** Easting **461782** Northing **75030372** Municipal Plan and Sublot Number:

Overburden and Bedrock Material / Abandonment / Sealing Record / Sealing Record (See Section 12.1)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	clay	Silt	Hard	0	3.1
Grey	clay	Silt	Hard	3.1	8.9
Grey	limestone		layered	8.9	24.3

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m <sup>3</sup> /ft <sup>3</sup> )
0	10.9	cement grout	0.4 m <sup>3</sup>

Method of Construction:

Cable Tool  Diamond  Public  Commercial  Not used

Rotary (Conventional)  Jetting  Domestic  Municipal  Dewatering

Rotary (Reverse)  Driving  Livestock  Test Hole  Monitoring

Boring  Digging  Irrigation  Cooling & Air Conditioning

Air percussion  Other, specify **Air Rotary**  Industrial  Other, specify

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		<input checked="" type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify <input type="checkbox"/> Other, specify
			From	To	
15.55	Steel	0.48	4.6	10.9	
15.55	Open Hole		10.9	23.4	

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

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested	Depth (m/ft)		Diameter (cm/in)
		From	To	
1.3	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	0	10.9	24.7
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	10.9	24.3	15.55

Business Name of Well Contractor: **Bourgeois Well Drilling Ltd.** Well Contractors License No.: **714117**

Business Address (Street Number/Name): **151 Montee D'Aoust** Municipality: **Napan**

Province: **ON** Postal Code: **K0B1G0** Business E-mail Address: **N/A**

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

After test of well yield, water was: <input checked="" type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:  Pump intake set at (m/ft): <b>20</b> Pumping rate (l/min / GPM): <b>56</b> Duration of pumping: <b>1</b> hrs + <b></b> min Final water level end of pumping (m/ft): <b>1.87</b> If flowing give rate (l/min / GPM): <b></b>	Static Level	1.04		1.87
	1		1	1.17
	2		2	1.10
	3		3	1.08
	4		4	1.08
	5	1.69	5	1.06
10	1.85	10	1.05	
15	1.85	15	1.04	
20	1.85	20	1.04	
25	1.87	25	1.04	
30	1.87	30	1.04	
40	1.88	40	1.04	
50	1.88	50	1.04	
60	1.87	60		

Please provide a map below following instructions on the back.

**EMRB - RECEIVED**

JAN 25 2012

NAPAN 714117 2140701

Colonial

Well owner's information package:  Date Package Delivered:  Audit No.:



Fax Sheet

14245, Conc.10-11,  
Crysler, Ontario  
K0A 1R0  
Tél: 613 987-5291  
Fax: 613 987 5736

Date: January 25 2012

Att: Well help desk  
Fax number: 416-235-5960  
Company: Ministry of the Environment

# of page 2 (including cover sheet)

Comments: Resition of well record well tag # A116305  
Changes made to well owner info.

Thank you

C-7147  
2140701  
A

---

## **Appendix C**

WSP Technical Memorandum  
(May 2023) – Resampling  
Results, Well PW11-1, and  
Updated Terrain Analysis



## TECHNICAL MEMORANDUM

**DATE** May 2, 2023

**Project No.** 21493887

**TO** City of Ottawa  
Public Works Department

**CC**

**FROM** Caitlin Cooke

**EMAIL** [caitlin.cooke@wsp.com](mailto:caitlin.cooke@wsp.com)

### **RESAMPLING RESULTS, WELL PW11-1, AND UPDATED TERRAIN ANALYSIS HYDRO ONE ORLEANS OC, PHASE 2 3440 FRANK KENNY ROAD, OTTAWA, ONTARIO**

Golder Associates Ltd. (Golder, amalgamated with WSP Canada Inc. in January 2023) was retained by J.L. Richards & Associates Ltd. (JLR) to collect a water sample from supply well PW11-1 at the proposed Hydro One Operations Centre (OC), Phase 2, located at 3440 Frank Kenny Road in Ottawa, Ontario. The purpose of the work was to evaluate the water quality at PW11-1, which is currently being used to supply the temporary building on the site. Well PW11-1 (well tag A116305) was constructed in 2011 by a licensed well contractor. A well inspection by a licensed geoscientist or engineer was not conducted at that time. The water quality at PW11-1 was previously reported in the February 2012 Golder report entitled “*Hydrogeology, Terrain Analysis and Impact Assessment Study, 3406-3450 Frank Kenny Road.*”

This memorandum is an addendum to the February 2012 Golder report (included as Attachment 1) and this current memorandum considers the City of Ottawa’s *Hydrogeological and Terrain Analysis Guidelines*, dated March 2021 and the Ontario Building Code.

#### **Method**

On March 9, 2022, a sample was collected from an untreated port (by bypassing the water softener and other treatment equipment) at the temporary building. Water was purged from the nearest tap (the kitchen sink) for approximately 10 minutes prior to the collection of the sample. The water sample was collected in laboratory supplied bottles and analyzed for the “subdivision suite” of parameters and filtered at the laboratory to be analysed for trace metals. Once collected, the sample was packed in a cooler with ice packs and was delivered to Eurofins Environment Testing (Eurofins) in Ottawa, Ontario for analysis.

On August 30, 2022 a second sample was collected from the same tap using the same sampling and purging methods. The water sample was collected in laboratory supplied bottles and analyzed for volatile organic compounds (VOC). Once collected, the sample was packed in a cooler with ice packs and was delivered to Eurofins in Ottawa, Ontario for analysis. The temperature, pH and conductivity of the water sample were measured in the field, and other sample observations, including colour, were noted.

A confirmation sample was collected on September 30, 2022 to confirm the colour level. The water sample was collected in laboratory supplied bottles, packed in a cooler with ice packs and delivered to Eurofins in Ottawa,

Ontario for analysis of true colour. The colour of the water sample was also measured in the field using a calibrated Hach 900 colour meter.

## Results

On the attached Table 1, the analytical results for the subdivision suite of parameters are compared to the Ontario Drinking-Water Quality Standards (ODWQS, Ontario Regulation 169/03) and to the standards (MAC), objectives (AO) and guidelines (OG) of the “Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines” (Ontario Ministry of the Environment, Conservation and Parks (MECP); Revised June, 2006). Table 1 also contains historic data collected during 2011 from PW11-1. The laboratory certificates of analysis (including the trace metals and VOC analyses) are also included (Attachment 2).

Analytical results of the groundwater sample collected from PW11-1 on March 9, 2022 indicate an AO exceedance for colour, which was measured to be 96 TCU, above the AO of 5 TCU (MECP, 2006). This colour result from the lab is not consistent with the observations in the field at the time of sampling (i.e., the sample was described as being clear and colourless when collected), and the lab result is considered to be anomalous and not representative of the raw water quality from PW11-1. This can occur for a number of reasons since pH or temperature-dependant reactions may occur in the sampling bottle between sample collection and lab analysis. The sample collected from PW11-1 on August 30, 2022 for volatile organic compounds (VOC) analysis was also described as clear and colourless. To confirm the colour measurement from PW11-1, a confirmatory sample was collected on September 30, 2022. The field measurement of colour on this date was below 5 TCU, the minimum level that can be measured using the Hach 900 colour meter. The lab measurement of true colour was 2 TCU (i.e., below to AO for colour and below the treatability limit of 7 TCU under Procedure D-5-5). Additionally, the colour results from 2011 were less than 2 TCU (refer to Attachment 1). Based on the field observations during sampling (consistently clear and colourless), the field measured colour and laboratory result for the confirmation sample collected on September 30, 2022, and the 2011 colour results, it is concluded that the groundwater from PW11-1 is below the AO for colour.

As commonly found in this area of Ontario, the concentration of hardness was 305 mg/L, above the OG of 100 mg/L (MECP, 2006). Hardness in this concentration can be treated with conventional water softening equipment. JLR has included water softeners in the treatment system design to address hardness concerns. It is recommended that this equipment be used to treat hardness to bring it below the OG.

The laboratory-measured concentration of hydrogen sulphide was 0.21 mg/L, above the AO of 0.05 mg/L (MECP, 2006). Hydrogen sulphide is typically removed from water by aeration or by chemical oxidation. Hydrogen sulfide does not have a maximum allowable limit in Procedure D-5-5, and the AO of 0.05 mg/L is an aesthetic (taste/odour) objective to produce palatable water for consumption. Based on the raw water quality data and supplier recommendations, JLR has included iron/sulphur removal filters in the water treatment system design. The filters include an air intake valve to assist with oxidizing hydrogen sulfide in the incoming water stream prior to filtration via the vessel media. Since taste/odour concerns are highly subjective, JLR has also included a taste/odour removal filter integral to the water bottle station, and a point of use reverse osmosis (RO) unit at a dedicated kitchen sink tap. It is recommended that this equipment be used to treat hydrogen sulphide to bring it below AO.

The turbidity concentration measured in the sample was 13.2 NTU, greater than the AO of 5 mg/L (applicable at the point of consumption). In accordance with Procedure D-5-5, the treatability limit for turbidity is 5 NTU for non-disinfected water supplies. However, JLR’s water treatment system includes iron/sulphur removal filters, water

softeners, and cartridge filters designed to treat turbidity at these levels. It is recommended that this equipment be used to treat turbidity to bring levels below the AO.

The sodium concentration was 46 mg/L, which is below the aesthetic objective for sodium in drinking water of 200 mg/L. However, in accordance with Procedure D-5-5, the local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

The iron concentration was 1.63 mg/L, above the AO of 0.30 mg/L. In accordance with Procedure D-5-5, the treatability limit for iron is 10 mg/L. Iron in this concentration can be treated with conventional water softening equipment or manganese greensand filters. JLR's water treatment design includes iron/sulphur removal filters and water softeners intended to treat iron. It is recommended that this equipment be used to treat iron to bring it below the AO.

The manganese concentration was 0.06 mg/L, slightly above the AO of 0.05 mg/L. In accordance with Procedure D-5-5, the treatability limit for manganese is 1.0 mg/L. Manganese in this concentration can be treated with conventional water softening equipment or manganese greensand filters. JLR's water treatment design includes iron/sulphur removal filters and water softeners intended to treat manganese. It is recommended that this equipment be used to treat manganese to bring it below the AO.

All of the other results of chemical analysis for PW11-1 were below the respective MACs and AOs (see Table 1). The concentrations of trace metals were below the applicable MAC, AO or OG (see lab report 1976973 in Attachment 2).

No VOCs were detected above their respective detection limits.

JLR has prepared a water treatment system design with several components intended to work together to effectively provide acceptable water quality. The water treatment system will include equipment suitable for providing safe drinking water for consumption per Ontario Drinking Water Quality Standards (O.Reg 169/03) and the Guidelines for Canadian Drinking Water Quality, and it is recommended that HONI install this equipment to treat the groundwater from PW11-1. Based on information provided by JLR, HONI plans to install the following water treatment equipment: two parallel iron/sulphur filters (both duty), one water softener, two parallel cartridge filters (one duty, one stand-by), and one ultraviolet (UV) disinfection unit. A cartridge filter will be installed at the facility bottle fill station and a point-of-use reverse osmosis (RO) unit will be installed at a dedicated kitchen sink tap for additional taste/odour treatment that may not be fully addressed by the water treatment system. All treatment system components will be certified for use in potable water applications per applicable NSF International standards and Canadian Standards Association (CSA) standards.

## Discussion

The groundwater quality at well PW11-1 indicates that the water quality continues to meet applicable standards or objectives for the analyzed parameters, with the exception of hydrogen sulphide, turbidity, iron, and manganese. Treatment may be necessary to reduce the levels of hydrogen sulphide, turbidity, iron and manganese below the AOs. Common techniques for treating hydrogen sulphide, iron and manganese include water softeners, manganese greensand filters or other oxidizing media. Field assessment of colour has consistently shown that the water from this well is clear and colourless upon sample collection. The elevated colour level measured in the



laboratory is assumed to be attributed to the elevated iron concentration, and treatment for iron is likely to be effective at reducing the colour level potentially to below the AO.

Turbidity was previously elevated in the samples collected in 2011 from PW11-1. Based on these elevated levels, a strategy was developed to reduce the turbidity of the groundwater at this well to below 1 NTU in order to meet the health-related objective under Table 2 of Procedure D-5-5. On December 22, 2011, the well was surged by the well driller and pumped at a rate of approximately 53 L/min (14 US GPM) for 6.5 hours. Just before pump shut-off, the field turbidity was measured to be 0.72 NTU, below the health-related objective under Procedure D-5-5. While repeating this approach could potentially reduce the 2022 turbidity levels to below 1 NTU, treatment using a carbon filtration system and/or reverse osmosis is recommended based on the reported low water use from this well.

Golder's 2012 report concluded that well PW11-1 was capable of supplying at least 16,350 L/day (i.e., more than the current estimated daily water demand for Phase 2 of the site). This capacity remains sufficient to provide water supply to Phase 2 of the development.

The water supply well formerly used for residential water supply at the now-demolished residence should be decommissioned in accordance with Ontario Regulation 903.

### **Updated Terrain Analysis**

The February 2012 Golder report included a terrain analysis based on a preliminary design concept. The design has since progressed and the total daily design sanitary sewage flow has been refined from the assumptions in the February 2012 report to be up to 10,000 L/day. The following discussion presents an updated terrain analysis that incorporates the new total daily design sanitary sewage flow.

A nitrate dilution model was utilized to assess the potential impact of septic effluent on the properties adjoining 3440 Frank Kenny Road. The net potential infiltration was based on the regional climatic data for the Ottawa area provided by Environment Canada. A maximum of 35 employees was assumed based on information provided by Hydro One. The background nitrate concentration was assumed to be less than 0.1 mg/L based on the groundwater sample taken from borehole BH11-5 (Golder, 2012), and the nitrate concentration of the effluent was assumed to be 40 mg/L as per the guidance in MECP Guideline D-5-4. A nitrate pre-treatment system is being designed for the operations facility, and the treatment unit will be constructed as a double-pass system. As per literature from Waterloo Biofilter, a double-pass system can achieve between 50 to 65% nitrogen reduction. A 50% reduction in nitrogen concentrations is therefore assumed for the purposes of this impact assessment. The site area used in the assessment was 2.6 hectares. The nitrate dilution calculation is provided in Attachment 3.

With regard to treatment and dispersal of effluent from the leaching beds, the maximum nitrate concentration at the property boundary was calculated to be 8.7 mg/L, less than the ODWQS of 10 mg/L. It should be noted that this calculation is conservative because many of the 35 employees will spend the majority of their workday away from the operations facility, and the number of full-day equivalent employees at the facility will be less than 10. It is concluded that the impact of the proposed operations facility on groundwater at the downgradient property boundary is considered acceptable in accordance with MECP Guideline D-5-4.



The source protection mapping in the Source Protection Information Atlas<sup>1</sup> illustrates that the site does not fall within a significant groundwater recharge area. The site does fall within an area marked as a vulnerable aquifer. Based on the results of the impact assessment, no potential impacts to nearby off-site groundwater users were identified.

Percolation/infiltration testing is not deemed to be required at this site. Based on the existing identified soils, a percolation rate (T) of 50 min/cm was estimated for the purposes of the septic design. Because this is the maximum value used in determining the size of the proposed leaching bed, it is considered a conservative estimate.

## Conclusions

Apart from the updated information presented here, the remaining conclusions and recommendations in the February 2012 Golder report (included in Attachment 1) remain valid.

## Closure

Should you have any questions or require further information, please do not hesitate to contact the undersigned.

**WSP Canada Inc.**



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CAMC/JPAO/rk

Attachments: Table 1 – Summary of Water Quality Results  
Attachment 1 – February 2012 Golder Report  
Attachment 2 – Water Quality Summary and Lab Reports 1973087, 1976973, 1985044 and 1987084  
Attachment 3 – Updated Nitrate Dilution Calculation

[https://golderassociates.sharepoint.com/sites/152302/project files/6 deliverables/well sampling/21493887-tm-rev0-well resampling\\_2023-05-02.docx](https://golderassociates.sharepoint.com/sites/152302/project%20files/6%20deliverables/well%20sampling/21493887-tm-rev0-well%20resampling_2023-05-02.docx)

## References

Golder Associates Ltd., 2012. Hydrogeology, Terrain Analysis and Impact Assessment Study, 3406-3450 Frank Kenney Road. Report No. 11-1122-0129(3000), February 2012.

Ontario Ministry of the Environment, Conservation and Parks, 2006. Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, PIBS 4449e01.

<sup>1</sup> <https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA>

**TABLE 1**

# Summary of Water Quality Results

**Table 1**  
**Summary of Water Quality Results**

Parameter	Unit	ODWQS (169/03)- Health <sup>(1)</sup>	ODWQS- AO <sup>(2)</sup>	ODWQS- OG <sup>(3)</sup>	PW11-1	PW11-1	PW11-1	PW11-1
					07-Nov-2011	07-Nov-2011	22-Dec-2011	09-Mar-2022
					S-1	S-4	PW11-1	HYDRO
<b>Bacterial</b>								
Escherichia coli	cfu/100ml	0	--	--	0	0	--	0
Fecal Coliform	cfu/100ml	--	--	--	0	0	--	0
Fecal Streptococci, Kf Agar	cfu/100ml	--	--	--	0	0	--	--
Heterotrophic Plate Count	cfu/ml	--	--	-- <sup>(4)</sup>	12	12	--	0
Total Coliform	cfu/100ml	0	--	--	<b>5</b>	<b>2</b>	--	0
<b>General Chemistry</b>								
Alkalinity (Total as CaCO3)	mg/l	--	--	500	284	295	--	290
Ammonia Nitrogen	mg/l	--	--	--	0.76	0.70	--	0.502
Chloride	mg/l	--	250	--	89	90	--	61
Chlorine, Total (Field)	mg/l	--	--	--	0.01	0	--	--
Chlorine, Free (Field)	mg/l	--	--	--	0	0	--	--
Color	color unit	--	5	--	<2	<2	--	<b>96</b>
Conductivity	uS/cm	--	--	--	848	853	--	747
Conductivity (Field)	uS/cm	--	--	--	823	813	--	2848
Dissolved Organic Carbon	mg/l	--	5	--	1.5	1.2	--	1.6
Fluoride	mg/l	1.5	--	--	0.29	0.27	--	0.27
Hardness, Calcium Carbonate	mg/l	--	--	100	297	279	--	<b>305</b>
Hydrogen Sulfide	mg/l	--	0.05	--	<b>2.88</b>	<0.10	--	<b>0.21</b>
Hydrogen Sulfide (Field)	mg/l	--	0.05	--	<b>2</b>	<b>2</b>	--	--
Ion Balance	no units	--	--	--	1.04	0.94	--	1.00
Nitrate as N	mg/l	10.0	--	--	0.14	<0.10	--	<0.10
Nitrite as N	mg/l	1.0	--	--	<0.10	<0.10	--	<0.10
Nitrogen, Total Kjeldahl	mg/l	--	--	--	0.74	0.87	--	0.629
pH	-	--	--	8.5	7.96	8.03	--	7.82
pH (Field)	-	--	--	8.5	7.6	7.5	--	7.15
Sulphate	mg/l	--	500 <sup>(5)</sup>	--	22	22	--	35
Tannin & Lignin	mg/l	--	--	--	<0.1	<0.1	--	<1.0
Temperature (Field)	deg c	--	15	--	11.4	11	--	11
Total Dissolved Solids	mg/l	--	500	--	<b>551</b>	<b>554</b>	--	486
Turbidity	ntu	--	5 <sup>(6)</sup>	-- <sup>(7)</sup>	<b>102</b>	<b>37.1</b>	--	<b>13.2</b>
Turbidity (Field)	ntu	--	5 <sup>(6)</sup>	-- <sup>(7)</sup>	<b>91.9</b>	<b>26.9</b>	0.72	--
<b>Metals</b>								
Calcium	mg/l	--	--	--	76	74	--	94
Iron	mg/l	--	0.3	--	<b>1.48</b>	<b>0.35</b>	--	<b>1.63</b>
Magnesium	mg/l	--	--	--	26	23	--	17
Manganese	mg/l	--	0.05	--	0.05	0.03	--	<b>0.06</b>
Potassium	mg/l	--	--	--	8	6	--	5
Sodium	mg/l	--	200 <sup>(8)</sup>	--	66	60	--	46
<b>Phenols</b>								
Phenolics, Total Recoverable	mg/l	--	--	--	0.002	<0.001	--	<0.001

Created by:CAMC  
Checked by:KAM

**ATTACHMENT 1**

**February 2012 Golder Report**



February 2012

## REPORT ON

# Hydrogeology, Terrain Analysis and Impact Assessment Study 3406-3450 Frank Kenny Road

**Submitted to:**

J.L. Richards & Associates Limited  
864 Lady Ellen Place  
Ottawa, Ontario  
K1Z 5M2

REPORT



**Report Number:** 11-1122-0129 (3000)

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- 5 copies - City of Ottawa
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## Table of Contents

<b>1.0 INTRODUCTION.....</b>	<b>1</b>
1.1 Scope of Work .....	1
1.2 Impact Assessment .....	2
1.3 Applicable Environmental Criteria.....	2
<b>2.0 BACKGROUND INFORMATION.....</b>	<b>3</b>
2.1 Surficial Geology.....	3
2.2 Bedrock Geology .....	3
2.3 Hydrogeology.....	3
<b>3.0 TERRAIN ANALYSIS .....</b>	<b>5</b>
3.1 Field Investigation Program .....	5
3.2 Subsurface Conditions.....	5
3.3 Class IV Sewage Disposal Systems .....	5
<b>4.0 HYDROGEOLOGY STUDY .....</b>	<b>7</b>
4.1 Field Investigation Program .....	7
4.1.1 Health and Safety.....	7
4.1.2 Well Construction.....	7
4.1.3 Pumping Test.....	7
4.1.4 Groundwater Sampling .....	8
4.2 Field Investigation Results.....	8
4.2.1 Subsurface Conditions .....	8
4.2.2 Pumping Test and Observation Wells .....	8
4.2.3 Groundwater Analytical Results .....	9
4.2.3.1 PW11-1 (S-1 and S-4) .....	9
4.2.3.2 Residential Well (S-2) .....	10
4.2.3.3 Bradley Bus Well (S-3) .....	11
<b>5.0 IMPACT ASSESSMENT.....</b>	<b>13</b>
<b>6.0 SUMMARY AND CONCLUSIONS .....</b>	<b>14</b>
<b>7.0 LIMITATIONS AND USE OF REPORT .....</b>	<b>15</b>



**8.0 CLOSURE..... 16**  
**REFERENCES..... 17**

**TABLES**

Table 1: Summary of Groundwater Analytical Results, 3406 and 3450 Frank Kenny Road

**FIGURES**

Figure 1: Key Plan

Figure 2: Site Plan

Figure 3: Surficial Geology

Figure 4: Trend in Depth to Bedrock

Figure 5: Bedrock Geology

Figure 6: Groundwater Level Drawdown, PW11-1

Figure 7: Groundwater Level Drawdown, Bradley Bus Well and Residential Well

**APPENDICES**

**APPENDIX A**

Water Well Record, Bradley Bus Well

**APPENDIX B**

Records of Boreholes BH11-3, BH11-4, BH11-5, BH11-6 and BH11-7 and Test Pits TP11-1, TP11-2, TP11-3 and TP11-4

**APPENDIX C**

Ontario Building Code Tables (Sewage Systems)

**APPENDIX D**

Water Well Record, PW11-1

**APPENDIX E**

Raw Pumping Test Data and Transmissivity Calculations

**APPENDIX F**

Laboratory Certificates of Analysis

**APPENDIX G**

Nitrate Dilution Calculation



## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) was retained by J.L. Richards & Associates Limited (JLR), on behalf of 743120 Ontario Inc., to conduct a hydrogeology, terrain analysis and impact assessment study in support of a proposed site of the future Hydro One Networks Inc. (HONI) Orleans Service Centre in Ottawa, Ontario (Figure 1). The property is comprised of two civic addresses, 3406 and 3450 Frank Kenny Road Site (see Figure 2), and is located in an industrial/agricultural area adjacent to the Village of Navan. The property is 5.32 hectares (13.16 acres) in area and is topographically flat. The northern part of the Site (3406 Frank Kenny Drive) is 2.53 hectares (6.26 acres) in area and is currently occupied by M. L. Bradley Bus Lines (Bradley), while the southern portion of the Site (3450 Frank Kenny Drive) is 2.79 hectares (6.9 acres) in area and is occupied by a residential bungalow and agricultural land (leased to a tenant by Bradley). HONI will initially lease a small portion of the south parcel of the Site (agricultural land). HONI will eventually lease to own 2.90 hectares south of the bus operation.

HONI proposes to build an operations facility on the south parcel. We understand that the proposed operations facility building will be approximately 30,000 square feet in size and will house up to 35 employees. It is proposed that water supply to the operations facility will be provided by a new water supply well. This study has been prepared based on estimates of the future staffing levels provided to Golder, with the estimated water demand equal to approximately 5,000 L/day.

The purpose of the hydrogeology and terrain analysis study is to determine the following:

- If adequate quantities of potable water are available for the proposed development;
- If the soils are suitable for the installation of an on-site sewage disposal system; and,
- If the impact from the sewage system on downgradient water resources is within acceptable limits.

### **1.1 Scope of Work**

The scope of work for the hydrogeology and terrain analysis study was based on the work program outlined in the Golder proposal to JLR, dated June 17, 2011. The hydrogeology study consisted of the following:

- Collection of background information for the site and surrounding area;
- Drilling of one test well on the site to determine the quality and quantity of groundwater available for water supply;
- Conducting a pumping test on the test well consisting of a pumping phase (6 hours) followed by a recovery phase (up to 10 hours);
- Monitoring of groundwater levels during the pumping and recovery phases in the pumping well and in existing water wells located at the Bradley office and at the nearby residence;
- Collection of groundwater samples from the pumping well after one hour of pumping and just before pump shut-off;
- Collection of groundwater samples at the residence and at the Bradley office; and,





- Submission of these groundwater samples for the analysis of chemical, physical and bacteriological parameters standard to subdivision supply requirements.

The terrain analysis consisted of the following:

- The excavation of four test pits and an inspection of the materials encountered;
- A review of materials encountered during drilling of seven boreholes completed as a part of the geotechnical investigation for the site (Golder, 2012); and,
- Installation of a shallow monitoring well in the clay overburden, collection of a groundwater sample and submission of this sample for analysis of nitrate.

## **1.2 Impact Assessment**

A groundwater impact assessment was conducted in accordance with MOE Procedure D-5-4 (MOE, 1996b). Although Procedure D-5-4 does not strictly apply to this type of development, the City of Ottawa requested, during the Pre-Application consultation meeting held October 18, 2011, that the hydrogeological report incorporate an impact assessment of groundwater resources with respect to hazardous materials storage at the site.

## **1.3 Applicable Environmental Criteria**

The procedures for the assessment of potential groundwater impact generally followed the MOE Guideline entitled “Technical Guideline for Individual On-site Sewage Systems: Water Quality Impact Risk Assessment”, dated August 1996 (Guideline D-5-4). It is assumed that the sewage system will be designed to be a small sewage system (handling no more than 10,000 L/day of effluent). The terrain analysis was not intended to provide specific design of the on-site sewage disposal system, but provided general recommendations for the type of system that would be appropriate for the site.

The procedures for the assessment of water supply for the site generally followed the Ministry of the Environment (MOE) guideline entitled, “Technical Guideline for Private Wells: Water Supply Assessment,” dated August 1996 (MOE Procedure D-5-5).



## 2.0 BACKGROUND INFORMATION

### 2.1 Surficial Geology

Published geological mapping indicates that in the area of 3450 Frank Kenny Road, surficial materials consist of offshore marine deposits (clay, silty clay and silt) and glacial till (see Figure 3, Surficial Geology). In the wider area, organic deposits, deltaic and estuary deposits and exposed bedrock are also present. Published geological mapping also indicates that the depth to bedrock is expected to be approximately 2 to 15 metres (Figure 4).

The well record from the existing water supply well at the Bradley office described 5.8 metres of clay underlain by 3.7 metres of glacial till (hardpan) over shale bedrock (Appendix A). At PW11-1, based on the well record, 8.9 metres of silty clay was found to overlie shale bedrock.

### 2.2 Bedrock Geology

Two bedrock units are indicated to be exposed in the area of the site: the Lindsay Formation and the overlying Billings Formation which are both Upper Ordovician in age (see Figure 5, Bedrock Geology). The Lindsay Formation consists of fossiliferous limestone with shaley partings while the Billings Formation consists of non-calcareous shale with thin limestone interbeds (Williams, 1991). Aquifers in the Lindsay Formation are restricted to seams that are in the calcareous shale layers (GSC, 2004). In the Billings Formation, supply is generally sufficient for domestic use with thick sections with no water. The quality is generally poor with mineral content in excess of accepted levels; aquifers commonly yield saline and sulfurous water (GSC, 2004).

### 2.3 Hydrogeology

A hydrogeological investigation of the Navan area water supply was conducted by Golder (Golder, 2001). The geology was found to consist of up to 10 m of clay followed by a glacial till aquifer underlain by bedrock of the Billings Formation shale (and/or dark grey to black limestone of the Eastview formation), underlain by the Gull River Formation limestone. Background information indicated that the gravel till was the best source of water and that the shale and limestone were poor water quality producers.

Golder also conducted a desktop review to assess the potential for provision of public water and wastewater services to all privately serviced villages in the City of Ottawa, including the village of Navan (Golder, 2007). The assessment was conducted for the area within 1 kilometre of the village boundaries, and examined information sources such as City of Ottawa base mapping, Ministry of Environment (MOE) water well information system (WWIS) and available mapping of topography, surficial and bedrock geology, drift thickness and surface water bodies. Municipal water supply and waste water services are not available at the site.

Based on an analysis of the WWIS for wells located within 1 km of the village of Navan, 81 overburden wells and 216 bedrock wells were identified. The well depths were reported to be up to 100 metres, with 88% of wells being 30 metres deep or less. Of the overburden wells, 90% reported well yields of 20 L/min/m or less; 36% of wells were reported as having fresh water and 64% of wells had salty water. Of the bedrock wells, 91% reported well yields of 20 L/min/m or less; 54% of wells were reported as having fresh water and 46% of wells had salty water.

Groundwater use within the vicinity of the site is limited to private water supply wells for residences and small businesses. Four groundwater users were identified within 500 metres of the site:

- 1) The Bradley Bus office well (3406 Frank Kenny Road);



- 2) On-site residential well (3450 Frank Kenny Road);
- 3) Private well at the property immediately north of the site (3372 Frank Kenny Road); and,
- 4) Private well located south of the site (1533 Colonial Road).



## 3.0 TERRAIN ANALYSIS

### 3.1 Field Investigation Program

Test pits TP11-1, TP11-2, TP11-3 and TP11-4 and boreholes BH11-4 and BH11-5 were advanced in the area of the proposed on-site sewage disposal system. Details of the subsurface conditions at each location are presented on the Record of Test Pits in Appendix B. The locations of the test pits are shown on Figure 2.

A groundwater sample was collected from the standpipe installed in borehole BH11-5 and submitted for analysis of nitrate in order to determine the background nitrate concentration.

### 3.2 Subsurface Conditions

This section provides a summarized account of the subsurface soils and groundwater conditions on the site based on the information obtained from the test pits completed on October 31, 2011. It is noted that in some cases the stratigraphic boundaries within the overburden represent a transition between soil types rather than an exact plane of geologic change.

Brown topsoil with a thickness of 0.15 metres was encountered at ground surface at all four test pit locations. Grey brown silty clay was found below the topsoil at all test pit locations. At test pit TP11-2, 1.40 metres of grey brown silty sand with some gravel and clay, with cobbles, and boulders (glacial till) was encountered below the silty clay; however, the sample taken from this layer was found to have a high clay content and was too fine for grain size analysis. The test pits were all terminated in the silty clay at depths of 1.60 to 2.00 mbgs, with the exception of test pit TP11-2 which was terminated in the glacial till at 2.40 mbgs. Groundwater seepage was observed in the test pits at depths of 1.50 to 2.00 mbgs.

Shale was encountered at depths of 3.1 to 4.3 mbgs in boreholes BH11-4, BH11-5, BH11-6 and BH11-7.

A nitrate concentration of less than 0.1 mg/L was measured in the groundwater sample collected from borehole BH11-5.

### 3.3 Class IV Sewage Disposal Systems

The following sewage system recommendations are based on a conventional Class IV Sewage System comprised of a septic tank and an absorption trench leaching bed. Design parameters contained in this section are derived from the 2006 Ontario Building Code (OBC), and are intended as guidelines only with respect to the feasibility of constructing a system at the proposed operations building. Prior to construction of a sewage system, the system will be designed for the proposed operations building.

For the purpose of demonstrating that this site has adequate land area for sewage disposal, the most conservative soil conditions and largest treatment and disposal area requirements were assumed. It is our understanding that total sewage flows are estimated to be in the range of 3,000 L/day to 5,000 L/day, based on estimates of future staffing levels of 35 employees.

The shallow soil profile in the majority of the site is characterized by a topsoil layer followed by a silty clay unit to at least 1.40 mbgs. Groundwater was encountered below the topsoil layer in the test pits at depths of 1.50 to 2.00 mbgs.



Due to the low permeability native soils present at the site a raised to partially raised leaching bed will be required. Imported sand is required for the construction of raised leaching beds. A minimum of 500 metres of distribution piping is required for conventional leaching bed construction based on the following formula:

$$L = \frac{QT}{200}$$

where:

- L = total length of the distribution pipe in metres;
- Q = the total daily design sanitary sewage flow in litres (5,000 L/day, assuming that the sewage system will be designed to be a small sewage system; and,
- T = the design percolation time imported sand (assumed to be 10 minutes (OBC Table 2)).

The clearances around the distribution piping are to be a minimum of those shown in the OBC Table 8.2.1.6 B. The leaching bed area should be chosen such that the bed is at no steeper grade than 1V:4H, and not in an area prone to flooding. The bed area should be backfilled so as not to settle and create any depressions. The bed should be shaped to shed water, and should be protected from erosion and any compaction, stress or pressure that could negatively impact the bed.

The percolation time of the silty clay encountered below the topsoil across most of the site will exceed 50 minutes per centimetre (see OBC Table 3). The loading rate corresponding to this percolation time is equal to 4 L/m<sup>2</sup>/day (see OBC Table 8.7.4.1.A). Therefore, the leaching bed area required for a total daily design sanitary sewage flow of 5,000 L/day is 1,250 m<sup>2</sup>.

The grassed area east of the proposed building footprint, adjacent to Frank Kenny Road is approximately 4,900 m<sup>2</sup>. The 1,250 m<sup>2</sup> sewage disposal footprint can be accommodated on this area of the site.



## 4.0 HYDROGEOLOGY STUDY

It should be noted that the hydrogeology study was completed in conjunction with a Phase I ESA and geotechnical program. Results of these investigations are provided under separate cover (Golder 2011 and 2012).

### 4.1 Field Investigation Program

#### 4.1.1 Health and Safety

Prior to initiating the fieldwork, Golder developed and implemented site-specific protocols to protect the health and safety of its employees and subcontractors through the preparation of a site-specific Health and Safety Plan.

Underground Services Locators Ltd. (a private service utility locator) was retained to coordinate utility clearances with the local utility companies, and to clear the proposed borehole location prior to the initiation of the fieldwork.

#### 4.1.2 Well Construction

A new well, PW11-1, shown on Figure 2, was drilled on November 4, 2011 by Bourgeois Well Drilling Ltd. of St. Albert, Ontario. The installation of the well casing was monitored by Golder field staff to ensure that appropriate grouting procedures were followed.

#### 4.1.3 Pumping Test

A pumping test of approximately 360 minutes in duration was conducted on PW11-1 from approximately 9:30 am until 4 pm on November 7, 2011. The well was pumped at a rate of approximately 15.1 L/min (4 US GPM) for the first 32 minutes of the test, after which the rate was reduced to approximately 9.5 L/min (2.5 US GPM) due to the large amount of drawdown observed in the pumping well. At the 40-minute mark, the rate was increased to 10.2 L/min (2.7 US GPM) and at 66 minutes, increased again to 11.3 L/min (3 US GPM) for the remainder of the test. The pumping rates used in the test are summarized in the following table.

Time Period of Pumping Test	Approximate Pumping Rate
0 to 32 minutes	15.1 L/min
32 to 40 minutes	9.5 L/min
40 to 66 minutes	10.2 L/min
66 minutes to end of test	11.3 L/min

During the test, a total of 4,328 L of water was extracted from the aquifer.

The water levels were measured in PW11-1 and at two observation wells (the nearby residential well and the Bradley Bus well) manually, using an electric water level tape, and electronically, using pressure transducer loggers which took measurements at appropriate intervals. The residential well and the Bradley Bus well are located approximately 60 metres and 220 metres from PW11-1, respectively. A barometric pressure logger was used on-site for post-processing barometric compensation. Following the cessation of pumping, groundwater levels in PW11-1 and the observation wells were measured until water levels had recovered to pre-pumping levels.

Pumped water was discharged to the roadside ditch located approximately 90 metres southeast of PW11-1.



#### **4.1.4 Groundwater Sampling**

Two samples of the pumped groundwater were collected from PW11-1 (labelled S-1 and S-4) and submitted to Exova Laboratories of Ottawa for analysis of chemical, physical and microbiological analyses of parameters commonly used to evaluate water quality for residential subdivision developments. The first sample was collected 70 minutes after the start of pumping on November 11, 2011, and the second sample was collected just prior to the end of pumping.

The two existing water supply wells at the site (at the residence (labelled S-2), and at the bus company (labelled S-3)) were sampled after approximately 3.5 hours and 4 hours into the pumping test, respectively, and submitted to Exova Laboratories for chemical, physical and microbiological analyses of parameters standard to subdivision supply requirements.

The turbidity of the discharge water was monitored periodically in the field during the pumping test. Field measurements of temperature, pH, conductivity, chlorine residual, turbidity and hydrogen sulphide were taken at PW11-1 and the observation wells at the time of sampling. All analyses were compared to the applicable maximum acceptable concentrations (MAC), interim maximum acceptable concentrations (IMAC), or aesthetic objectives (AO) found in the Technical Support Document for Ontario Drinking Water Quality Standards, Objectives and Guidelines (ODWQS) (MOE, 2006).

### **4.2 Field Investigation Results**

#### **4.2.1 Subsurface Conditions**

Based on the water well record, the 152 millimetre diameter well was completed at a depth of 24.3 metres. During drilling, silty clay overburden was encountered to a depth of 8.9 metres where shale bedrock was encountered. PW11-1 was cased to a depth of 10.9 metres using steel casing. At the end of drilling, the groundwater level in PW11-1 was 9.5 metres below the top of the steel casing. The groundwater level on November 7, 2011, prior to the start of the pumping test, was 1.72 metres below the top of the steel casing. The water well record for PW11-1 is located in Appendix D.

#### **4.2.2 Pumping Test and Observation Wells**

The drawdown observed at PW11-1 during the November 2011 pumping test is illustrated on Figure 6, and the drawdown observed at the observation wells is illustrated on Figure 7. The two observation wells were in use during the pumping test on PW11-1 and the abrupt changes in the amount of drawdown measured in these wells were attributed to coincidental pumping from these wells during the pumping test. The general downward trend in measured water levels in the observation wells were assumed to represent the response from pumping PW11-1.

The water level recovery in PW11-1 achieved 95% recovery approximately 26 minutes following the cessation of pumping. The drawdown in the observation wells was small relative to the precision of the pressure transducer loggers and the manual water level tape, and relative to the drawdown caused by coincidental water usage at these wells during the pumping test. As a result, it was difficult to calculate the percent recovery at these wells following the cessation of the pumping test. The residual drawdown measured at the residential well 23 minutes after the end of pumping was 0.04 metres, and at the Bradley Bus well 53 minutes after the end of pumping was 0.02 metres.





Aquifer transmissivity was estimated using the Cooper and Jacob drawdown method (Cooper and Jacob, 1946) and the Theis recovery method (Theis, 1935) to interpret drawdown data collected during the pumping test at PW11-1 (see Appendix E). The water levels at the residential well and at the Bradley Bus well exhibited a decrease of approximately 0.06 metres and 0.03 metres, respectively, in response to pumping at PW11-1. Based on pumping well and observation well data, the aquifer transmissivity is indicated to range from approximately 0.5 to 99 m<sup>2</sup>/day, and the storativity is indicated to range from approximately 1.1x10<sup>-4</sup> to 2.6x10<sup>-4</sup>.

The wide range in transmissivity calculated from the data can be attributed to an imperfect hydraulic connection between the pumping well and the observation wells.

Based on the data obtained during the pumping test, it can be concluded that PW11-1 is capable of supplying at least 11.3 L/min (16,350 L/day). During the course of the six hour pumping test period, about 31 percent of the available drawdown was utilized while pumping at an average rate of 11.3 L/min. As such, the yield of PW11-1 considerably exceeds the assumed water usage for the new operations facility of 5,000 L/day.

Additional surging followed by pumping was performed on PW11-1 to reduce turbidity (Section 4.2.3.1). This additional well development not only reduced the turbidity, it substantially increased the yield of the well. The well maintained a pumping rate of 53 L/min for 6.5 hours and the water level measured at the end of pumping was 1.86 metres below the top of the well casing. A total of 20,700 L of water were extracted during this operation.

### **4.2.3 Groundwater Analytical Results**

The field observations and the results of the laboratory microbiological, chemical and physical analyses for the groundwater samples collected from PW11-1, the Bradley Bus well and the residential well are summarized in Table 1 following the text of this report. The certificates of laboratory analyses are included in Appendix F.

All laboratory results were compared to the applicable maximum acceptable concentrations (MAC), interim maximum acceptable concentrations (IMAC), aesthetic objectives (AO) found in the Technical Support Document for Ontario Drinking Water Quality Standards (MOE, 2006).

#### **4.2.3.1 PW11-1 (S-1 and S-4)**

Analytical results of the groundwater samples collected from PW11-1 on November 7, 2011 indicate an AO exceedance for the total dissolved solids (TDS) concentration, which was measured to be 551 mg/L after 70 minutes of pumping and 554 mg/L after 6.3 hours of pumping, just before pump shut-off. The AO for TDS is 500 mg/L (MOE, 2006). The potential for corrosion or encrustation problems associated with elevated TDS was assessed by calculating the Langelier Saturation Indices (LSI) for the 70-minute and 6.3-hour samples, which were 0.1 and 0, respectively. These LSI values are within the range generally considered stable (between -0.5 and +0.5) and indicate that corrosion or encrustation problems are unlikely.

The field hydrogen sulphide concentrations measured in the samples collected after 70 minutes and 6.3 hours of pumping were 2 mg/L and 2 mg/L, respectively, greater than the AO of 0.05 mg/L. Laboratory measured concentrations of hydrogen sulphide were 2.88 mg/L (initial) and non-detectable at the end of the test. Hydrogen sulphide in these concentrations can be treated with conventional water treatment equipment.

The field turbidity concentrations measured in the samples collected after 70 minutes and 6.3 hours of pumping were 91.9 NTU and 26.9 NTU, respectively, greater than the AO of 5 mg/L (applicable at the point of





consumption). In accordance with Procedure D-5-5, the treatability limit for turbidity is 5 NTU for non-disinfected water supplies.

Based on the elevated levels of turbidity measured in the samples taken from PW11-1, a strategy was developed to reduce the turbidity of the groundwater at this well to below 1 NTU in order to meet the health-related objective under Table 2 of Procedure D-5-5. On December 22, 2011, the well was surged by the well driller and pumped at a rate of approximately 53 L/min (14 US GPM) for 6.5 hours. Just before pump shut-off, the field turbidity was measured to be 0.72 NTU, below the health-related objective under Procedure D-5-5.

The sodium concentration measured in the samples collected after 70 minutes and 6.3 hours of pumping, was 66 mg/L and 60 mg/L, respectively, which is below the aesthetic objective for sodium in drinking water of 200 mg/L. However, in accordance with Procedure D-5-5, the local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

The iron concentrations measured in the samples collected after 70 minutes and 6.3 hours of pumping were 1.48 mg/L and 0.35 mg/L, respectively, slightly greater than the AO of 0.30 mg/L. In accordance with Procedure D-5-5, the treatability limit for iron is 10 mg/L. Iron in these concentrations can be treated with conventional water treatment equipment.

All of the bacteriological parameters with the exception of the heterotrophic plate count and total coliforms were measured below the laboratory method detection limits for the samples collected after 70 minutes and 6.3 hours of pumping. Heterotrophic plate counts of 12 and 12 cfu/mL were measured in the samples collected after 70 minutes and 6.3 hours of pumping, respectively. The presence of heterotrophic bacteria is not considered a health concern.

Total coliforms of 5 and 2 cfu/100mL were measured in the samples collected after 70 minutes and 6.3 hours of pumping, respectively, above the health-related ODWQS of 0 cfu/100mL established for water systems that are disinfected. In accordance with Procedure D-5-5, a total coliform count of less than 6 cfu/100mL is considered as indicative of acceptable water quality for a raw groundwater supply. However, despite acceptable raw water bacteriological quality, Hydro One has a policy that all groundwater supplies that service their facilities are equipped with disinfection equipment. This policy will apply to both the permanent facility and any temporary facility used by Hydro One.

All of the other results of chemical analysis for PW11-1 were below the respective MACs and AOs (see Table 1).

#### **4.2.3.2 Residential Well (S-2)**

Analytical results of the groundwater sample collected from the residential well on November 7, 2011 indicate an AO exceedance for the total dissolved solids (TDS) concentration, which was measured to be 645 mg/L. The AO for TDS is 500 mg/L (MOE, 2006). The potential for corrosion or encrustation problems associated with elevated TDS was assessed by calculating the Langelier Saturation Index (LSI), which was 0.3. This LSI value is within the range generally considered stable (between -0.5 and +0.5) and indicates that corrosion or encrustation problems are unlikely.

The field hydrogen sulphide concentration measured in the sample was 0.1 mg/L, greater than the AO of 0.05 mg/L, but within treatable limits.



The field turbidity concentration measured in the sample was 14.1 NTU, greater than the AO of 5 NTU. In accordance with Procedure D-5-5, the treatability limit for turbidity is 5 NTU. Elevated turbidity is frequently a function of insufficient well development.

The sodium concentration measured in the sample was 41 mg/L, which is below the aesthetic objective for sodium in drinking water of 200 mg/L. However, in accordance with Procedure D-5-5, the local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

The iron concentration measured in the sample collected was 1.86 mg/L, respectively, greater than the AO of 0.30 mg/L. In accordance with Procedure D-5-5, the treatability limit for iron is 10 mg/L.

The manganese concentration measured in the sample collected was 0.08 mg/L, respectively, greater than the AO of 0.05 mg/L. In accordance with Procedure D-5-5, the treatability limit for manganese is 1.0 mg/L.

All of the other results of chemical analysis for the residential well were below the respective MACs and AOs (see Table 1).

All of the bacteriological parameters with the exception of the total coliforms and heterotrophic plate count were measured below the laboratory method detection limits for the sample collected. Total coliforms of 12 cfu/100mL were measured, above the health-related ODWQS of 0 cfu/100mL established for water systems that are disinfected. A total coliforms count of less than 6 cfu/100mL is generally considered acceptable for untreated supplies. A heterotrophic plate count of 5 cfu/mL was measured. The presence of heterotrophic bacteria is not considered a health concern. The owner of the well was notified of the coliform result. It is also noted that when the site is developed, the residence will be demolished and the residential well will be abandoned in accordance with O. Reg. 903.

The presence of elevated bacterial levels in groundwater is usually specific to a particular well, as opposed to a wider problem within a water supply aquifer. Although a determination of the reason for elevated bacterial levels at the residential well is outside the scope of this study, bacteria may be present in a well due to reasons such as improper well construction, deteriorating well casing, contamination during pump maintenance, etc. No information was provided on the construction of the residential well. The slightly elevated bacterial levels detected in the residential well would not be expected to affect the water quality at PW11-1, as demonstrated by the excellent bacteriological results obtained from this well.

#### **4.2.3.3 Bradley Bus Well (S-3)**

Analytical results of the groundwater sample collected from the Bradley Bus well on November 7, 2011 indicate an AO exceedance for the total dissolved solids (TDS) concentration, which was measured to be 650 mg/L. The AO for TDS is 500 mg/L (MOE, 2006). The potential for corrosion or encrustation problems associated with elevated TDS was assessed by calculating the Langelier Saturation Index (LSI), which was 0.1. This LSI value is within the range generally considered stable (between -0.5 and +0.5) and indicates that corrosion or encrustation problems are unlikely.

The laboratory-measured turbidity concentration measured in the sample was 7.6 NTU, greater than the AO of 5 NTU; however, the field turbidity concentration measured at the time of sampling was 3.77 NTU. In accordance with Procedure D-5-5, the treatability limit for turbidity is 5 NTU.



The sodium concentration measured in the sample was 51 mg/L, which is below the aesthetic objective for sodium in drinking water of 200 mg/L. However, in accordance with Procedure D-5-5, the local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

The iron concentration measured in the sample collected was 0.82 mg/L, respectively, greater than the AO of 0.30 mg/L. In accordance with Procedure D-5-5, the treatability limit for iron is 10 mg/L.

All of the bacteriological parameters with the exception of the heterotrophic plate count were measured below the laboratory method detection limits for the sample collected. A heterotrophic plate count of 18 cfu/mL was measured. The presence of heterotrophic bacteria is not considered a health concern.

All of the other results of chemical analysis for the Bradley Bus well were below the respective MACs and AOs (see Table 1).



## 5.0 IMPACT ASSESSMENT

A nitrate dilution model was utilized to assess the potential impact of septic effluent on the properties adjoining 3450 Frank Kenny Road. The net potential infiltration was based on the regional climatic data for the Ottawa area provided by Environment Canada. The daily effluent loading was based on 125 L/day per employee, assuming that showers would be built in the operations centre. A maximum of 35 employees was assumed based on information provided by HONI. The background nitrate concentration was assumed to be less than 0.1 mg/L based on the groundwater sample taken from borehole BH11-5, and the nitrate concentration of the effluent was assumed to be 40 mg/L. The site area was assumed to be 2.90 hectares. The nitrate dilution calculation is provided in Appendix G.

With regard to treatment and dispersal of effluent from the leaching beds, the maximum nitrate concentration at the property boundary was calculated to be 9.4 mg/L, less than the ODWQS of 10 mg/L. It should be noted that this calculation is conservative since many of the 35 employees will spend the majority of their work day away from the operations facility, and the number of full-day equivalent employees at the facility will be less than 10. Nevertheless, a nitrate pre-treatment system may be considered for the operations facility, if required. It is concluded that the impact of the proposed operations facility on groundwater at the downgradient property boundary is considered acceptable in accordance with MOE Guideline D-5-4.

It is understood that the operations facility will include limited hazardous materials storage (e.g. PCBs). HONI has established procedures and guidelines for storage of hazardous materials that meet applicable provincial environmental requirements.



## 6.0 SUMMARY AND CONCLUSIONS

Based on the terrain evaluation and groundwater supply investigation carried out by Golder Associates at the site, the following summary and conclusions are provided:

- a) A septic system at the site must be constructed in accordance with the 2006 Ontario Building Code (OBC). Section 3.3 provides general septic leaching bed design considerations. Based on these considerations, the site can accommodate a septic field for the proposed operations centre. Prior to construction of a septic system, detailed design will be required;
- b) According to the nitrate dilution calculation, maximum nitrate concentration at the property boundary was calculated to be 9.4 mg/L, less than the maximum of 10 mg/L under Procedure D-5-4. It is concluded that the impact of the proposed operations facility on groundwater at the downgradient property boundary is considered acceptable;
- c) It is understood that the operations facility will include limited hazardous materials storage (e.g. PCBs). It is recommended that any hazardous materials storage on the site incorporate measures to prevent release of these materials to the environment, to prevent contamination of the aquifer from sources located at ground surface. HONI has established procedures and guidelines for storage of hazardous materials that meet applicable provincial environmental requirements;
- d) The pumping test conducted at well PW11-1 suggests that a sufficient quantity of water is available in the bedrock to satisfy a daily water consumption of 16,350 L/day, above the assumed water usage for the new operations facility of 5,000 L/day or less based on 35 employees at the proposed operations centre;
- e) The groundwater quality at well PW11-1 indicates that the water quality meets applicable standards or objectives for the analyzed parameters, with the exception of TDS, iron, hydrogen sulphide and total coliforms. Treatment may be necessary to reduce the iron and hydrogen sulphide concentrations below the AOs. Common techniques for iron include water softeners, manganese greensand filters or other oxidizing media. Corrosion or encrustation problems associated with TDS are considered unlikely. Total coliforms were measured to be 5 and 2 cfu/100mL in raw samples from the well, slightly above the health-related ODWQS of 0 cfu/100mL established for water systems that are disinfected; however, in accordance with Procedure D-5-5, a total coliform count of less than 6 cfu/100mL is considered as indicative of acceptable water quality; and,
- f) Based on the small amount of drawdown measured at the observation wells, located approximately 61 and 220 metres from PW11-1, it is not expected that the proposed use of PW11-1 would adversely affect other nearby groundwater users, including the nearby residence and the Bradley Bus office.



## **7.0 LIMITATIONS AND USE OF REPORT**

This letter report was prepared for the exclusive use of the J.L. Richards & Associates, 743120 Ontario Inc. and Hydro One Networks Inc. Should additional parties require reliance on this report, written authorization from Golder Associates Ltd. would be required. The report, which specifically includes all tables, figures and attachments is based on data and information collected during the hydrogeology assessment conducted by Golder Associates Ltd. and is based solely on the conditions of the property at the time of the field investigation, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this report.

The services performed as described in this letter report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this letter report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this letter.

The content of this letter report is based on information collected during our investigation, our present understanding of the site conditions, and our professional judgement in light of such information at the time of this letter report. This letter report provides a professional opinion and therefore no warranty is either expressed, implied, or made as to the conclusions, advice and recommendations offered in this letter report. This letter report does not provide a legal opinion regarding compliance with applicable Canadian laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statutes are subject to change.

The findings and conclusions of this letter report are valid only as of the date of this report. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this letter report, and to provide amendments as required. The groundwater supply well installed during the course of this investigation has been left in place. This well is the property of the owner/client and not Golder Associates Ltd.





## 8.0 CLOSURE

We trust this report satisfies your current needs. If you have any questions regarding this report, please contact the undersigned.

### GOLDER ASSOCIATES LTD.

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**Table 1**  
**Summary of Groundwater Analytical Results**  
**3406 and 3450 Frank Kenny Road**

Parameter	Unit	(2) (1)	(4) (3)	(6) (5)	PW11-1	PW11-1	PW11-1
		ODWQS(169/03)	ODWQS-	MOE	11/7/2011	11/7/2011	12/22/2011
		Health	AO	D-5-5	S-1	S-4	PW11-1
<b>Bacterial</b>							
Coliform	cfu/100ml	0	--	--	5	2	--
Escherichia coli	cfu/100ml	0	--	--	0	0	--
Fecal Coliform	cfu/100ml	--	--	--	0	0	--
Fecal Streptococci, Kf Agar	cfu/100ml	--	--	--	0	0	--
Heterotrophic Plate Count	cfu/ml	--	--	--	12	12	--
<b>General Chemistry</b>							
Alkalinity as CaCO <sub>3</sub>	mg/l	--	--	--	284	295	--
Ammonia Nitrogen	mg/l	--	--	--	0.76	0.70	--
Chloride	mg/l	--	250	250	89	90	--
Chlorine, Total (Field)	mg/l	--	--	--	0.01	0	--
Chlorine, Free (Field)	mg/l	--	--	--	0	0	--
Color	color unit	--	5	7	<2	<2	--
Conductivity	uS/cm	--	--	--	848	853	--
Conductivity (Field)	uS/cm	--	--	--	823	813	--
Dissolved Organic Carbon	mg/l	--	5	10	1.5	1.2	--
Fluoride	mg/l	1.5	--	--	0.29	0.27	--
Hardness, Calcium Carbonate	mg/l	--	--	--	297	279	--
Hydrogen Sulfide	mg/l	--	0.05	--	<u>2.88</u>	<u>&lt;0.10</u>	--
Hydrogen Sulfide (Field)	mg/l	--	0.05	--	<u>2</u>	<u>2</u>	--
Ion Balance	-	--	--	--	1.04	0.94	--
Nitrate as N	mg/l	10	--	--	0.14	<0.10	--
Nitrite as N	mg/l	1	--	--	<0.10	<0.10	--
Nitrogen, Total Kjeldahl	mg/l	--	--	--	0.74	0.87	--
pH	-	--	--	--	7.96	8.03	--
pH (Field)	-	--	--	--	7.6	7.5	--
Sulfate	mg/l	--	500 <sup>(8)</sup>	500	22	22	--
Tannin & Lignin	mg/l	--	--	--	<0.1	<0.1	--
Temperature (Field)	deg c	--	15	--	11.4	11	--
Total Dissolved Solids	mg/l	--	500	-- <sup>(13)</sup>	<u>551</u>	<u>554</u>	--
Turbidity	ntu	--	5 <sup>(9)</sup>	5	<u>102</u>	<u>37.1</u>	--
Turbidity (Field)	ntu	--	5 <sup>(9)</sup>	5	<u>91.9</u>	<u>26.9</u>	0.72
<b>Metals</b>							
Calcium	mg/l	--	--	--	76	74	--
Iron	mg/l	--	0.3	5 <sup>(12)</sup>	<u>1.48</u>	<u>0.35</u>	--
Magnesium	mg/l	--	--	--	26	23	--
Manganese	mg/l	--	0.05	1	0.05	0.03	--
Potassium	mg/l	--	--	--	8	6	--
Sodium	mg/l	--	200 <sup>(11)</sup>	200	66	60	--
<b>Phenols</b>							
Phenolics, Total Recoverable	mg/l	--	--	--	0.002	<0.001	--

Created by:CAMC  
Checked by:SRW  
Page 1 of 4

**Table 1**  
**Summary of Groundwater Analytical Results**  
**3406 and 3450 Frank Kenny Road**

Parameter	Unit	(2) (1)	(4) (3)	DOMESTIC WELL
		ODWQS(169/03)- Health	ODWQS- AO	11/7/2011
				S-2
<b>Bacterial</b>				
Coliform	cfu/100ml	0	--	<b>12</b>
Escherichia coli	cfu/100ml	0	--	0
Fecal Coliform	cfu/100ml	--	--	0
Fecal Streptococci, Kf Agar	cfu/100ml	--	--	0
Heterotrophic Plate Count	cfu/ml	--	--	5
<b>General Chemistry</b>				
Alkalinity as CaCO <sub>3</sub>	mg/l	--	--	312
Ammonia Nitrogen	mg/l	--	--	0.14
Chloride	mg/l	--	250	80
Chlorine, Total (Field)	mg/l	--	--	0
Chlorine, Free (Field)	mg/l	--	--	0
Color	color unit	--	5	<2
Conductivity	uS/cm	--	--	992
Conductivity (Field)	uS/cm	--	--	940
Dissolved Organic Carbon	mg/l	--	5	1.3
Fluoride	mg/l	1.5	--	0.11
Hardness, Calcium Carbonate	mg/l	--	--	471
Hydrogen Sulfide	mg/l	--	0.05	<u>0.14</u>
Hydrogen Sulfide (Field)	mg/l	--	0.05	<u>0.1</u>
Ion Balance	-	--	--	1.08
Nitrate as N	mg/l	10	--	<0.10
Nitrite as N	mg/l	1	--	<0.10
Nitrogen, Total Kjeldahl	mg/l	--	--	0.26
pH	-	--	--	7.91
pH (Field)	-	--	--	7.41
Sulfate	mg/l	--	500 <sup>(8)</sup>	95
Tannin & Lignin	mg/l	--	--	<0.1
Temperature (Field)	deg c	--	15	11.4
Total Dissolved Solids	mg/l	--	500	<u>645</u>
Turbidity	ntu	--	5 <sup>(9)</sup>	<u>28.4</u>
Turbidity (Field)	ntu	--	5 <sup>(9)</sup>	<u>14.1</u>
<b>Metals</b>				
Calcium	mg/l	--	--	169
Iron	mg/l	--	0.3	<u>1.86</u>
Magnesium	mg/l	--	--	12
Manganese	mg/l	--	0.05	<u>0.08</u>
Potassium	mg/l	--	--	3
Sodium	mg/l	--	200 <sup>(11)</sup>	41
<b>Phenols</b>				
Phenolics, Total Recoverable	mg/l	--	--	<0.001

**Table 1**  
**Summary of Groundwater Analytical Results**  
**3406 and 3450 Frank Kenny Road**

Parameter	Unit	(2) (1)	(4) (3)	BUS DEPOT WELL
		ODWQS(169/03)- Health	ODWQS- AO	11/7/2011
				S-3
<b>Bacterial</b>				
Coliform	cfu/100ml	0	--	0
Escherichia coli	cfu/100ml	0	--	0
Fecal Coliform	cfu/100ml	--	--	0
Fecal Streptococci, Kf Agar	cfu/100ml	--	--	0
Heterotrophic Plate Count	cfu/ml	--	--	18
<b>General Chemistry</b>				
Alkalinity as CaCO <sub>3</sub>	mg/l	--	--	332
Ammonia Nitrogen	mg/l	--	--	0.07
Chloride	mg/l	--	250	104
Chlorine, Total (Field)	mg/l	--	--	0.02
Chlorine, Free (Field)	mg/l	--	--	0.01
Color	color unit	--	5	2
Conductivity	uS/cm	--	--	1000
Conductivity (Field)	uS/cm	--	--	964
Dissolved Organic Carbon	mg/l	--	5	1.6
Fluoride	mg/l	1.5	--	<0.10
Hardness, Calcium Carbonate	mg/l	--	--	439
Hydrogen Sulfide	mg/l	--	0.05	<0.01
Hydrogen Sulfide (Field)	mg/l	--	0.05	0
Ion Balance	-	--	--	1.06
Nitrate as N	mg/l	10	--	<0.10
Nitrite as N	mg/l	1	--	<0.10
Nitrogen, Total Kjeldahl	mg/l	--	--	<0.10
pH	-	--	--	7.90
pH (Field)	-	--	--	7.23
Sulfate	mg/l	--	500 <sup>(8)</sup>	43
Tannin & Lignin	mg/l	--	--	<0.1
Temperature (Field)	deg c	--	15	13.2
Total Dissolved Solids	mg/l	--	500	<u>650</u>
Turbidity	ntu	--	5 <sup>(9)</sup>	<u>7.6</u>
Turbidity (Field)	ntu	--	5 <sup>(9)</sup>	3.77
<b>Metals</b>				
Calcium	mg/l	--	--	156
Iron	mg/l	--	0.3	<u>0.82</u>
Magnesium	mg/l	--	--	12
Manganese	mg/l	--	0.05	0.05
Potassium	mg/l	--	--	2
Sodium	mg/l	--	200 <sup>(11)</sup>	51
<b>Phenols</b>				
Phenolics, Total Recoverable	mg/l	--	--	<0.001

Created by:CAMC  
Checked by:SRW  
Page 3 of 4

**Footnotes:**

Tables should be read in conjunction with the accompanying document.

< value = Indicates parameter not detected above laboratory method detection limit

> value = Indicates parameter detected above equipment analytical range

-- Chemical not analyzed or criteria not defined

(01) Ontario Drinking Water Quality Standards - Health Based Standards

(02) Bold = Parameter concentration greater than ODWQS(169/03)-Health

(03) Ontario Drinking Water Quality Standards - Aesthetic Objectives. Aesthetic Objectives are established for parameters that may impair the taste, odour or colour of water or which may interfere with good water quality control practices. For certain parameters, both aesthetic objectives and health-related MACs have been derived.

(04) Underline = Parameter concentration greater than ODWQS-AO

(05) Maximum concentration considered reasonably treatable for several aesthetic parameters as found in MOE Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment, Last Revision August 1996.

(06) Italic = Parameter concentration greater than MOE D-5-5

(07) Increases in HPC concentrations above baseline levels are considered undesirable.

(08) There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L.

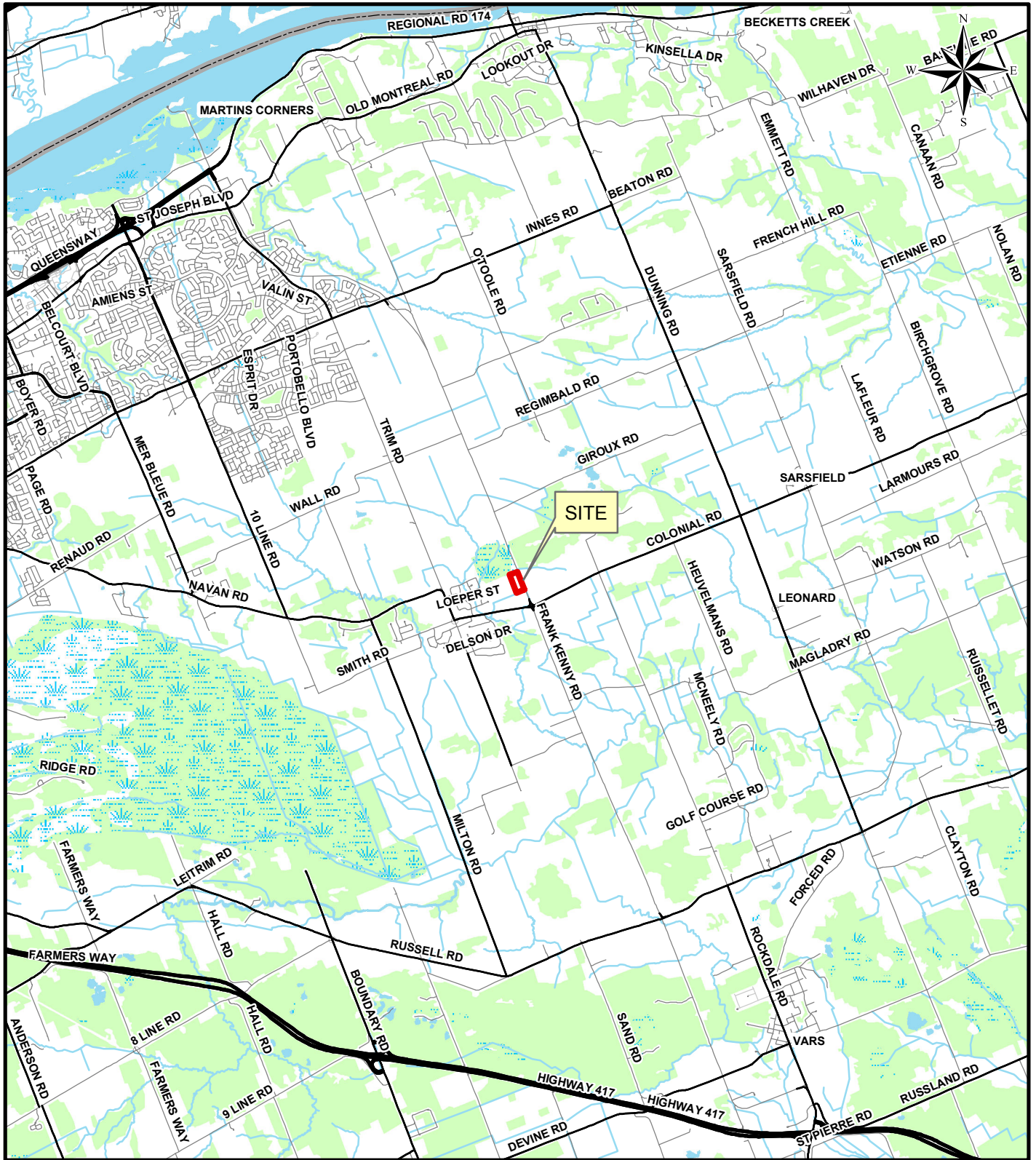
(09) Applicable for all waters at the point of consumption.

(10) The Operational Guidelines for filtration processes are provided as performance criteria in the Procedure for Disinfection of Drinking Water in Ontario.

(11) The aesthetic objective for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets.

(12) iron concentrations up to up to 5.0 mg/L treatable with water softeners or manganese greensand filters; iron concentrations between 5.0 to 10.0 mg/L treatable by oxidation with filtration through proprietary filter media or chlorination followed by sand or multimedia filtration

(13) requires written rationale that corrosion, encrustation or taste problems will not occur

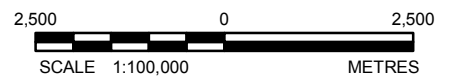



**NOTE**

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 10-1122-0129/3000

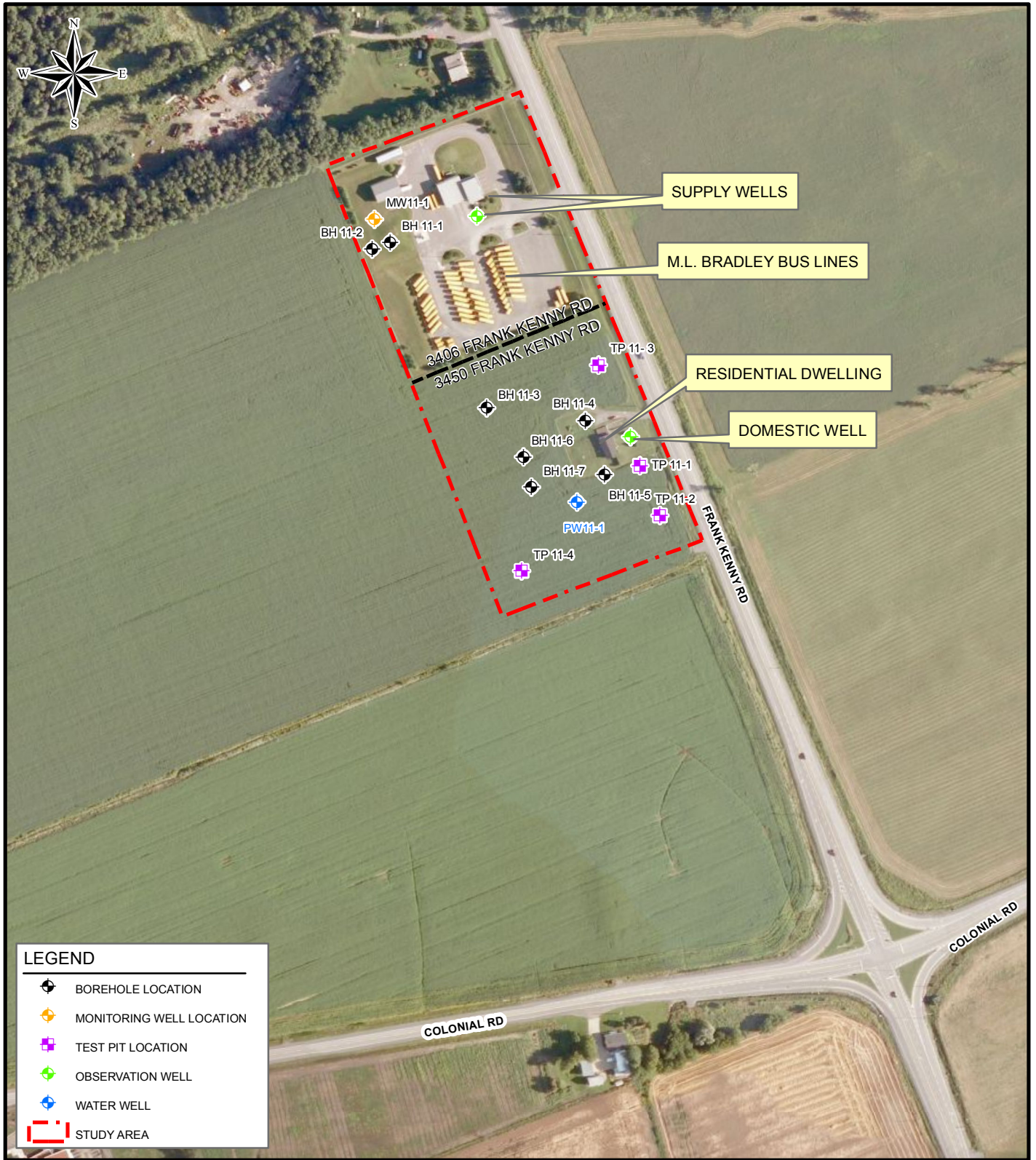
**REFERENCE**

DIGITAL BASE MAP DATA SUPPLIED BY DMTI SPATIAL INC. CANMAP, 2008  
 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: MTM ZONE 9



 Ottawa, Ontario	DATE	Nov. 2011	TITLE	<h1 style="text-align: center;">KEY PLAN</h1>		
	DESIGN	CAMC				
	GIS	BJ				
PROJECT No.	11-1122-0129	CHECK	CAMC	PROJECT TERRAIN ANALYSIS AND HYDROGEOLOGICAL STUDY 3406-3450 FRANK KENNY ROAD, OTTAWA, ONTARIO		
SCALE	AS SHOWN	REV.	0		REVIEW	SRW



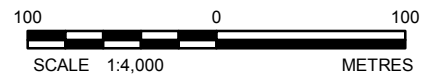


**LEGEND**

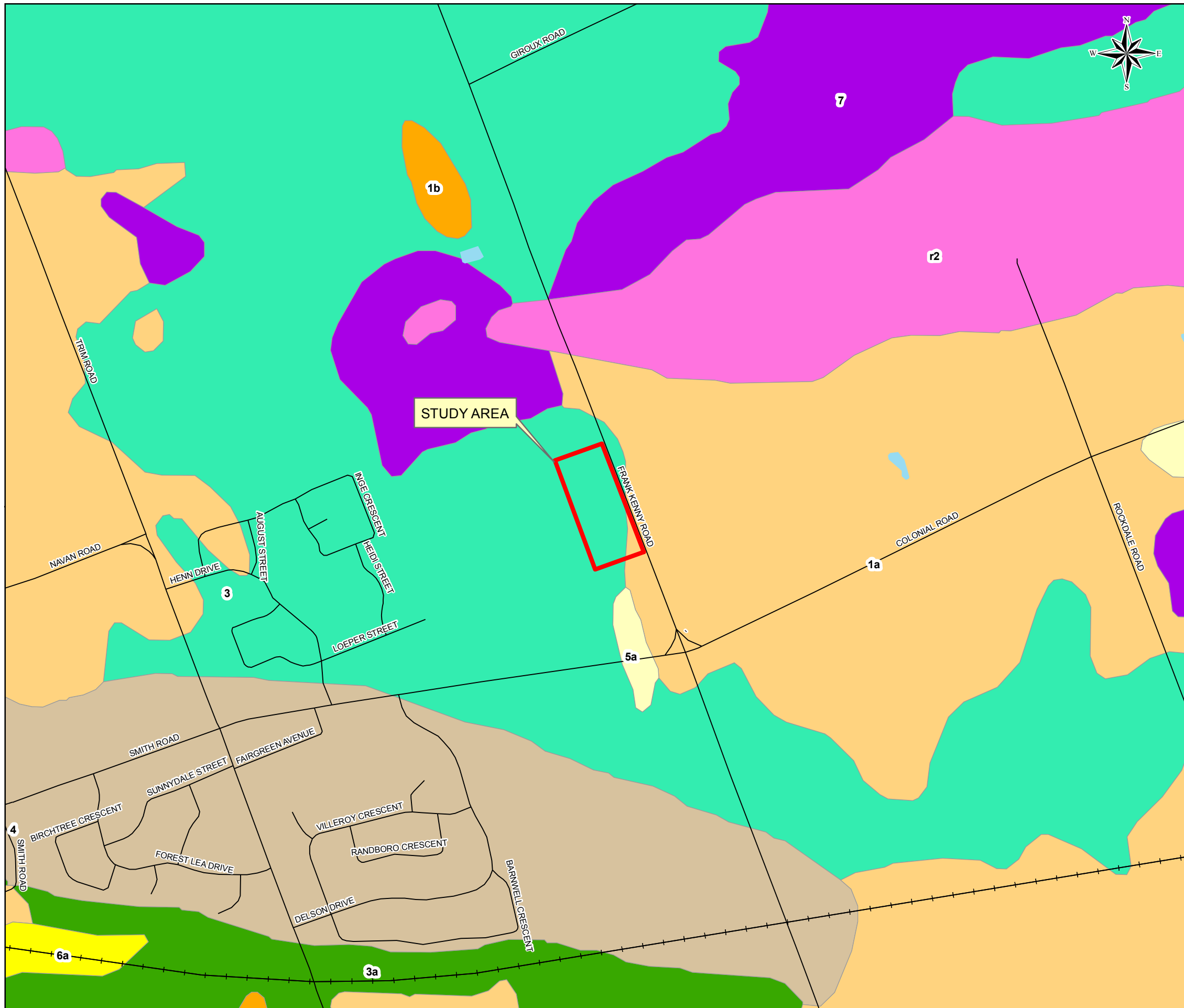
- BOREHOLE LOCATION
- MONITORING WELL LOCATION
- TEST PIT LOCATION
- OBSERVATION WELL
- WATER WELL
- STUDY AREA

**NOTE**  
 THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD.' REPORT NO. 11-1122-0129/3000

**REFERENCE**  
 DIGITAL BASE MAP DATA SUPPLIED BY ESRI CANADA 2011.  
 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18



<p><b>Golder Associates</b> Ottawa, Ontario</p>	DATE	Nov. 2011	<p><b>SITE PLAN</b></p>	
	DESIGN	CAMC		
	GIS	BJ		
PROJECT No.	11-1122-0129	CHECK	CAMC	<p>PROJECT TERRAIN ANALYSIS AND HYDROGEOLOGICAL STUDY 3406-3450 FRANK KENNY ROAD, OTTAWA, ONTARIO</p>
SCALE	AS SHOWN	REV.	0	
		REVIEW	SRW	



**LEGEND**

**SURFICIAL GEOLOGY**

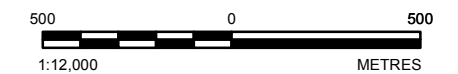
- 1a TILL, PLAIN WITH LOCAL RELIEF <5m
- 1b TILL, DRUMLINIZED
- 1c TILL, HUMMOCKY TO ROLLING WITH LOCAL RELIEF 5 TO 10 m
- 2 ICE CONTACT STRATIFIED DRIFT: GRAVEL & SAND
- 3 OFFSHORE MARINE DEPOSITS: CLAY, SILTY CLAY & SILT
- 3\_g OFFSHORE MARINE DEPOSITS: CLAY, SILTY CLAY & SILT (GULLIES & RAVINES)
- 3a OFFSHORE MARINE DEPOSITS: CLAY & SILT UNDERLYING EROSIONAL TERRACES
- 3a\_g OFFSHORE MARINE DEPOSITS: CLAY & SILT UNDERLYING EROSIONAL TERRACES (GULLIES & RAVINES)
- 4 DELTAIC AND ESTUARY DEPOSITS: MEDIUM TO FINE GRAINED SAND
- 4\_g DELTAIC AND ESTUARY DEPOSITS: MEDIUM TO FINE GRAINED SAND (GULLIES & RAVINES)
- 5a NEARSHORE SEDIMENTS: GRAVEL, SAND & BOULDERS
- 5b NEARSHORE SEDIMENTS: FINE TO MEDIUM GRAINED SAND
- 6a ALLUVIAL DEPOSITS: SILTY SAND, SILT, SAND & CLAY
- 6a\_g ALLUVIAL DEPOSITS: SILTY SAND, SILT, SAND & CLAY (GULLIES & RAVINES)
- 6b ALLUVIAL DEPOSITS: MEDIUM GRAINED STRATIFIED SAND WITH SOME SILT
- 6b\_g ALLUVIAL DEPOSITS: MEDIUM GRAINED STRATIFIED SAND WITH SOME SILT (GULLIES & RAVINES)
- 7 ORGANIC DEPOSITS: MUCK & PEAT
- d DUNE
- d\_g DUNE (GULLIES & RAVINES)
- l LANDSLIDE AREA
- l\_g LANDSLIDE AREA (GULLIES & RAVINES)
- r1 BEDROCK: INTRUSIVE & METAMORPHIC
- r2 BEDROCK: LIMESTONE, DOLOMITE, SANDSTONE & LOCAL SHALE
- r2\_g BEDROCK: LIMESTONE, DOLOMITE, SANDSTONE & LOCAL SHALE (GULLIES & RAVINES)
- zz WATER

**NOTE**

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 11-1122-0129/3000

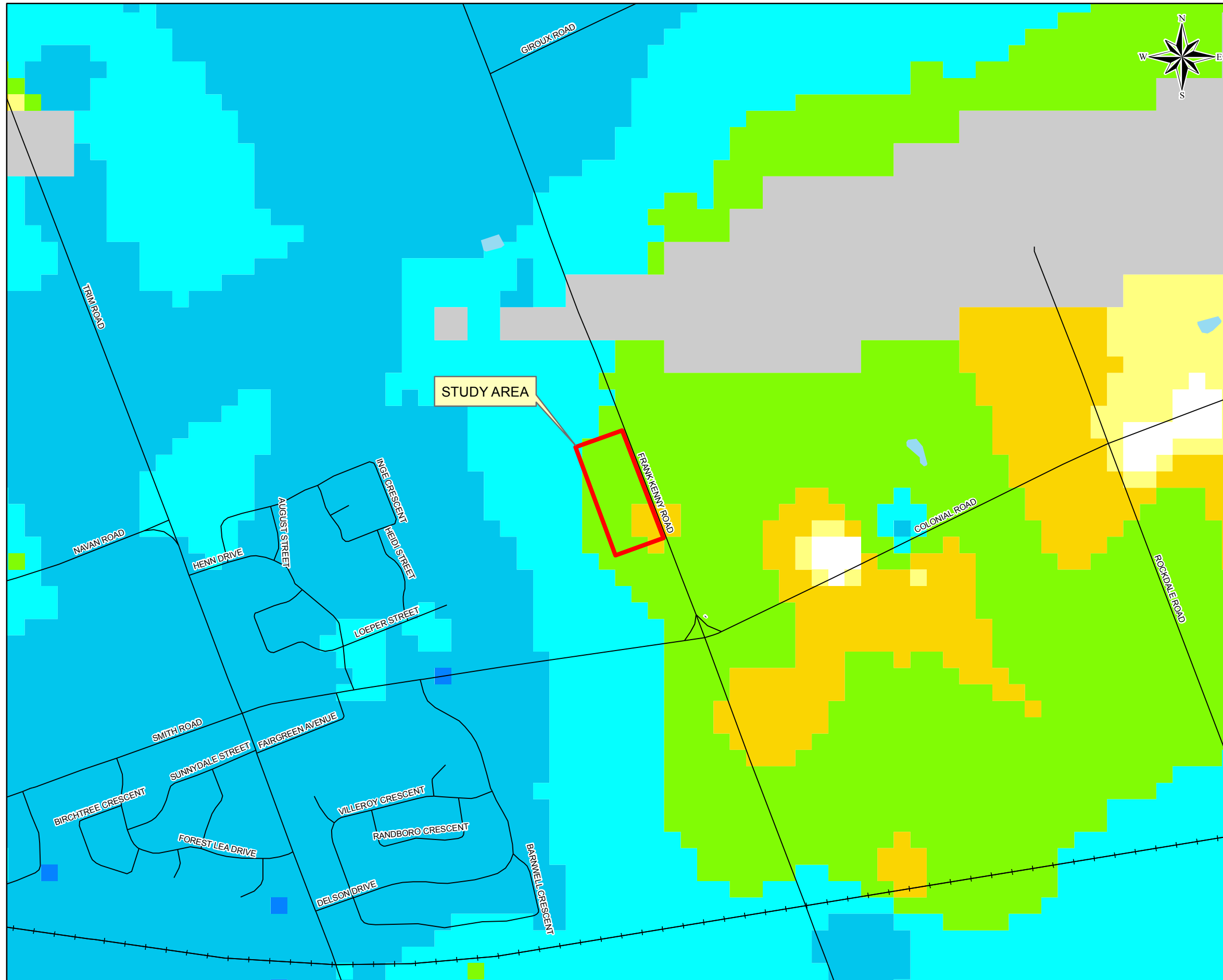
**REFERENCE**

BÉLANGER, J. R., URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE D3256, 2001  
 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83  
 COORDINATE SYSTEM: UTM ZONE 18



PROJECT			
TERRAIN ANALYSIS AND HYDROGEOLOGICAL STUDY 3406-3450 FRANK KENNY ROAD, OTTAWA, ONTARIO			
TITLE			
<b>SURFICIAL GEOLOGY</b>			
 Golder Associates Ottawa, Ontario	PROJECT No. 11-122-0129	SCALE AS SHOWN	REV. 0
	DESIGN CAMC Nov. 2011		
	GIS BJ Nov. 2011		
	CHECK CAMC Nov. 2011		
	REVIEW SRW Nov. 2011		
<b>FIGURE 3</b>			

Path: N:\Active\2011\1122 - Contaminated Lands\11-1122-0129 Hydro One Frank Kenny Road\Spatial\_IMMXD\Phase 3000\111220129-3000-04.mxd



**LEGEND**

- STUDY AREA
- RAILWAY
- ROAD
- WATERBODY

**TREND IN DEPTH TO BEDROCK (METRES)**

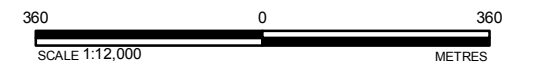
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 5
- 5 to 10
- 10 to 15
- 15 to 25
- 25 to 50
- 50 to 100
- 100 to 200

**NOTE**

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATED LIMITED REPORT No. 11-1122-0129/3000

**REFERENCE**

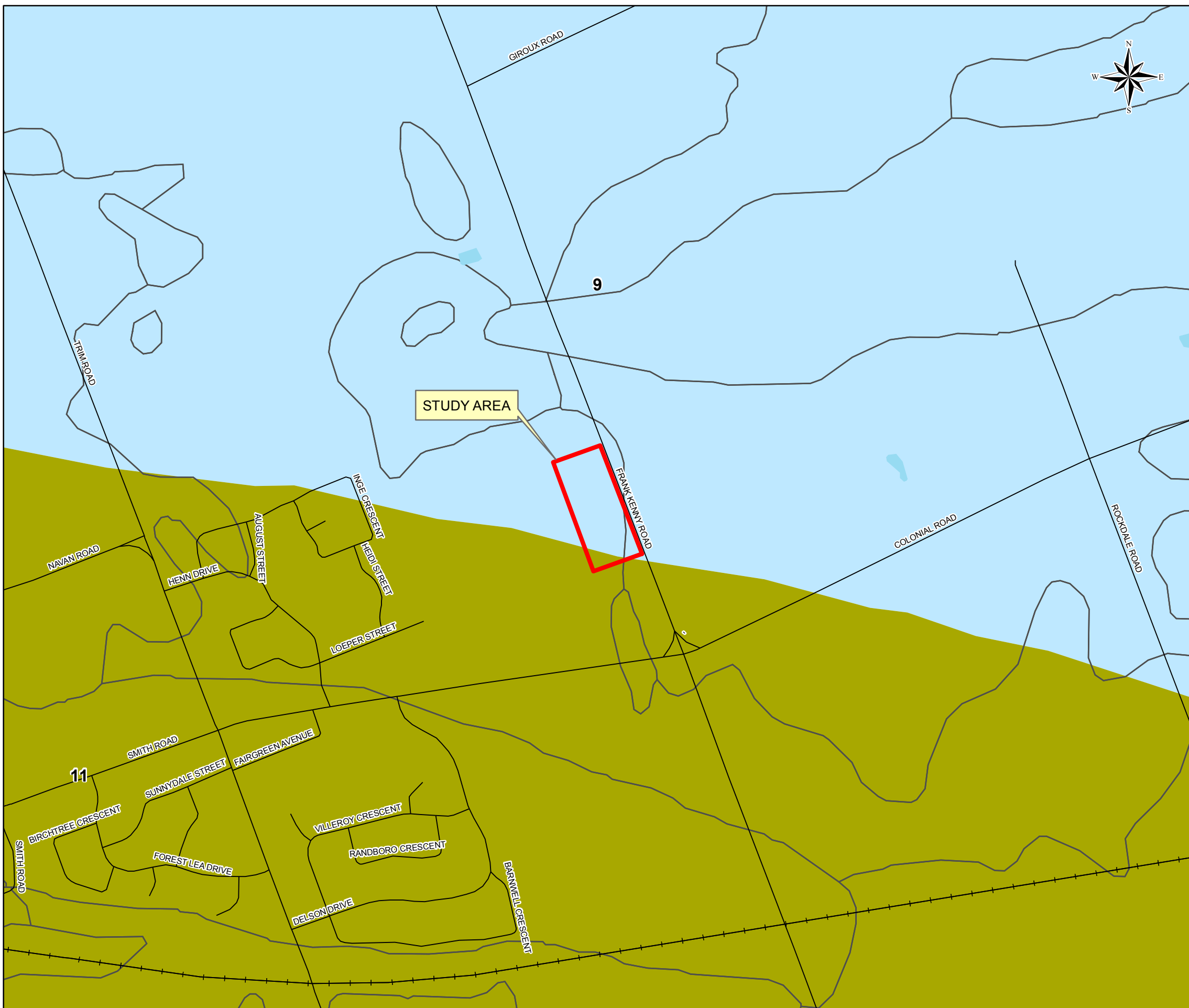
BASE DATA - CANVEC PROVIDED BY HER MAJESTY THE QUEEN IN RIGHT OF CANADA, DEPARTMENT OF NATURAL RESOURCES, 2010  
 BÉLANGER, J. R., URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE D3256, 2001  
 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18



PROJECT			
TERRAIN ANALYSIS AND HYDROGEOLOGICAL STUDY 3406-3450 FRANK KENNY ROAD, OTTAWA, ONTARIO			
TITLE			
<b>TREND IN DEPTH TO BEDROCK</b>			
	PROJECT No. 11-1122-0129		SCALE AS SHOWN
	DESIGN	CAMC	Nov. 2011
	GIS	BJ	Nov. 2011
	CHECK	CAMC	Nov. 2011
	REVIEW	SRW	Nov. 2011
<b>FIGURE 4</b>			REV. 0.0



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**LEGEND**

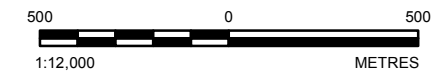
- 13** QUEENSTON FORMATION: RED TO LIGHT GREENISH GRAY SILTSTONE AND SHALE, WITH INTERBEDS OF SILTY BIOCLASTIC LIMESTONE IN LOWER PART
- 12** CARLSBAD FORMATION: INTERBEDDED DARK GRAY SHALE, FOSSILIFEROUS CALCAREOUS SILTSTONE, AND SILTY BIOCLASTIC LIMESTONE
- 11** BILLINGS FORMATION: DARK BROWN TO BLACK SHALE, WITH LAMINATIONS OF CALCAREOUS SILTSTONE
- 10** EASTVIEW FORMATION: INTERBEDDED SUBLITHOGRAPHIC TO FINE CRYSTALLINE LIMESTONE AND DARK BROWN TO DARK GREY SHALE
- MIDDLE TO UPPER ORDOVICIAN**
- 9** LINDSAY FORMATION: SUBLITHOGRAPHIC TO FINE CRYSTALLINE LIMESTONE, NODULAR IN PART, WITH INTERBEDS OF CALCARENITE AND SHALE
- 8** VERULAM FORMATION: INTERBEDDED BIOCLASTIC LIMESTONE, SUBLITHOGRAPHIC TO FINE CRYSTALLINE LIMESTONE
- 7** BOBCAYGEON FORMATION: INTERBEDDED SILTY DOLOMITE, LITHOGRAPHIC TO FINE CRYSTALLINE LIMESTONE, OOLITIC LIMESTONE, SHALE, AND FINE-GRAINED CALCAREOUS QUARTZ SANDSTONE
- 6** GULL RIVER FORMATION: INTERBEDDED SILTY DOLOMITE, LITHOGRAPHIC TO FINE CRYSTALLINE LIMESTONE, OOLITIC LIMESTONE, SHALE, AND FINE-GRAINED CALCAREOUS QUARTZ SANDSTONE
- 5** ROCKCLIFFE FORMATION: INTERBEDDED FINE-GRAINED LIGHT GREENISH GREY QUARTZ SANDSTONE, SHALEY LIMESTONE AND SHALE. LOCALLY CONGLOMERATE AT BASE, INTERBEDS OF CALCARENITE (ST. MARTIN MEMBER, 5A) AND SILTY DOLOSTONE IN UPPER PART
- LOWER ORDOVICIAN**
- 4** OXFORD FORMATION: SUBLITHOGRAPHIC TO FINE CRYSTALLINE DOLOSTONE
- 4\*** ALTERED FROM PUBLISHED MAPPING
- 3** MARCH FORMATION: INTERBEDDED QUARTZ SANDSTONE, SANDY DOLOSTONE, AND DOLOSTONE
- CAMBRIO ORDOVICIAN**
- 2** NEPEAN FORMATION: FINE TO COARSE GRAINED QUARTZ SANDSTONE, PARTIALLY CALCAREOUS IN UPPER PART
- 1** COVEY HILL FORMATION: NONCALCAREOUS FELDSPATHIC, FINE TO COARSE GRAINED QUARTZ SANDSTONE AND QUARTZ PEBBLE CONGLOMERATE
- UNCONFORMITY**
- PRECAMBRIAN**
- PC** UNDIFFERENTIATED METAMORPHIC AND IGNEOUS ROCKS

**NOTE**

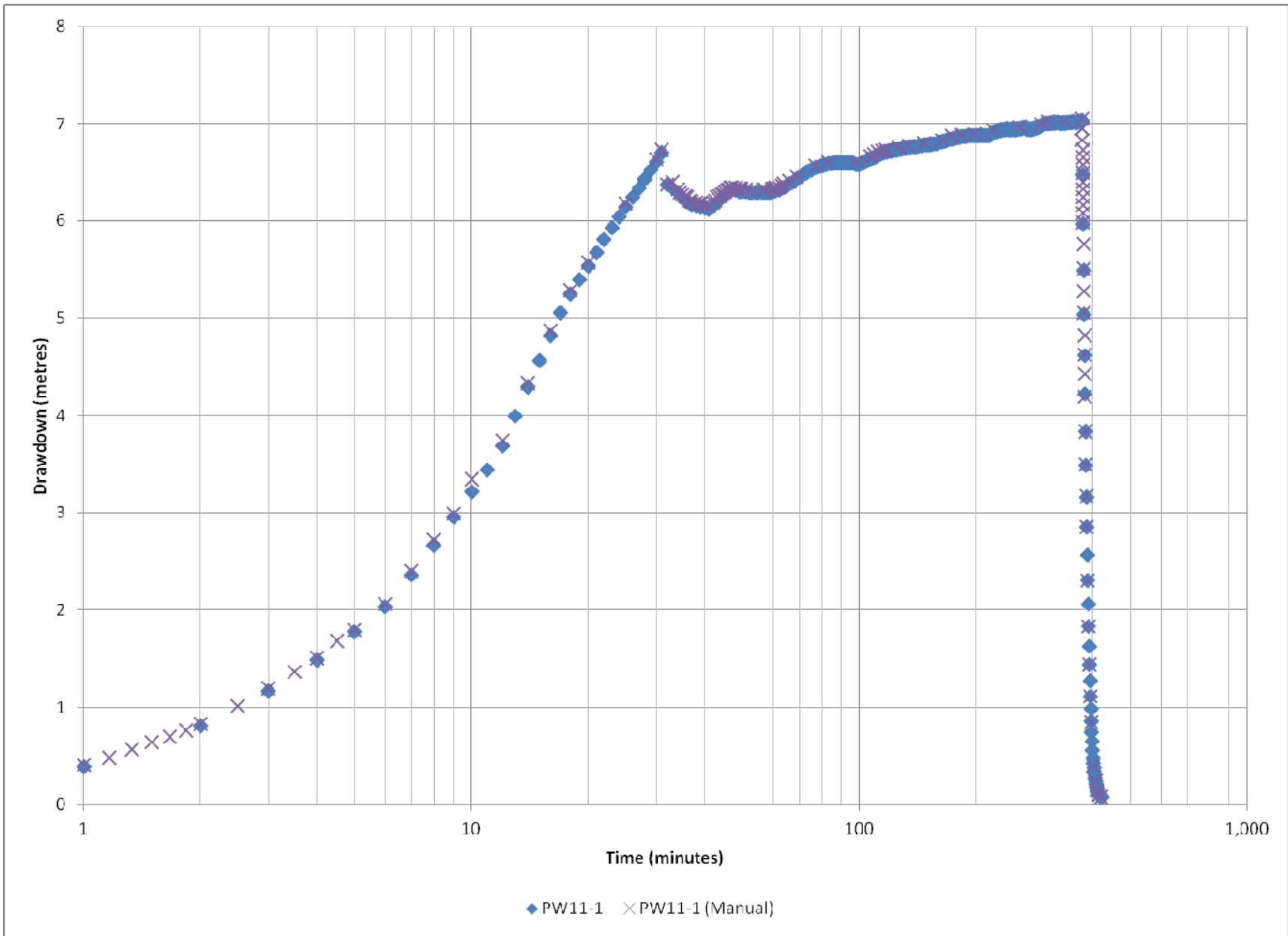
THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 11-1122-0129/3000

**REFERENCE**

BÉLANGER, J. R., URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE D3256, 2001  
 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83  
 COORDINATE SYSTEM: UTM ZONE 18



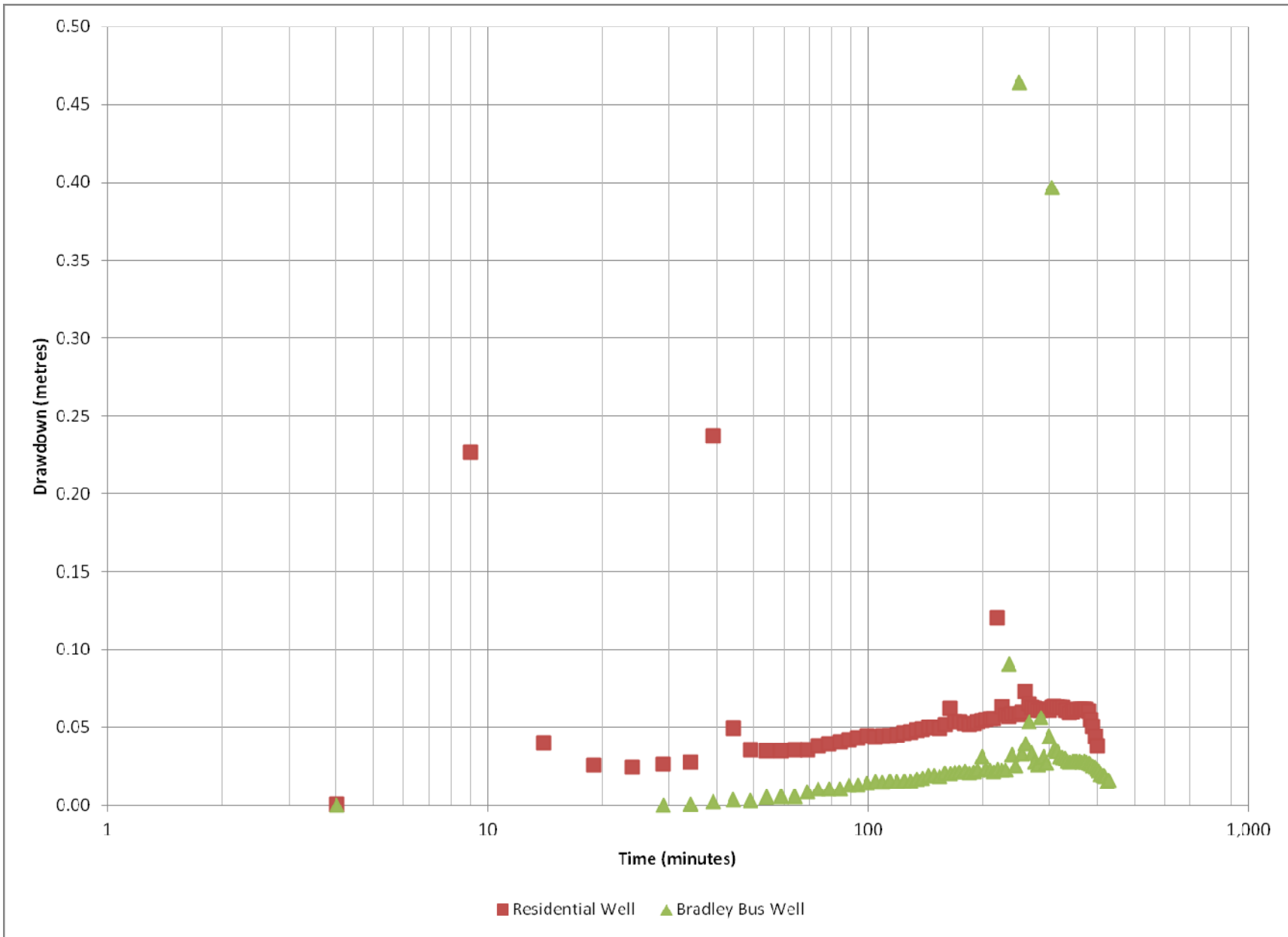
PROJECT		TERRAIN ANALYSIS AND HYDROGEOLOGICAL STUDY 3406-3450 FRANK KENNY ROAD, OTTAWA, ONTARIO	
TITLE		<b>BEDROCK GEOLOGY</b>	
<p>Golder Associates Ottawa, Ontario</p>	PROJECT No. 11-1122-0129	SCALE AS SHOWN	REV. 0
	DESIGN CAMC	Nov. 2011	
	CIS BJ	Nov. 2011	
	CHECK CAMC	Nov. 2011	
	REVIEW SRW	Nov. 2011	
			<b>FIGURE 5</b>



Date: November 2011 Drawn: DH  
 Project: 11-1122-0129 Chkd: CAMC

GROUNDWATER LEVEL DRAWDOWN  
 PW11-1

FIGURE 6



Date: November 2011 Drawn: DH  
 Project: 11-1122-0129 Chkd: CAMC

GROUNDWATER LEVEL DRAWDOWN  
 BRADLEY BUS WELL AND RESIDENTIAL WELL

FIGURE 7



# APPENDIX A

## Water Well Record, Bradley Bus Well



# The Ontario Water Resources Act WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED  
2. CHECK  CORRECT BOX WHERE APPLICABLE

COUNTY OR DISTRICT <b>OTTAWA-CARLETON</b>	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE <b>CUMBERLAND</b>	CON. BLOCK, TRACT, SURVEY ETC. <b>PART 9+10 CON 2</b>	LOT <b>101</b>
OWNER (SURNAME FIRST) <b>BRADLEY BUS LINE</b>	ADDRESS	DATE COMPLETED DAY <b>9</b> MO <b>1</b> YR <b>91</b>	

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)					
GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
BROWN	CLAY			0	19
BLACK	HARD PAN	BOULDERS		19	31
BLACK	SHALE			31	41

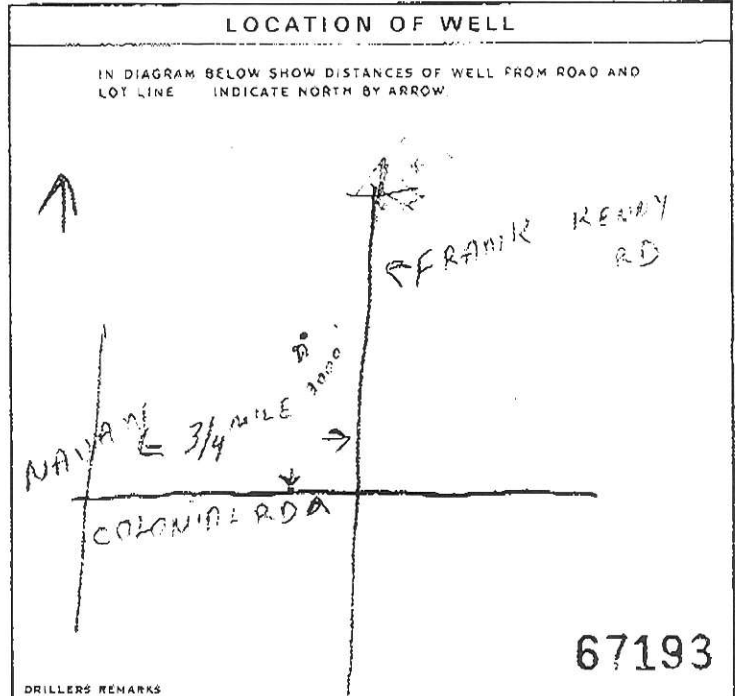
WATER RECORD	
WATER FOUND AT - FEET	KIND OF WATER
39	<input checked="" type="checkbox"/> FRESH <input type="checkbox"/> SALTY <input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERALS <input type="checkbox"/> GAS
	<input type="checkbox"/> FRESH <input type="checkbox"/> SALTY <input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERALS <input type="checkbox"/> GAS
	<input type="checkbox"/> FRESH <input type="checkbox"/> SALTY <input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERALS <input type="checkbox"/> GAS
	<input type="checkbox"/> FRESH <input type="checkbox"/> SALTY <input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERALS <input type="checkbox"/> GAS
	<input type="checkbox"/> FRESH <input type="checkbox"/> SALTY <input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERALS <input type="checkbox"/> GAS

CASING & OPEN HOLE RECORD				
INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET	
			FROM	TO
6 3/4	<input checked="" type="checkbox"/> STEEL <input type="checkbox"/> GALVANIZED <input type="checkbox"/> CONCRETE <input type="checkbox"/> OPEN HOLE <input type="checkbox"/> PLASTIC	1.85	0	31
	<input type="checkbox"/> STEEL <input type="checkbox"/> GALVANIZED <input type="checkbox"/> CONCRETE <input type="checkbox"/> OPEN HOLE <input type="checkbox"/> PLASTIC			
	<input type="checkbox"/> STEEL <input type="checkbox"/> GALVANIZED <input type="checkbox"/> CONCRETE <input type="checkbox"/> OPEN HOLE <input type="checkbox"/> PLASTIC			

SCREEN	SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
		INCHES	FEET
	MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN	
		INCHES	FEET

PLUGGING & SEALING RECORD			
DEPTH SET AT	FEET	MATERIAL AND TYPE	CEMENT GROUT LEAD PACKED ETC.
4	20	CEMENT GROUT	

PUMPING TEST	PUMPING TEST METHOD <input type="checkbox"/> PUMP <input checked="" type="checkbox"/> BAILER	PUMPING RATE 19 GPM	DURATION OF PUMPING 1 HOURS 20 MIN			
	STATIC LEVEL 7 FEET	WATER LEVEL END OF PUMPING 28 FEET	WATER LEVELS DURING PUMPING <input checked="" type="checkbox"/> PUMPING <input type="checkbox"/> RECOVERY			
			15 MINUTES: 25 FEET	30 MINUTES: 28 FEET	45 MINUTES: 28 FEET	60 MINUTES: 28 FEET
	IF FLOWING, GIVE RATE	PUMP INTAKE SET AT 35 FEET	WATER AT END OF TEST <input type="checkbox"/> CLEAR <input checked="" type="checkbox"/> CLOUDY			
	RECOMMENDED PUMP TYPE <input type="checkbox"/> SHALLOW <input checked="" type="checkbox"/> DEEP	RECOMMENDED PUMP SETTING 35 FEET	RECOMMENDED PUMPING RATE 10 GPM			



FINAL STATUS OF WELL	<input checked="" type="checkbox"/> WATER SUPPLY	<input type="checkbox"/> ABANDONED - INSUFFICIENT SUPPLY
	<input type="checkbox"/> OBSERVATION WELL	<input type="checkbox"/> ABANDONED - POOR QUALITY
	<input type="checkbox"/> TEST HOLE	<input type="checkbox"/> UNFINISHED
	<input type="checkbox"/> RECHARGE WELL	<input type="checkbox"/> DEWATERING
WATER USE	<input type="checkbox"/> DOMESTIC	<input checked="" type="checkbox"/> COMMERCIAL
	<input type="checkbox"/> STOCK	<input type="checkbox"/> MUNICIPAL
	<input type="checkbox"/> IRRIGATION	<input type="checkbox"/> PUBLIC SUPPLY
	<input type="checkbox"/> INDUSTRIAL	<input type="checkbox"/> COOLING OR AIR CONDITIONING
	<input type="checkbox"/> OTHER	<input type="checkbox"/> NOT USED
METHOD OF CONSTRUCTION	<input checked="" type="checkbox"/> CABLE TOOL	<input type="checkbox"/> BORING
	<input type="checkbox"/> ROTARY (CONVENTIONAL)	<input type="checkbox"/> DIAMOND
	<input type="checkbox"/> ROTARY (REVERSE)	<input type="checkbox"/> JETTING
	<input type="checkbox"/> ROTARY (AIR)	<input type="checkbox"/> DRIVING
	<input type="checkbox"/> AIR PERCUSSION	<input type="checkbox"/> DIGGING
		<input type="checkbox"/> OTHER

CONTRACTOR	NAME OF WELL CONTRACTOR <b>FRANKER WELL DRILLING</b>	WELL CONTRACTOR'S LICENCR NUMBER 2351
	ADDRESS	
	NAME OF WELL TECHNICIAN <b>BOY A.T. CASSELLMAN</b>	WELL TECHNICIAN'S LICENCE NUMBER 7-0389
	SIGNATURE OF TECHNICIAN/CONTRACTOR <i>[Signature]</i>	ISSUANCE DATE DAY <b>9</b> MO <b>1</b> YR <b>91</b>

OFFICE USE ONLY	



# APPENDIX B

Records of Boreholes BH11-3, BH11-4, BH11-5, BH11-6 and  
BH11-7 and Test Pits TP11-1, TP11-2, TP11-3 and TP11-4

## LIST OF ABBREVIATIONS

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

<b>I. SAMPLE TYPE</b>		<b>III. SOIL DESCRIPTION</b>	
AS Auger sample		(a)	<b>Cohesionless Soils</b>
BS Block sample			
CS Chunk sample		<b>Density Index</b>	<b>N</b>
DO Drive open		<b>(Relative Density)</b>	<u>Blows/300 mm</u>
DS Denison type sample			<u>Or Blows/ft.</u>
FS Foil sample		Very loose	0 to 4
RC Rock core		Loose	4 to 10
SC Soil core		Compact	10 to 30
ST Slotted tube		Dense	30 to 50
TO Thin-walled, open		Very dense	over 50
TP Thin-walled, piston			
WS Wash sample		(b)	<b>Cohesive Soils</b>
DT Dual Tube sample		<b>Consistency</b>	<b>C<sub>u</sub> or S<sub>u</sub></b>
<b>II. PENETRATION RESISTANCE</b>			
<b>Standard Penetration Resistance (SPT), N:</b>		<u>Kpa</u>	<u>Psf</u>
The number of blows by a 63.5 kg. (140 lb.)		Very soft	0 to 12
hammer dropped 760 mm (30 in.) required		Soft	12 to 25
to drive a 50 mm (2 in.) drive open		Firm	25 to 50
Sampler for a distance of 300 mm (12 in.)		Stiff	50 to 100
DD- Diamond Drilling		Very stiff	100 to 200
		Hard	Over 200
			Over 4,000
<b>Dynamic Penetration Resistance; N<sub>d</sub>:</b>		<b>IV. SOIL TESTS</b>	
The number of blows by a 63.5 kg (140 lb.)		w	water content
hammer dropped 760 mm (30 in.) to drive		w <sub>p</sub>	plastic limited
Uncased a 50 mm (2 in.) diameter, 60° cone		w <sub>l</sub>	liquid limit
attached to "A" size drill rods for a distance		C	consolidation (oedometer) test
of 300 mm (12 in.).		CHEM	chemical analysis (refer to text)
		CID	consolidated isotropically drained triaxial test <sup>1</sup>
		CIU	consolidated isotropically undrained triaxial test
			with porewater pressure measurement <sup>1</sup>
<b>PH:</b> Sampler advanced by hydraulic pressure		D <sub>R</sub>	relative density (specific gravity, G <sub>s</sub> )
<b>PM:</b> Sampler advanced by manual pressure		DS	direct shear test
<b>WH:</b> Sampler advanced by static weight of hammer		M	sieve analysis for particle size
<b>WR:</b> Sampler advanced by weight of sampler and rod		MH	combined sieve and hydrometer (H) analysis
		MPC	modified Proctor compaction test
<b>Peizo-Cone Penetration Test (CPT):</b>		SPC	standard Proctor compaction test
An electronic cone penetrometer with		OC	organic content test
a 60° conical tip and a projected end area		SO <sub>4</sub>	concentration of water-soluble sulphates
of 10 cm <sup>2</sup> pushed through ground		UC	unconfined compression test
at a penetration rate of 2 cm/s. Measurements		UU	unconsolidated undrained triaxial test
of tip resistance (Q <sub>t</sub> ), porewater pressure		V	field vane test (LV-laboratory vane test)
(PWP) and friction along a sleeve are recorded		γ	unit weight
Electronically at 25 mm penetration intervals.			

Note:

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

## LIST OF SYMBOLS

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

### I. GENERAL

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

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma'$
$\varepsilon$	linear strain
$\varepsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1 \sigma_2 \sigma_3$	principal stresses (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
$u$	porewater pressure
$E$	modulus of deformation
$G$	shear modulus of deformation
$K$	bulk modulus of compressibility

### III. SOIL PROPERTIES

#### (a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s/\rho_w$ ) formerly ( $G_s$ )
$e$	void ratio
$n$	porosity
$S$	degree of saturation
*	Density symbol is $\rho$ . Unit weight symbol is $\gamma$ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

#### (a) Index Properties (cont'd.)

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

#### (b) Hydraulic Properties

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

#### (c) Consolidation (one-dimensional)

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

#### (d) Shear Strength

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

Notes: 1.  $\tau = c' + \sigma' \tan \phi'$   
2. Shear strength = (Compressive strength)/2



PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-1

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 31, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. + rem V. ⊕ ⊖		Q - U - ⊙		Wp			W
0		GROUND SURFACE		86.36													
		Dark brown silty fine sand, trace organic matter (FILL)		0.00													
		Loose brown fine sand (FILL)		0.08													
		Very stiff to stiff brown to grey brown SILTY CLAY (Weathered Crust)		86.05	1	50 DO	6										
				0.31													
1					2	50 DO	12										
2					3	50 DO	5										
					4	50 DO	3										
3		Firm grey SILTY CLAY		83.31													
				3.05													
					5	50 DO	1										
4	Power Auger 200 mm Diam. (Hollow Stem)							⊕	+								
								⊕	+								
5					6	50 DO	WH										
								⊕	+								
6								⊕	+								
					7	50 DO	WH										
7		End of Borehole		79.40													
				6.96													

MIS-BHS 001 1111220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-2

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 31, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+				Q - U	
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE		85.78													
		TOPSOIL		0.00													
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		0.08	1	50 DO	12										
1					2	50 DO	7										
2					3	50 DO	4										
2		End of Borehole		83.80													
				1.98													
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

MIS-BHS 001 1111220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-3

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: November 1, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. + rem V. ⊕ ⊙		10 <sup>-6</sup> 10 <sup>-5</sup> 10 <sup>-4</sup> 10 <sup>-3</sup>		Wp			W
0		GROUND SURFACE		85.48													
		TOPSOIL		0.00													
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		0.15													
1	Power Auger 200 mm Diam. (Hollow Stem)				1	50 DO	5										
2																	
3		Firm grey SILTY CLAY		82.58 2.90													
4		Compact to dense dark grey to black SILTY SAND, some gravel, with shale fragments, cobbles, and boulders (GLACIAL TILL)		81.42 4.06													
5																	
6		End of Borehole		79.84 5.64													

MIS-BHS 001 1111220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-3A

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: November 2, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+				Q - U	
0		GROUND SURFACE		85.48													
		TOPSOIL		0.00													
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		0.15													
1																	
2																	
3	Power Auger 200 mm Diam. (Hollow Stem)	Firm grey SILTY CLAY		82.74 2.74	1	73 TP											
4					2	73 TP											
5						3	50 DO										
6						4	50 DO										
7		Compact dark grey to black SILTY SAND, with shale fragments (GLACIAL TILL)		80.73 4.75													
8		End of Borehole		80.43 5.05													
9		Note: Shallow portion of stratigraphy inferred from BH 11-3															
10																	

MIS-BHS 001 1111220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-4

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: November 2, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								20 40 60 80		nat V. + rem V. ⊕ - ⊙		10 <sup>-6</sup> 10 <sup>-5</sup> 10 <sup>-4</sup> 10 <sup>-3</sup>				Wp  -----  W  -----  WI	
0		GROUND SURFACE		85.90													
		Dark brown clayey topsoil (FILL)		0.00													
		Grey crushed stone (FILL)		0.15													
		Grey brown SILTY CLAY (Disturbed)															
1	Power Auger 200 mm Diam. (Hollow Stem)			84.68	1	50 DO	6										
		Stiff grey brown SILTY CLAY (Weathered Crust)		1.22													
2					2	50 DO	3	⊕	+				○				
3					3	50 DO	16	⊕		+				○			
			Compact dark grey to black SILTY SAND, with shale fragments, cobbles, and boulders (GLACIAL TILL)		83.36												
4																	
5				81.63													
		Highly weathered black SHALE BEDROCK		4.27													
		End of Borehole Sampler Refusal		81.38	6	50 DO	>50										
				4.52													

MIS-BHS 001 11-11220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-5

SHEET 1 OF 1

LOCATION: See Site Plan

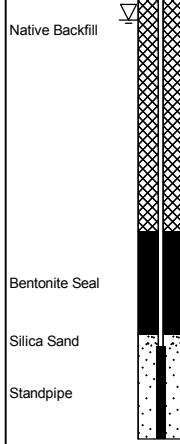
BORING DATE: November 1, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+ Q - U				Wp	
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE		85.64													
		TOPSOIL		0.00													
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		0.15	1	50 DO	9										
1																	
2		Compact dark grey to black SILTY SAND, some gravel, with cobbles, boulders, and shale fragments (GLACIAL TILL)		83.51													
				2.13	4	50 DO	11										
3																	
4		Highly weathered black SHALE BEDROCK		81.83													
				3.81													
				81.58	6	50 DO	>50										
		End of Borehole		4.06													



W.L. in Standpipe at Elev. 84.37 m on Nov. 14, 2011

MIS-BHS 001 1111220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-6

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: November 1, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								20 40 60 80		nat V. + Q - rem V. ⊕ U - ○		10 <sup>-6</sup> 10 <sup>-5</sup> 10 <sup>-4</sup> 10 <sup>-3</sup>				Wp  -----  W  -----  Wl	
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE		85.44													
		TOPSOIL		0.00													
		Very stiff to stiff brown SILTY CLAY (Weathered Crust)		0.15													
1						1	50 DO	4									
2					2	50 DO	2										
3		Compact dark grey to black SILTY SAND, with shale fragments (GLACIAL TILL)		82.70 2.74		3	50 DO	7									
		Highly weathered black SHALE BEDROCK		82.39 3.05		4	50 DO	21									
4		End of Borehole		81.78 3.66													

MIS-BHS 001 1111220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: 11-7

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: November 1, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+		Q - U -			Wp
0		GROUND SURFACE		85.42													
		TOPSOIL		0.00													
		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		0.15													
1					1	50 DO	5										
					2	50 DO	2										
2				83.44													
		Compact dark grey to black SILTY SAND, with shale fragments, cobbles, and boulders (GLACIAL TILL)		1.98													
					3	50 DO	16										
					4	50 DO	17										
				81.91													
		Highly weathered SHALE BEDROCK		3.51													
					5	50 DO	20										
					6	50 DO	>50										
5		End of Borehole		80.70													
				4.72													

MIS-BHS 001\_1111220129.GPJ GAL-MIS.GDT\_1/12/12\_JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD



PROJECT: 11-1122-0129-2000

# RECORD OF BOREHOLE: MW11-1

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 31, 2011

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT					
								Cu, kPa		nat V. rem V.		+		Q - U			Wp
0		GROUND SURFACE		85.96													
		Grey crushed stone (FILL)		0.00	1	50 DO	22									Gravel	
1		Very stiff to stiff grey brown SILTY CLAY (Weathered Crust)		85.35 0.61	2	50 DO	8									Bentonite Seal	
					3	50 DO	5									Silica Sand	
2	Power Auger 200 mm Diam. (Hollow Stem)				4	50 DO	4										
		Firm grey SILTY CLAY		83.52 2.44	5	50 DO	1									51 mm Diam. PVC #10 Slot Screen	
					6	50 DO	1										
4		End of Borehole		82.30 3.66												W.L. in Screen at Elev. 84.77 m on November 4, 2011	

MIS-BHS 001 1111220129.GPJ GAL-MIS.GDT 1/12/12 JEM

DEPTH SCALE

1 : 50



LOGGED: HEC

CHECKED: SD

**TABLE 1**  
**RECORD OF TEST PITS**

<u>Test Pit Number</u> <u>(Elevation)</u>	<u>Depth</u> <u>(metres)</u>	<u>Description</u>		
11-1 (85.74 metres)	0.00 – 0.15	TOPSOIL		
	0.15 – 2.00	Grey brown SILTY CLAY (Weathered Crust)		
	2.00	END OF TEST PIT		
		Note: Groundwater seepage at 2.00 metres depth		
			<u>Sample</u>	<u>Depth (m)</u>
			1	1.00
11-2 (85.72 metres)	0.00 – 0.15	TOPSOIL		
	0.15 – 1.00	Grey brown SILTY CLAY (Weathered Crust)		
	1.00 – 2.40	Grey brown SILTY SAND, some gravel and clay, with cobbles and boulders (GLACIAL TILL)		
	2.40	END OF TEST PIT		
		Note: Groundwater seepage at 2.00 metres depth		
			<u>Sample</u>	<u>Depth (m)</u>
			1	2.00
11-3 (85.90 metres)	0.00 – 0.15	TOPSOIL		
	0.15 – 2.00	Grey brown SILTY CLAY (Weathered Crust)		
	2.00	END OF TEST PIT		
		Note: Groundwater seepage at 2.00 metres depth		
11-4 (85.08 metres)	0.00 – 0.15	TOPSOIL		
	0.15 – 1.60	Grey brown SILTY CLAY (Weathered Crust)		
	1.60	END OF TEST PIT		
		Note: Groundwater seepage at 1.50 metres depth		
			<u>Sample</u>	<u>Depth (m)</u>
			1	0.50
			2	1.00



# APPENDIX C

## Ontario Building Code Tables (Sewage Systems)

(4) Where an *occupancy* is not listed in Table 8.2.1.3.B., the highest of metered flow data from at least 3 similar establishments shall be acceptable for determining total daily design *sanitary sewage* flow.

Table 8.2.1.3.A.  
**Residential Occupancy**  
 Forming Part of Sentence 8.2.1.3.(1)

<i>Residential Occupancy</i>	Volume, litres
Apartments, Condominiums, Other Multi-family Dwellings - per person <sup>(1)</sup>	275
Boarding Houses	
(a) Per person,	
i) with meals and laundry facilities, or,	200
ii) without meal or laundry facilities, and	150
(b) Per non-resident staff per 8 hour shift	40
Boarding School - per person	300
Dwellings	
(a) 1 bedroom dwelling	750
(b) 2 bedroom dwelling	1100
(c) 3 bedroom dwelling	1600
(d) 4 bedroom dwelling	2000
(e) 5 bedroom dwelling	2500
(f) Additional flow for <sup>(2)</sup>	
i) each bedroom over 5,	500
ii) A) each 10 m <sup>2</sup> (or part of it) over 200 m <sup>2</sup> up to 400 m <sup>2</sup> <sup>(3)</sup> ,	100
B) each 10 m <sup>2</sup> (or part of it) over 400 m <sup>2</sup> up to 600 m <sup>2</sup> <sup>(3)</sup> , and	75
C) each 10 m <sup>2</sup> (or part of it) over 600 m <sup>2</sup> <sup>(3)</sup> , or	50
iii) each fixture unit over 20 fixture units	50
Hotels and Motels (excluding bars and restaurants)	
(a) Regular, per room	250
(b) Resort hotel, cottage, per person	500
(c) Self service laundry, add per machine	2500
Work Camp/Construction Camp, semi-permanent per worker	250
Column 1	2

**Notes to Table 8.2.1.3.A.:**

- (1) The *occupant load* shall be calculated using Subsection 3.1.17.
- (2) Where multiple calculations of sewage volume is permitted the calculation resulting the highest flow shall be used in determining the design *daily sanitary sewage* flow.
- (3) Total finished area, excluding the area of the finished *basement*.

Table 8.2.1.3.B.  
Other Occupancies  
Forming Part of Sentence 8.2.1.3.(2)

Establishments <sup>(1)</sup>	Volume, litres
Airports, Bus Terminals, Train Stations, Dock/Port Facilities (Food Services excluded)	
(a) Per passenger, and	20
(b) Per employee per 8 hour shift	40
Assembly Hall - per seat	
(a) No food service, or	8
(b) Food service provided	36
Barber Shop/Beauty Salon - per service chair	650
Bowling Alleys (Food Service not included) - per lane	400
Churches and Similar Places of Worship - per seat	
(a) No kitchen facilities, or	8
(b) Kitchen facilities provided	36
Country Club (excluding Food Service)	
(a) Per resident,	375
(b) Per employee per 8 hour shift, and	50
(c) Per member or patron	40
Day Care Facility per person (staff and children)	75
Dentist Office	
(a) Per wet service chair, and	275
(b) Per dry service chair	190
Doctors Office	
(a) Per practitioner, and	275
(b) Per employee per 8 hour shift	75
Factory (excluding process or cleaning waters) - per employee per 8 hour shift	
(a) No showers, or	75
(b) Including showers	125
Flea Markets <sup>(2)</sup> (open not more than 3 days per week)	
(a) Per non-food service vendor space,	60
(b) Per food service establishment / 9.25 m <sup>2</sup> of floor space, and	190
(c) Per limited food service outlet	95
Column 1	2

Table 8.2.1.3.B. (Cont'd)  
Other Occupancies  
Forming Part of Sentence 8.2.1.3.(2)

Establishments <sup>(1)</sup>	Volume, litres
Food Service Operations	
(a) Restaurant (not 24 hour), per seat	125
(b) Restaurant (24 hour), per seat	200
(c) Restaurant on controlled access highway, per seat	400
(d) Paper service restaurant, per seat	60
(e) Donut shop, per seat	400
(f) Bar and cocktail lounge, per seat	125
(g) Drive-in restaurant per parking space	60
(h) Take-out restaurant (no seating area)	
i) per 9.25 m <sup>2</sup> of floor area, and	190
ii) per employee per 8 hour shift	75
(i) Cafeteria - per meal	12
(j) Food outlet	
i) excluding delicatessen, bakery and meat department, per 9.25 m <sup>2</sup> of floor space,	40
ii) per 9.25 m <sup>2</sup> of delicatessen floor space	190
iii) per 9.25 m <sup>2</sup> of bakery floor space	190
iv) per 9.25 m <sup>2</sup> of meat department floor space, and	380
v) per water closet	950
Hospitals - per bed	
(a) Including laundry facilities, or	750
(b) Excluding laundry facilities	550
Nursing Homes, Rest Homes, etc. - per bed	450
Office Building <sup>(3)</sup>	
(a) Per employee per 8 hour shift, or	75
(b) Per each 9.3 m <sup>2</sup> of floor space	75
Public Parks	
(a) With toilets only per person, or	20
(b) With bathhouse, showers, and toilets per person	50
Recreational Vehicle or Campground Park	
(a) Per site without water or sewer hook-up, or	275
(b) Per site with water and sewer hook-up	425
Column 1	2

Table 8.2.1.3.B. (Cont'd)  
Other Occupancies  
Forming Part of Sentence 8.2.1.3.(2)

Establishments <sup>(1)</sup>	Volume, litres
Schools - per student	
(a) Day school,	30
(b) With showers,	30
(c) With cafeteria, and	30
(d) Per non-teaching employee per 8 hour shift	50
Service Stations (no vehicle washing) <sup>(3)</sup>	
(a) Per water closet, and	950
i) per fuel outlet <sup>(4)</sup> , or	560
ii) per vehicle served	20
Shopping Centre (excluding food and laundry) - per 1.0 m <sup>2</sup> of floor space	5
Stadiums, Race Tracks, Ball Parks - per seat	20
Stores <sup>(3)</sup>	
(a) Per 1.0 m <sup>2</sup> of floor area, or	5
(b) Per water closet	1230
Swimming and Bathing Facilities (Public) - per person	40
Theatres	
(a) Indoor, auditoriums per seat,	20
(b) Outdoor, drive-ins per space, or	40
(c) Movie theatres per seat	15
Veterinary Clinics	
(a) Per practitioner,	275
(b) Per employee per 8 hour shift, and	75
(c) Per stall, kennel, or cage if floor drain connected	75
Warehouse	
(a) Per water closet, and	950
(b) Per loading bay	150
Column 1	2

**Notes to Table 8.2.1.3.B.:**

- (1) The *occupant load* shall be calculated using Subsection 3.1.17.
- (2) Flea markets open more than 3 days per week shall be assessed using the volumes stated under the heading "Stores".
- (3) Where multiple calculations of *sanitary sewage* volume is permitted the calculation resulting in the highest flow shall be used in determining the design daily *sanitary sewage* flow.
- (4) The number of fuel outlets is considered the maximum number of gas nozzles that could be in use at the same time.

**Table 8.2.1.6.A.**  
**Minimum Clearances for Treatment Units**  
 Forming Part of Sentence 8.2.1.6.(1)

Object	Minimum Clearance, m
Structure	1.5
Well	15
Lake	15
Pond	15
Reservoir	15
River	15
Spring	15
Stream	15
Property Line	3
Column 1	2

(2) Except as provided in Sentences 8.2.1.4.(1) and (2), a *distribution pipe* shall not be located closer than the minimum horizontal distances set out in Table 8.2.1.6.B. and these distances shall be increased when required by Sentence 8.7.4.2.(9).

**Table 8.2.1.6.B.**  
**Minimum Clearances for Distribution Piping**  
 Forming Part of Sentence 8.2.1.6.(2)

Object	Minimum Clearance, m
Structure	5
Well with a watertight casing to a depth of 6 m	15
Any other well	30
Lake	15
Pond	15
Reservoir	15
River	15
Spring not used as a source of <i>potable</i> water	15
Stream	15
Property Line	3
Column 1	2

(3) Except as provided in Sentences 8.2.1.4.(1) and (2), a *holding tank* shall not be located closer than the minimum horizontal distances set out in Table 8.2.1.6.C.



Table 8.7.3.3.A.  
Septic Stone  
Forming Part Of Sentence 8.7.3.3.(5)

Gradation of Septic Stone	
Particle Size	Percent Passing
53 mm	100
19 mm	0-5
75 µm	0-1
Column 1	2

**8.7.4. Fill Based Absorption Trenches**

**8.7.4.1. Loading Requirements**

(1) The area described in Sentence 8.7.4.2.(1) shall be designed such that the *loading rate* does not exceed, for *soil* having a *percolation time* set out in Column 1 of Table 8.7.4.1.A., the maximum value set out opposite it in Column 2 of Table 8.7.4.1.A.

Table 8.7.4.1.A.  
Loading Rates for Fill Based Absorption Trenches and Filter Beds  
Forming Part of Sentences 8.7.4.1.(1) and 8.7.5.2.(2)

Percolation Time (T) of Soil, min/cm	Loading Rates, (L/m <sup>2</sup> )/day
1 < T ≤ 20	10
20 < T ≤ 35	8
35 < T ≤ 50	6
T > 50	4
Column 1	2

**8.7.4.2. Construction Requirements** (See Appendix A.)

- (1) A *leaching bed* comprised of *absorption trenches* may be *constructed* in *leaching bed fill* if *unsaturated soil* or *leaching bed fill* complying with Clause 8.7.2.1.(1)(b) extends,
  - (a) to a depth of at least 250 mm over the area covered by the *leaching bed fill*, and
  - (b) for at least 15 m beyond the outer *distribution pipes* in any direction in which the *effluent* entering the *soil* or *leaching bed fill* will move horizontally.
- (2) If the *unsaturated soil* or *leaching bed fill* described in Sentence (1) has a *percolation time* greater than 15 minutes, any *leaching bed fill* added to form the *leaching bed* shall have a *percolation time* not less than 75% of the *percolation time* of the *unsaturated soil* or *leaching bed fill*.
- (3) *Leaching bed fill* that does not meet the requirements of Sentence (2) may be used to form the *leaching bed* if,
  - (a) the distance from the bottom of the *absorption trench* to *native soil* is not less than 900 mm, or
  - (b) where the distance from the bottom of the *absorption trench* to *native soil* is less than 900 mm, the *percolation time* of the least permeable *soil* or *leaching bed fill* within 900 mm from the bottom of the *absorption trench* is used to calculate the length of the *distribution pipe* under Article 8.7.3.1.

# SB-6 Percolation Time and Soil Descriptions

## ESTIMATION OF PERCOLATION TIME

- (a) The purpose of this Section and the associated Tables and Charts is to provide assistance to those who must decide on the percolation time(s) to be used in design. Suggested relationships between percolation time, coefficient of permeability and soils of various types are given. **IT MUST BE EMPHASIZED THAT, PARTICULARLY FOR FINE GRAINED SOILS, THERE IS NO CONSISTENT RELATIONSHIP DUE TO THE MANY FACTORS INVOLVED.** The following guidance is presented for the soil types outlined in the Unified Soil Classification System (Table 1). In order to assess a particular soil.
- (i) Table 2 and Table 3 - Approximate relationship of soil types to permeability and percolation time.
  - (ii) Charts 1 to 14 - Typical grain size distribution curves for soil types in the Unified Soil Classification System.
- (b) In Table 2 and Table 3, a range of values of "K" and of "T" are given for various soil descriptions. The principal modifiers which will influence selection of a "T" value within the range given are:
- (i) The structure - "massive" fine-grained soils have high values of "T".
  - (ii) The density - For a given soil higher density produces a higher value of "T".
  - (iii) The percentage of clay - the higher the percentage the higher the value of "T".
  - (iv) The mineralogy of the clay portion - The more it "swells" the higher the value of "T".
  - (v) The plasticity of the soil - The higher the plasticity index the higher the value of "T".
  - (vi) Liquid Limit - the higher the liquid limit the higher the value of "T".
  - (vii) Organic content - The presence of fine organic particles, detectable by colouration and odour, can significantly reduce the permeability and raise the value of "T".

Table 1  
Unified Soil Classification

Coarse - Grained Soils		Fine - Grained Soils	
Group Symbols	Typical Names	Group Symbols	Typical Names
GW	Well-graded gravels, gravel-sand mixtures, little or no fines	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
GM	Silty gravels, gravel-sand-silt mixtures	OL	Organic silts and organic silty clays of low plasticity
GC	Clayey gravels, gravel-sand-clay mixtures	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
SW	Well-graded sands, gravelly sands, little or no fines	CH	Inorganic clays of high plasticity, fat clays
SP	Poorly-graded sands, gravelly sands, little or no fines	OH	Organic clays of medium to high plasticity, organic silts
SM	Silty sands, sand-silt mixtures		
SC	Clayey sands, sand-clay mixtures	PT (highly organic soils)	Peat and other highly organic soils
Column 1	2	3	4

Table 2  
Approximate Relationship of Coarse Grained Soil Types to Permeability and Percolation Time

Soil Type (Unified Soil Classification)	Coefficient of Permeability, K - cm/sec	Percolation Time, T - mins/cm	Comment
Coarse Grained More than 50% Larger than #200			
G.W. - Well graded gravels, gravel-sand mixtures, little or no fines.	$10^{-1}$	<1	very permeable unacceptable
G.P. - Poorly graded gravels, gravel-sand mixtures, little or no fines.	$10^{-1}$	<1	very permeable unacceptable
G.M. - Silty gravels, gravel-sand-silt mixtures.	$10^{-2} - 10^{-4}$	4 - 12	Permeable to medium permeable depending on amount of silt.
G.C. - Clayey gravels, gravel-sand-clay mixtures.	$10^{-4} - 10^{-6}$	12 - 50	Important to estimate amount of silt and clay
S.W. - Well graded sands, gravelly sands little or no fines.	$10^{-1} - 10^{-4}$	2 - 12	medium permeability
S.P. - Poorly graded sands, gravelly sand, little or no fines.	$10^{-1} - 10^{-3}$	2 - 8	medium permeability
S.M. - Silty sands, sand-silt mixtures.	$10^{-3} - 10^{-5}$	8 - 20	medium to low permeability
S.C. - Clayey sands, sand-clay mixtures.	$10^{-4} - 10^{-6}$	12 - 50	medium to low permeability depending on amount of clay
Column 1	2	3	4

**Table 3**  
**Approximate Relationship of Fine Grained Soil Types to Permeability and Percolation Time**

Soil Type (Unified Soil Classification)	Coefficient of Permeability, K - cm/sec	Percolation Time, T - mins/cm	Comment
Fine Grained More than 50% Passing #200			
M.L. - Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, clayey silts with slight plasticity	$10^{-5} - 10^{-6}$	20 - 50	medium to low permeability
C.L. - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	$10^{-6}$ and less	over 50	unacceptable
O.L. - Organic silts, organic silty clays of low plasticity; liquid limit less than 50	$10^{-5}$ and less	20 - over 50	acceptable depends on clay content
M.H. - Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	$10^{-6}$ and less	over 50	unacceptable
C.H. - Inorganic clays of medium to high plasticity, organic silts	$10^{-7}$ and less	over 50	unacceptable
O.H. - Organic clays of medium to high plasticity organic silt; liquid limit over 50	$10^{-6}$ and less	over 50	unacceptable
Column 1	2	3	4

#### SELECTION OF "T" TIME FROM THE ABOVE TABULATION

A range of "T" times for each soil type is shown above. Select from within this range by determining if the soil is within the low, middle or high part of the range considering the soil identifiers and soil characteristics. Consider structure, density, colour, prevalence of organics, the clay content and mineralogy, the plasticity index and liquid limit and the functioning of existing systems in similar soils in the area.

#### Notes:

The following Ministry of the Environment Reports provide further information on the relationship between grain size, coefficient of permeability and percolation time.

1. "Study on the Feasibility of Correlating Percolation Time with Laboratory Permeability" - 1975 - Research Report No. S56 by H. T. Chan, PhD., P.Eng.
2. "Study of Conventional Tile Fields in Fine-Grained Soils" - 1979 Research Report 74 by H. T. Chan, PhD., P.Eng.



# APPENDIX D

## Water Well Record, PW11-1



Ministry of the Environment

Well Tag No. (Place Stic

A116305

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in:  Metric  Imperial

Page of

A 116305

**Well Owner Information**

First Name: **ML Bradley Ltd** Last Name / Organization: **ML** E-mail Address: **N/A**  Well Constructed by Well Owner

Mailing Address (Street Number/Name): **PO BOX 70 Napan** Municipality: **Napan** Province: **ON** Postal Code: **K0B1G3** Telephone No. (inc. area code): **613-835-2488**

Well Location

Address of Well Location (Street Number/Name): **3450 Frank Kenny St** Township: **Cumberland** Lot: **10** Concession: **8**

County/District/Municipality: **Ottawa** City/Town/Village: **Ottawa** Province: **Ontario** Postal Code:

UTM Coordinates: Zone: **18** Easting: **10716** Northing: **8275030372** Municipal Plan and Sublot Number:  Other:

General Colour	Most Common Material	Other Materials	General Description	Depth (mft) From	Depth (mft) To
Brown	clay	Silt	Hard	0	3.1
Grey	clay	Silt	Hard	3.1	8.9
Grey	limestone		Layered	8.9	24.3

Depth Set at (mft) From	Depth Set at (mft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³)
0	10.9	cement grout	0.4 m³

**Method of Construction**

Cable Tool  Diamond  Public  Commercial  Not used

Rotary (Conventional)  Jetting  Domestic  Municipal  Dewatering

Rotary (Reverse)  Drilling  Livestock  Test Hole  Monitoring

Boring  Digging  Irrigation  Cooling & Air Conditioning

Air percussion  Industrial

Other, specify: **Air Rotary**  Other, specify

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Well Thickness (cm/in)	Depth (mft)		<input checked="" type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify <input type="checkbox"/> Other, specify
			From	To	
15.55	Steel	0.48	4.6	10.9	
15.55	Open Hole		10.9	23.4	

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

Water found at Depth (mft)	Kind of Water: <input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	Depth (mft)		Diameter (cm/in)
		From	To	
1.9		0	10.9	24.67
		10.9	24.3	15.55

**Business Name of Well Contractor:** **Bourgeois Well Drilling Ltd** Well Contractor's License No.: **741117**

**Business Address (Street Number/Name):** **151 Montee D'Aoust** Municipality: **Napan**

Province: **ON** Postal Code: **K0B1G3** Business E-mail Address: **N/A**

**Bus. Telephone No. (inc. area code):** **613-835-2488** **Name of Well Technician (Last Name, First Name):** **GENIER, MICHAEL**

**Well Technician License No.:** **31413** **Signature of Technician and/or Contractor:** **[Signature]** **Date Submitted:** **2011/11/23**

After test of well yield, water was:

Clear and sand free  Other, specify

If pumping discontinued, give reason:

Pump intake set at (mft): **20**

Pumping rate (l/min / GPM): **56**

Duration of pumping: **1** hrs +  min

Final water level end of pumping (mft): **1.87**

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

Recommended pump depth (mft):

Recommended pump rate (l/min / GPM):

Well production (l/min / GPM):

Disinfected?  Yes  No

Time (min)	Draw Down		Recovery	
	Water Level (mft)	Time (min)	Water Level (mft)	Time (min)
Static Level	1.04		1.87	
1		1	1.17	
2		2	1.10	
3		3	1.08	
4		4	1.05	
5	1.59	5	1.06	
10	1.85	10	1.05	
15	1.85	15	1.04	
20	1.85	20	1.04	
25	1.87	25	1.04	
30	1.87	30	1.04	
40	1.88	40	1.04	
50	1.88	50	1.04	
60	1.87	60		

Please provide a map below following instructions on the back.

**Comments:** **Colonial**

**Well owner's information:**  Yes  No

**Date Package Delivered:** **2011/11/23** **Date Work Completed:** **2011/11/23**

**2140701**



# APPENDIX E

## Raw Pumping Test Data and Transmissivity Calculations

## PW11-1

**Notes:****Datalogger installed at 10.7 m below top of casing****Static WL** 1.715 m below top of casing**Start of Test** 11/7/2011 9:36**End of Test** 11/7/2011 15:52

<u>Date/Time</u>	<u>Time</u> <u>(min)</u>	<u>Pumping Rate</u> <u>(L/min)</u>	<u>Datalogger</u> <u>Level (m)</u>	<u>Temperature</u> <u>(deg C)</u>	<u>Datalogger</u> <u>Drawdown (m)</u>	<u>Water Level</u> <u>(m btoc)</u>
11/7/2011 9:36	0	15.14	9.2122	8.385	0.00	1.71
11/7/2011 9:37	1	15.14	8.825	8.361	0.39	2.10
11/7/2011 9:38	2	15.14	8.4062	8.349	0.81	2.52
11/7/2011 9:39	3	15.14	8.038	8.343	1.17	2.88
11/7/2011 9:40	4	15.14	7.7232	8.345	1.49	3.20
11/7/2011 9:41	5	15.14	7.4403	8.354	1.77	3.48
11/7/2011 9:42	6	15.14	7.1782	8.361	2.03	3.74
11/7/2011 9:43	7	15.14	6.8541	8.386	2.36	4.07
11/7/2011 9:44	8	15.14	6.5403	8.423	2.67	4.38
11/7/2011 9:45	9	15.14	6.2556	8.474	2.96	4.67
11/7/2011 9:46	10	15.14	6.0008	8.531	3.21	4.92
11/7/2011 9:47	11	15.14	5.7696	8.592	3.44	5.15
11/7/2011 9:48	12	15.14	5.5226	8.69	3.69	5.40
11/7/2011 9:49	13	15.14	5.2192	8.764	3.99	5.70
11/7/2011 9:50	14	15.14	4.9205	8.857	4.29	6.00
11/7/2011 9:51	15	15.14	4.6517	8.956	4.56	6.27
11/7/2011 9:52	16	15.14	4.388	9.042	4.82	6.53
11/7/2011 9:53	17	15.14	4.1523	9.144	5.06	6.77
11/7/2011 9:54	18	15.14	3.9616	9.237	5.25	6.96
11/7/2011 9:55	19	15.14	3.8107	9.27	5.40	7.11
11/7/2011 9:56	20	15.14	3.6776	9.286	5.53	7.24
11/7/2011 9:57	21	15.14	3.5343	9.275	5.68	7.39
11/7/2011 9:58	22	15.14	3.4041	9.288	5.81	7.52
11/7/2011 9:59	23	15.14	3.2832	9.282	5.93	7.64
11/7/2011 10:00	24	15.14	3.1722	9.254	6.04	7.75
11/7/2011 10:01	25	15.14	3.0663	9.217	6.15	7.86
11/7/2011 10:02	26	15.14	2.9659	9.239	6.25	7.96
11/7/2011 10:03	27	15.14	2.8715	9.234	6.34	8.05
11/7/2011 10:04	28	15.14	2.7769	9.199	6.44	8.15
11/7/2011 10:05	29	15.14	2.691	9.21	6.52	8.23
11/7/2011 10:06	30	15.14	2.605	9.171	6.61	8.32
11/7/2011 10:07	31	15.14	2.5161	9.135	6.70	8.41
11/7/2011 10:08	32	9.46	2.8412	9.053	6.37	8.08
11/7/2011 10:09	33	9.46	2.874	8.893	6.34	8.05
11/7/2011 10:10	34	9.46	2.9246	8.804	6.29	8.00
11/7/2011 10:11	35	9.46	2.9747	8.733	6.24	7.95
11/7/2011 10:12	36	9.46	3.0168	8.682	6.20	7.91
11/7/2011 10:13	37	9.46	3.0534	8.637	6.16	7.87
11/7/2011 10:14	38	9.46	3.0633	8.62	6.15	7.86
11/7/2011 10:15	39	9.46	3.0708	8.596	6.14	7.85
11/7/2011 10:16	40	10.22	3.0804	8.583	6.13	7.84
11/7/2011 10:17	41	10.22	3.0944	8.564	6.12	7.83
11/7/2011 10:18	42	10.22	3.0621	8.547	6.15	7.86
11/7/2011 10:19	43	10.22	3.0213	8.557	6.19	7.90
11/7/2011 10:20	44	10.22	2.9779	8.563	6.23	7.94
11/7/2011 10:21	45	10.22	2.944	8.573	6.27	7.98
11/7/2011 10:22	46	10.22	2.9133	8.579	6.30	8.01
11/7/2011 10:23	47	10.22	2.8856	8.587	6.33	8.04
11/7/2011 10:24	48	10.22	2.8952	8.59	6.32	8.03
11/7/2011 10:25	49	10.22	2.9073	8.58	6.30	8.02
11/7/2011 10:26	50	10.22	2.9118	8.57	6.30	8.01
11/7/2011 10:27	51	10.22	2.9147	8.571	6.30	8.01
11/7/2011 10:28	52	10.22	2.919	8.565	6.29	8.00

Golder Associates



## PW11-1

**Notes:****Datalogger installed at 10.7 m below top of casing****Static WL**

1.715 m below top of casing

**Start of Test**

11/7/2011 9:36

**End of Test**

11/7/2011 15:52

<u>Date/Time</u>	<u>Time</u> <u>(min)</u>	<u>Pumping Rate</u> <u>(L/min)</u>	<u>Datalogger</u> <u>Level (m)</u>	<u>Temperature</u> <u>(deg C)</u>	<u>Datalogger</u> <u>Drawdown (m)</u>	<u>Water Level</u> <u>(m btoc)</u>
11/7/2011 10:29	53	10.22	2.9244	8.55	6.29	8.00
11/7/2011 10:30	54	10.22	2.9233	8.535	6.29	8.00
11/7/2011 10:31	55	10.22	2.921	8.522	6.29	8.00
11/7/2011 10:32	56	10.22	2.9235	8.531	6.29	8.00
11/7/2011 10:33	57	10.22	2.9196	8.518	6.29	8.00
11/7/2011 10:34	58	10.22	2.9219	8.507	6.29	8.00
11/7/2011 10:35	59	10.22	2.9219	8.503	6.29	8.00
11/7/2011 10:36	60	10.22	2.9125	8.505	6.30	8.01
11/7/2011 10:37	61	10.22	2.9014	8.505	6.31	8.02
11/7/2011 10:38	62	10.22	2.8938	8.498	6.32	8.03
11/7/2011 10:39	63	10.22	2.8759	8.508	6.34	8.05
11/7/2011 10:40	64	10.22	2.8628	8.5	6.35	8.06
11/7/2011 10:41	65	10.22	2.8467	8.495	6.37	8.08
11/7/2011 10:42	66	11.32	2.8316	8.498	6.38	8.09
11/7/2011 10:43	67	11.32	2.8181	8.495	6.39	8.10
11/7/2011 10:44	68	11.32	2.8026	8.495	6.41	8.12
11/7/2011 10:45	69	11.32	2.7805	8.497	6.43	8.14
11/7/2011 10:46	70	11.32	2.763	8.488	6.45	8.16
11/7/2011 10:47	71	11.32	2.7455	8.485	6.47	8.18
11/7/2011 10:48	72	11.32	2.7271	8.483	6.49	8.20
11/7/2011 10:49	73	11.32	2.7123	8.486	6.50	8.21
11/7/2011 10:50	74	11.32	2.7018	8.482	6.51	8.22
11/7/2011 10:51	75	11.32	2.6864	8.476	6.53	8.24
11/7/2011 10:52	76	11.32	2.6755	8.471	6.54	8.25
11/7/2011 10:53	77	11.32	2.6649	8.465	6.55	8.26
11/7/2011 10:54	78	11.32	2.6577	8.456	6.55	8.26
11/7/2011 10:55	79	11.32	2.6506	8.453	6.56	8.27
11/7/2011 10:56	80	11.32	2.6418	8.454	6.57	8.28
11/7/2011 10:57	81	11.32	2.6378	8.451	6.57	8.28
11/7/2011 10:58	82	11.32	2.6312	8.454	6.58	8.29
11/7/2011 10:59	83	11.32	2.6267	8.451	6.59	8.30
11/7/2011 11:00	84	11.32	2.6219	8.447	6.59	8.30
11/7/2011 11:01	85	11.32	2.6195	8.441	6.59	8.30
11/7/2011 11:02	86	11.32	2.6158	8.432	6.60	8.31
11/7/2011 11:03	87	11.32	2.6135	8.429	6.60	8.31
11/7/2011 11:04	88	11.32	2.6147	8.426	6.60	8.31
11/7/2011 11:05	89	11.32	2.6145	8.426	6.60	8.31
11/7/2011 11:06	90	11.32	2.6135	8.422	6.60	8.31
11/7/2011 11:07	91	11.32	2.6138	8.42	6.60	8.31
11/7/2011 11:08	92	11.32	2.6138	8.416	6.60	8.31
11/7/2011 11:09	93	11.32	2.6107	8.408	6.60	8.31
11/7/2011 11:10	94	11.32	2.6116	8.408	6.60	8.31
11/7/2011 11:11	95	11.32	2.6144	8.408	6.60	8.31
11/7/2011 11:12	96	11.32	2.6177	8.407	6.59	8.30
11/7/2011 11:13	97	11.32	2.621	8.402	6.59	8.30
11/7/2011 11:14	98	11.32	2.6294	8.405	6.58	8.29
11/7/2011 11:15	99	11.32	2.6337	8.407	6.58	8.29
11/7/2011 11:16	100	11.32	2.6302	8.404	6.58	8.29
11/7/2011 11:17	101	11.32	2.6215	8.396	6.59	8.30
11/7/2011 11:18	102	11.32	2.6144	8.394	6.60	8.31
11/7/2011 11:19	103	11.32	2.6041	8.391	6.61	8.32
11/7/2011 11:20	104	11.32	2.5953	8.393	6.62	8.33
11/7/2011 11:21	105	11.32	2.588	8.39	6.62	8.33

Golder Associates

## PW11-1

**Notes:****Datalogger installed at 10.7 m below top of casing****Static WL** 1.715 m below top of casing**Start of Test** 11/7/2011 9:36**End of Test** 11/7/2011 15:52

<u>Date/Time</u>	<u>Time</u> (min)	<u>Pumping Rate</u> (L/min)	<u>Datalogger</u> Level (m)	<u>Temperature</u> (deg C)	<u>Datalogger</u> Drawdown (m)	<u>Water Level</u> (m btoc)
11/7/2011 11:22	106	11.32	2.5795	8.395	6.63	8.34
11/7/2011 11:23	107	11.32	2.5741	8.398	6.64	8.35
11/7/2011 11:24	108	11.32	2.5647	8.4	6.65	8.36
11/7/2011 11:25	109	11.32	2.5589	8.401	6.65	8.36
11/7/2011 11:26	110	11.32	2.5465	8.398	6.67	8.38
11/7/2011 11:27	111	11.32	2.5375	8.395	6.67	8.38
11/7/2011 11:28	112	11.32	2.5297	8.392	6.68	8.39
11/7/2011 11:29	113	11.32	2.5207	8.392	6.69	8.40
11/7/2011 11:30	114	11.32	2.5141	8.388	6.70	8.41
11/7/2011 11:31	115	11.32	2.508	8.385	6.70	8.41
11/7/2011 11:32	116	11.32	2.5053	8.383	6.71	8.42
11/7/2011 11:33	117	11.32	2.5022	8.386	6.71	8.42
11/7/2011 11:34	118	11.32	2.5001	8.386	6.71	8.42
11/7/2011 11:35	119	11.32	2.496	8.385	6.72	8.43
11/7/2011 11:36	120	11.32	2.4945	8.381	6.72	8.43
11/7/2011 11:37	121	11.32	2.4903	8.38	6.72	8.43
11/7/2011 11:38	122	11.32	2.4871	8.382	6.73	8.44
11/7/2011 11:39	123	11.32	2.4833	8.38	6.73	8.44
11/7/2011 11:40	124	11.32	2.4826	8.371	6.73	8.44
11/7/2011 11:41	125	11.32	2.4801	8.372	6.73	8.44
11/7/2011 11:42	126	11.32	2.4777	8.37	6.73	8.44
11/7/2011 11:43	127	11.32	2.4724	8.371	6.74	8.45
11/7/2011 11:44	128	11.32	2.4707	8.366	6.74	8.45
11/7/2011 11:45	129	11.32	2.4699	8.367	6.74	8.45
11/7/2011 11:46	130	11.32	2.4663	8.365	6.75	8.46
11/7/2011 11:47	131	11.32	2.4636	8.365	6.75	8.46
11/7/2011 11:48	132	11.32	2.4615	8.365	6.75	8.46
11/7/2011 11:49	133	11.32	2.4589	8.364	6.75	8.46
11/7/2011 11:50	134	11.32	2.4568	8.364	6.76	8.47
11/7/2011 11:51	135	11.32	2.4543	8.365	6.76	8.47
11/7/2011 11:52	136	11.32	2.4514	8.369	6.76	8.47
11/7/2011 11:53	137	11.32	2.4505	8.369	6.76	8.47
11/7/2011 11:54	138	11.32	2.4486	8.365	6.76	8.47
11/7/2011 11:55	139	11.32	2.4464	8.364	6.77	8.48
11/7/2011 11:56	140	11.32	2.4459	8.364	6.77	8.48
11/7/2011 11:57	141	11.32	2.4434	8.361	6.77	8.48
11/7/2011 11:58	142	11.32	2.4408	8.36	6.77	8.48
11/7/2011 11:59	143	11.32	2.4394	8.357	6.77	8.48
11/7/2011 12:00	144	11.32	2.4381	8.356	6.77	8.48
11/7/2011 12:01	145	11.32	2.4335	8.356	6.78	8.49
11/7/2011 12:02	146	11.32	2.4313	8.356	6.78	8.49
11/7/2011 12:03	147	11.32	2.4272	8.354	6.79	8.50
11/7/2011 12:04	148	11.32	2.4275	8.352	6.78	8.49
11/7/2011 12:05	149	11.32	2.4313	8.351	6.78	8.49
11/7/2011 12:06	150	11.32	2.4291	8.349	6.78	8.49
11/7/2011 12:07	151	11.32	2.4296	8.349	6.78	8.49
11/7/2011 12:08	152	11.32	2.4254	8.35	6.79	8.50
11/7/2011 12:09	153	11.32	2.4261	8.351	6.79	8.50
11/7/2011 12:10	154	11.32	2.4226	8.349	6.79	8.50
11/7/2011 12:11	155	11.32	2.4227	8.347	6.79	8.50
11/7/2011 12:12	156	11.32	2.4222	8.351	6.79	8.50
11/7/2011 12:13	157	11.32	2.4205	8.351	6.79	8.50
11/7/2011 12:14	158	11.32	2.4156	8.348	6.80	8.51

Golder Associates

## PW11-1

**Notes:****Datalogger installed at 10.7 m below top of casing****Static WL**

1.715 m below top of casing

**Start of Test**

11/7/2011 9:36

**End of Test**

11/7/2011 15:52

<u>Date/Time</u>	<u>Time</u> (min)	<u>Pumping Rate</u> (L/min)	<u>Datalogger</u> Level (m)	<u>Temperature</u> (deg C)	<u>Datalogger</u> Drawdown (m)	<u>Water Level</u> (m btoc)
11/7/2011 12:15	159	11.32	2.4137	8.345	6.80	8.51
11/7/2011 12:16	160	11.32	2.4123	8.346	6.80	8.51
11/7/2011 12:17	161	11.32	2.404	8.346	6.81	8.52
11/7/2011 12:18	162	11.32	2.4001	8.346	6.81	8.52
11/7/2011 12:19	163	11.32	2.3962	8.344	6.82	8.53
11/7/2011 12:20	164	11.32	2.3941	8.346	6.82	8.53
11/7/2011 12:21	165	11.32	2.3886	8.345	6.82	8.53
11/7/2011 12:22	166	11.32	2.3887	8.346	6.82	8.53
11/7/2011 12:23	167	11.32	2.3884	8.348	6.82	8.53
11/7/2011 12:24	168	11.32	2.3841	8.348	6.83	8.54
11/7/2011 12:25	169	11.32	2.3796	8.346	6.83	8.54
11/7/2011 12:26	170	11.32	2.375	8.343	6.84	8.55
11/7/2011 12:27	171	11.32	2.3738	8.342	6.84	8.55
11/7/2011 12:28	172	11.32	2.3689	8.344	6.84	8.55
11/7/2011 12:29	173	11.32	2.3687	8.341	6.84	8.55
11/7/2011 12:30	174	11.32	2.3671	8.341	6.85	8.56
11/7/2011 12:31	175	11.32	2.3655	8.343	6.85	8.56
11/7/2011 12:32	176	11.32	2.3631	8.342	6.85	8.56
11/7/2011 12:33	177	11.32	2.3607	8.34	6.85	8.56
11/7/2011 12:34	178	11.32	2.3581	8.342	6.85	8.56
11/7/2011 12:35	179	11.32	2.3561	8.343	6.86	8.57
11/7/2011 12:36	180	11.32	2.3544	8.342	6.86	8.57
11/7/2011 12:37	181	11.32	2.3533	8.343	6.86	8.57
11/7/2011 12:38	182	11.32	2.3501	8.343	6.86	8.57
11/7/2011 12:39	183	11.32	2.346	8.343	6.87	8.58
11/7/2011 12:40	184	11.32	2.3442	8.343	6.87	8.58
11/7/2011 12:41	185	11.32	2.3429	8.343	6.87	8.58
11/7/2011 12:42	186	11.32	2.3434	8.342	6.87	8.58
11/7/2011 12:43	187	11.32	2.3439	8.342	6.87	8.58
11/7/2011 12:44	188	11.32	2.3435	8.341	6.87	8.58
11/7/2011 12:45	189	11.32	2.3418	8.338	6.87	8.58
11/7/2011 12:46	190	11.32	2.3373	8.339	6.87	8.59
11/7/2011 12:47	191	11.32	2.3369	8.339	6.88	8.59
11/7/2011 12:48	192	11.32	2.3375	8.337	6.87	8.58
11/7/2011 12:49	193	11.32	2.3372	8.339	6.88	8.59
11/7/2011 12:50	194	11.32	2.3359	8.336	6.88	8.59
11/7/2011 12:51	195	11.32	2.3395	8.333	6.87	8.58
11/7/2011 12:52	196	11.32	2.3396	8.333	6.87	8.58
11/7/2011 12:53	197	11.32	2.3365	8.334	6.88	8.59
11/7/2011 12:54	198	11.32	2.3384	8.333	6.87	8.58
11/7/2011 12:55	199	11.32	2.3364	8.334	6.88	8.59
11/7/2011 12:56	200	11.32	2.3381	8.333	6.87	8.58
11/7/2011 12:57	201	11.32	2.3369	8.333	6.88	8.59
11/7/2011 12:58	202	11.32	2.3312	8.335	6.88	8.59
11/7/2011 12:59	203	11.32	2.3344	8.333	6.88	8.59
11/7/2011 13:00	204	11.32	2.3354	8.331	6.88	8.59
11/7/2011 13:01	205	11.32	2.3317	8.331	6.88	8.59
11/7/2011 13:02	206	11.32	2.3341	8.334	6.88	8.59
11/7/2011 13:03	207	11.32	2.3361	8.333	6.88	8.59
11/7/2011 13:04	208	11.32	2.3319	8.335	6.88	8.59
11/7/2011 13:05	209	11.32	2.3357	8.334	6.88	8.59
11/7/2011 13:06	210	11.32	2.3344	8.332	6.88	8.59
11/7/2011 13:07	211	11.32	2.3375	8.331	6.87	8.58

Golder Associates

**Notes:**  
**Datalogger installed at 10.7 m below top of casing**  
**Static WL** 1.715 m below top of casing  
**Start of Test** 11/7/2011 9:36  
**End of Test** 11/7/2011 15:52

<u>Date/Time</u>	<u>Time (min)</u>	<u>Pumping Rate (L/min)</u>	<u>Datalogger Level (m)</u>	<u>Temperature (deg C)</u>	<u>Datalogger Drawdown (m)</u>	<u>Water Level (m btoc)</u>
11/7/2011 13:08	212	11.32	2.3355	8.333	6.88	8.59
11/7/2011 13:09	213	11.32	2.3373	8.332	6.87	8.59
11/7/2011 13:10	214	11.32	2.337	8.331	6.88	8.59
11/7/2011 13:11	215	11.32	2.3345	8.333	6.88	8.59
11/7/2011 13:12	216	11.32	2.3326	8.332	6.88	8.59
11/7/2011 13:13	217	11.32	2.3312	8.333	6.88	8.59
11/7/2011 13:14	218	11.32	2.3236	8.332	6.89	8.60
11/7/2011 13:15	219	11.32	2.3159	8.331	6.90	8.61
11/7/2011 13:16	220	11.32	2.3103	8.331	6.90	8.61
11/7/2011 13:17	221	11.32	2.3044	8.33	6.91	8.62
11/7/2011 13:18	222	11.32	2.2939	8.331	6.92	8.63
11/7/2011 13:19	223	11.32	2.2973	8.33	6.91	8.63
11/7/2011 13:20	224	11.32	2.2892	8.331	6.92	8.63
11/7/2011 13:21	225	11.32	2.2834	8.332	6.93	8.64
11/7/2011 13:22	226	11.32	2.2845	8.328	6.93	8.64
11/7/2011 13:23	227	11.32	2.2885	8.329	6.92	8.63
11/7/2011 13:24	228	11.32	2.2808	8.329	6.93	8.64
11/7/2011 13:25	229	11.32	2.2759	8.332	6.94	8.65
11/7/2011 13:26	230	11.32	2.2772	8.333	6.94	8.65
11/7/2011 13:27	231	11.32	2.2762	8.333	6.94	8.65
11/7/2011 13:28	232	11.32	2.273	8.331	6.94	8.65
11/7/2011 13:29	233	11.32	2.2765	8.331	6.94	8.65
11/7/2011 13:30	234	11.32	2.2733	8.331	6.94	8.65
11/7/2011 13:31	235	11.32	2.2689	8.332	6.94	8.65
11/7/2011 13:32	236	11.32	2.2666	8.331	6.95	8.66
11/7/2011 13:33	237	11.32	2.269	8.33	6.94	8.65
11/7/2011 13:34	238	11.32	2.2676	8.328	6.94	8.65
11/7/2011 13:35	239	11.32	2.2665	8.33	6.95	8.66
11/7/2011 13:36	240	11.32	2.2645	8.33	6.95	8.66
11/7/2011 13:37	241	11.32	2.2623	8.329	6.95	8.66
11/7/2011 13:38	242	11.32	2.2667	8.328	6.95	8.66
11/7/2011 13:39	243	11.32	2.2706	8.329	6.94	8.65
11/7/2011 13:40	244	11.32	2.2683	8.327	6.94	8.65
11/7/2011 13:41	245	11.32	2.2669	8.329	6.95	8.66
11/7/2011 13:42	246	11.32	2.2685	8.328	6.94	8.65
11/7/2011 13:43	247	11.32	2.2656	8.327	6.95	8.66
11/7/2011 13:44	248	11.32	2.2666	8.325	6.95	8.66
11/7/2011 13:45	249	11.32	2.2674	8.328	6.94	8.66
11/7/2011 13:46	250	11.32	2.2648	8.326	6.95	8.66
11/7/2011 13:47	251	11.32	2.2614	8.324	6.95	8.66
11/7/2011 13:48	252	11.32	2.268	8.325	6.94	8.65
11/7/2011 13:49	253	11.32	2.2671	8.325	6.95	8.66
11/7/2011 13:50	254	11.32	2.267	8.324	6.95	8.66
11/7/2011 13:51	255	11.32	2.2672	8.325	6.95	8.66
11/7/2011 13:52	256	11.32	2.2641	8.325	6.95	8.66
11/7/2011 13:53	257	11.32	2.2627	8.322	6.95	8.66
11/7/2011 13:54	258	11.32	2.2626	8.323	6.95	8.66
11/7/2011 13:55	259	11.32	2.2619	8.323	6.95	8.66
11/7/2011 13:56	260	11.32	2.2592	8.323	6.95	8.66
11/7/2011 13:57	261	11.32	2.2574	8.323	6.95	8.67
11/7/2011 13:58	262	11.32	2.2569	8.324	6.96	8.67
11/7/2011 13:59	263	11.32	2.2554	8.325	6.96	8.67
11/7/2011 14:00	264	11.32	2.2563	8.325	6.96	8.67

PW11-1

**Notes:**  
**Datalogger installed at 10.7 m below top of casing**  
**Static WL** 1.715 m below top of casing  
**Start of Test** 11/7/2011 9:36  
**End of Test** 11/7/2011 15:52

<u>Date/Time</u>	<u>Time (min)</u>	<u>Pumping Rate (L/min)</u>	<u>Datalogger Level (m)</u>	<u>Temperature (deg C)</u>	<u>Datalogger Drawdown (m)</u>	<u>Water Level (m btoc)</u>
11/7/2011 14:01	265	11.32	2.254	8.325	6.96	8.67
11/7/2011 14:02	266	11.32	2.2532	8.325	6.96	8.67
11/7/2011 14:03	267	11.32	2.2524	8.326	6.96	8.67
11/7/2011 14:04	268	11.32	2.2527	8.323	6.96	8.67
11/7/2011 14:05	269	11.32	2.255	8.324	6.96	8.67
11/7/2011 14:06	270	11.32	2.2603	8.324	6.95	8.66
11/7/2011 14:07	271	11.32	2.2666	8.323	6.95	8.66
11/7/2011 14:08	272	11.32	2.2644	8.323	6.95	8.66
11/7/2011 14:09	273	11.32	2.2591	8.324	6.95	8.66
11/7/2011 14:10	274	11.32	2.2597	8.323	6.95	8.66
11/7/2011 14:11	275	11.32	2.2673	8.323	6.94	8.66
11/7/2011 14:12	276	11.32	2.2688	8.323	6.94	8.65
11/7/2011 14:13	277	11.32	2.2683	8.323	6.94	8.65
11/7/2011 14:14	278	11.32	2.2668	8.326	6.95	8.66
11/7/2011 14:15	279	11.32	2.2637	8.326	6.95	8.66
11/7/2011 14:16	280	11.32	2.2614	8.327	6.95	8.66
11/7/2011 14:17	281	11.32	2.2614	8.326	6.95	8.66
11/7/2011 14:18	282	11.32	2.2593	8.326	6.95	8.66
11/7/2011 14:19	283	11.32	2.2574	8.326	6.95	8.67
11/7/2011 14:20	284	11.32	2.2561	8.327	6.96	8.67
11/7/2011 14:21	285	11.32	2.2521	8.328	6.96	8.67
11/7/2011 14:22	286	11.32	2.251	8.328	6.96	8.67
11/7/2011 14:23	287	11.32	2.2496	8.328	6.96	8.67
11/7/2011 14:24	288	11.32	2.2495	8.328	6.96	8.67
11/7/2011 14:25	289	11.32	2.2451	8.326	6.97	8.68
11/7/2011 14:26	290	11.32	2.2456	8.324	6.97	8.68
11/7/2011 14:27	291	11.32	2.2409	8.324	6.97	8.68
11/7/2011 14:28	292	11.32	2.2357	8.324	6.98	8.69
11/7/2011 14:29	293	11.32	2.2326	8.323	6.98	8.69
11/7/2011 14:30	294	11.32	2.2279	8.324	6.98	8.69
11/7/2011 14:31	295	11.32	2.2234	8.323	6.99	8.70
11/7/2011 14:32	296	11.32	2.22	8.323	6.99	8.70
11/7/2011 14:33	297	11.32	2.2181	8.324	6.99	8.70
11/7/2011 14:34	298	11.32	2.2158	8.325	7.00	8.71
11/7/2011 14:35	299	11.32	2.2142	8.325	7.00	8.71
11/7/2011 14:36	300	11.32	2.21	8.323	7.00	8.71
11/7/2011 14:37	301	11.32	2.2086	8.321	7.00	8.71
11/7/2011 14:38	302	11.32	2.2082	8.32	7.00	8.71
11/7/2011 14:39	303	11.32	2.2061	8.319	7.01	8.72
11/7/2011 14:40	304	11.32	2.2045	8.319	7.01	8.72
11/7/2011 14:41	305	11.32	2.2053	8.321	7.01	8.72
11/7/2011 14:42	306	11.32	2.2047	8.321	7.01	8.72
11/7/2011 14:43	307	11.32	2.2041	8.32	7.01	8.72
11/7/2011 14:44	308	11.32	2.204	8.32	7.01	8.72
11/7/2011 14:45	309	11.32	2.2036	8.32	7.01	8.72
11/7/2011 14:46	310	11.32	2.2015	8.321	7.01	8.72
11/7/2011 14:47	311	11.32	2.2003	8.322	7.01	8.72
11/7/2011 14:48	312	11.32	2.2016	8.321	7.01	8.72
11/7/2011 14:49	313	11.32	2.2012	8.323	7.01	8.72
11/7/2011 14:50	314	11.32	2.2013	8.322	7.01	8.72
11/7/2011 14:51	315	11.32	2.1999	8.322	7.01	8.72
11/7/2011 14:52	316	11.32	2.1992	8.323	7.01	8.72
11/7/2011 14:53	317	11.32	2.1982	8.324	7.01	8.72

## PW11-1

**Notes:****Datalogger installed at 10.7 m below top of casing****Static WL** 1.715 m below top of casing**Start of Test** 11/7/2011 9:36**End of Test** 11/7/2011 15:52

<u>Date/Time</u>	<u>Time</u> <u>(min)</u>	<u>Pumping Rate</u> <u>(L/min)</u>	<u>Datalogger</u> <u>Level (m)</u>	<u>Temperature</u> <u>(deg C)</u>	<u>Datalogger</u> <u>Drawdown (m)</u>	<u>Water Level</u> <u>(m btoc)</u>
11/7/2011 14:54	318	11.32	2.2016	8.324	7.01	8.72
11/7/2011 14:55	319	11.32	2.2002	8.323	7.01	8.72
11/7/2011 14:56	320	11.32	2.2016	8.323	7.01	8.72
11/7/2011 14:57	321	11.32	2.1995	8.322	7.01	8.72
11/7/2011 14:58	322	11.32	2.1982	8.322	7.01	8.72
11/7/2011 14:59	323	11.32	2.197	8.32	7.02	8.73
11/7/2011 15:00	324	11.32	2.197	8.322	7.02	8.73
11/7/2011 15:01	325	11.32	2.1965	8.323	7.02	8.73
11/7/2011 15:02	326	11.32	2.1951	8.322	7.02	8.73
11/7/2011 15:03	327	11.32	2.1948	8.322	7.02	8.73
11/7/2011 15:04	328	11.32	2.2016	8.322	7.01	8.72
11/7/2011 15:05	329	11.32	2.2025	8.322	7.01	8.72
11/7/2011 15:06	330	11.32	2.2011	8.32	7.01	8.72
11/7/2011 15:07	331	11.32	2.2023	8.32	7.01	8.72
11/7/2011 15:08	332	11.32	2.2028	8.321	7.01	8.72
11/7/2011 15:09	333	11.32	2.2007	8.321	7.01	8.72
11/7/2011 15:10	334	11.32	2.2002	8.32	7.01	8.72
11/7/2011 15:11	335	11.32	2.2009	8.321	7.01	8.72
11/7/2011 15:12	336	11.32	2.1996	8.321	7.01	8.72
11/7/2011 15:13	337	11.32	2.2004	8.323	7.01	8.72
11/7/2011 15:14	338	11.32	2.2012	8.323	7.01	8.72
11/7/2011 15:15	339	11.32	2.2026	8.322	7.01	8.72
11/7/2011 15:16	340	11.32	2.1998	8.323	7.01	8.72
11/7/2011 15:17	341	11.32	2.201	8.323	7.01	8.72
11/7/2011 15:18	342	11.32	2.1959	8.321	7.02	8.73
11/7/2011 15:19	343	11.32	2.1975	8.322	7.01	8.72
11/7/2011 15:20	344	11.32	2.1974	8.322	7.01	8.73
11/7/2011 15:21	345	11.32	2.1978	8.321	7.01	8.72
11/7/2011 15:22	346	11.32	2.1979	8.319	7.01	8.72
11/7/2011 15:23	347	11.32	2.1953	8.319	7.02	8.73
11/7/2011 15:24	348	11.32	2.1944	8.32	7.02	8.73
11/7/2011 15:25	349	11.32	2.195	8.319	7.02	8.73
11/7/2011 15:26	350	11.32	2.1934	8.319	7.02	8.73
11/7/2011 15:27	351	11.32	2.1941	8.32	7.02	8.73
11/7/2011 15:28	352	11.32	2.1922	8.321	7.02	8.73
11/7/2011 15:29	353	11.32	2.1914	8.322	7.02	8.73
11/7/2011 15:30	354	11.32	2.1921	8.32	7.02	8.73
11/7/2011 15:31	355	11.32	2.1904	8.32	7.02	8.73
11/7/2011 15:32	356	11.32	2.1891	8.319	7.02	8.73
11/7/2011 15:33	357	11.32	2.1903	8.32	7.02	8.73
11/7/2011 15:34	358	11.32	2.1905	8.32	7.02	8.73
11/7/2011 15:35	359	11.32	2.1936	8.32	7.02	8.73
11/7/2011 15:36	360	11.32	2.192	8.32	7.02	8.73
11/7/2011 15:37	361	11.32	2.1935	8.319	7.02	8.51
11/7/2011 15:38	362	11.32	2.1935	8.319	7.02	8.73
11/7/2011 15:39	363	11.32	2.1939	8.32	7.02	8.73
11/7/2011 15:40	364	11.32	2.1944	8.321	7.02	8.73
11/7/2011 15:41	365	11.32	2.1927	8.319	7.02	8.73
11/7/2011 15:42	366	11.32	2.192	8.319	7.02	8.73
11/7/2011 15:43	367	11.32	2.1906	8.319	7.02	8.73
11/7/2011 15:44	368	11.32	2.1884	8.321	7.02	8.73
11/7/2011 15:45	369	11.32	2.1874	8.321	7.02	8.74
11/7/2011 15:46	370	11.32	2.1888	8.32	7.02	8.73

Golder Associates

## PW11-1

**Notes:****Datalogger installed at 10.7 m below top of casing****Static WL**

1.715 m below top of casing

**Start of Test**

11/7/2011 9:36

**End of Test**

11/7/2011 15:52

<u>Date/Time</u>	<u>Time</u> (min)	<u>Pumping Rate</u> (L/min)	<u>Datalogger</u> Level (m)	<u>Temperature</u> (deg C)	<u>Datalogger</u> Drawdown (m)	<u>Water Level</u> (m btoc)
11/7/2011 15:47	371	11.32	2.1896	8.317	7.02	8.73
11/7/2011 15:48	372	11.32	2.186	8.319	7.03	8.74
11/7/2011 15:49	373	11.32	2.1858	8.319	7.03	8.74
11/7/2011 15:50	374	11.32	2.182	8.318	7.03	8.74
11/7/2011 15:51	375	11.32	2.1814	8.318	7.03	8.74
<b>11/7/2011 15:52</b>	376	0	<b>2.1782</b>	<b>8.317</b>	<b>7.03</b>	<b>8.74</b>
11/7/2011 15:53	377	0	2.7355	8.308	6.48	8.19
11/7/2011 15:54	378	0	3.2417	8.293	5.97	7.68
11/7/2011 15:55	379	0	3.7198	8.28	5.49	7.20
11/7/2011 15:56	380	0	4.1715	8.272	5.04	6.75
11/7/2011 15:57	381	0	4.5965	8.268	4.62	6.33
11/7/2011 15:58	382	0	4.9962	8.263	4.22	5.93
11/7/2011 15:59	383	0	5.374	8.261	3.84	5.55
11/7/2011 16:00	384	0	5.7259	8.258	3.49	5.20
11/7/2011 16:01	385	0	6.0546	8.256	3.16	4.87
11/7/2011 16:02	386	0	6.3606	8.255	2.85	4.56
11/7/2011 16:03	387	0	6.6445	8.255	2.57	4.28
11/7/2011 16:04	388	0	6.9091	8.254	2.30	4.01
11/7/2011 16:05	389	0	7.1517	8.252	2.06	3.77
11/7/2011 16:06	390	0	7.3772	8.253	1.84	3.55
11/7/2011 16:07	391	0	7.5812	8.251	1.63	3.34
11/7/2011 16:08	392	0	7.7687	8.25	1.44	3.15
11/7/2011 16:09	393	0	7.9376	8.251	1.27	2.98
11/7/2011 16:10	394	0	8.0927	8.25	1.12	2.83
11/7/2011 16:11	395	0	8.2311	8.25	0.98	2.69
11/7/2011 16:12	396	0	8.355	8.25	0.86	2.57
11/7/2011 16:13	397	0	8.4663	8.249	0.75	2.46
11/7/2011 16:14	398	0	8.5647	8.249	0.65	2.36
11/7/2011 16:15	399	0	8.65	8.25	0.56	2.27
11/7/2011 16:16	400	0	8.7241	8.249	0.49	2.20
11/7/2011 16:17	401	0	8.787	8.249	0.43	2.14
11/7/2011 16:18	402	0	8.8317	8.249	0.38	2.09
11/7/2011 16:19	403	0	8.8712	8.25	0.34	2.05
11/7/2011 16:20	404	0	8.9085	8.25	0.30	2.01
11/7/2011 16:21	405	0	8.9433	8.25	0.27	1.98
11/7/2011 16:22	406	0	8.9724	8.25	0.24	1.95
11/7/2011 16:23	407	0	8.9973	8.25	0.21	1.93
11/7/2011 16:24	408	0	9.0187	8.25	0.19	1.90
11/7/2011 16:25	409	0	9.0368	8.25	0.18	1.89
11/7/2011 16:26	410	0	9.0535	8.25	0.16	1.87
11/7/2011 16:27	411	0	9.0682	8.25	0.14	1.85
11/7/2011 16:28	412	0	9.0801	8.252	0.13	1.84
11/7/2011 16:29	413	0	9.0906	8.252	0.12	1.83
11/7/2011 16:30	414	0	9.0998	8.252	0.11	1.82
11/7/2011 16:31	415	0	9.1077	8.252	0.10	1.81
11/7/2011 16:32	416	0	9.1148	8.253	0.10	1.81
11/7/2011 16:33	417	0	9.1208	8.254	0.09	1.80
11/7/2011 16:34	418	0	9.1258	8.258	0.09	1.80
11/7/2011 16:35	419	0	9.1298	8.258	0.08	1.79
11/7/2011 16:36	420	0	9.134	8.261	0.08	1.79
11/7/2011 16:37	421	0	9.1381	8.262	0.07	1.78
11/7/2011 16:38	422	0	9.1406	8.263	0.07	1.78

## Residential Well

<b>Notes</b>
Datalogger installed at 10 m below top of casing
Static WL 2.39 m below top of casing

<u>Date/Time</u>	<u>Time (min)</u>	<u>Datalogger Level (m)</u>	<u>Temperature (deg C)</u>	<u>Datalogger Drawdown (m)</u>	<u>Water Level (m btoc)</u>
11/7/2011 9:35		8.8294	9.528	0	2.390
11/7/2011 9:40	4	8.8286	9.54	0.001	2.391
11/7/2011 9:45	9	8.6027	9.568	0.227	2.617
11/7/2011 9:50	14	8.7893	9.659	0.040	2.430
11/7/2011 9:55	19	8.8033	9.683	0.026	2.416
11/7/2011 10:00	24	8.805	9.667	0.024	2.414
11/7/2011 10:05	29	8.8025	9.625	0.027	2.417
11/7/2011 10:10	34	8.8014	9.611	0.028	2.418
11/7/2011 10:15	39	8.5922	9.647	0.237	2.627
11/7/2011 10:20	44	8.78	9.69	0.049	2.439
11/7/2011 10:25	49	8.7933	9.689	0.036	2.426
11/7/2011 10:30	54	8.7939	9.682	0.035	2.426
11/7/2011 10:35	59	8.7939	9.665	0.035	2.426
11/7/2011 10:40	64	8.7933	9.65	0.036	2.426
11/7/2011 10:45	69	8.7932	9.629	0.036	2.426
11/7/2011 10:50	74	8.7908	9.611	0.039	2.429
11/7/2011 10:55	79	8.7901	9.588	0.039	2.429
11/7/2011 11:00	84	8.7889	9.585	0.040	2.431
11/7/2011 11:05	89	8.7875	9.574	0.042	2.432
11/7/2011 11:10	94	8.7865	9.562	0.043	2.433
11/7/2011 11:15	99	8.7849	9.55	0.044	2.435
11/7/2011 11:20	104	8.7856	9.54	0.044	2.434
11/7/2011 11:25	109	8.7846	9.527	0.045	2.435
11/7/2011 11:30	114	8.7844	9.513	0.045	2.435
11/7/2011 11:35	119	8.7841	9.5	0.045	2.435
11/7/2011 11:40	124	8.7827	9.491	0.047	2.437
11/7/2011 11:45	129	8.7821	9.478	0.047	2.437
11/7/2011 11:50	134	8.7811	9.472	0.048	2.438
11/7/2011 11:55	139	8.7805	9.468	0.049	2.439
11/7/2011 12:00	144	8.7797	9.462	0.050	2.440
11/7/2011 12:05	149	8.7796	9.453	0.050	2.440
11/7/2011 12:10	154	8.78	9.443	0.049	2.439
11/7/2011 12:15	159	8.7779	9.434	0.051	2.442
11/7/2011 12:20	164	8.7672	9.459	0.062	2.452
11/7/2011 12:25	169	8.7761	9.471	0.053	2.443
11/7/2011 12:30	174	8.7762	9.476	0.053	2.443
11/7/2011 12:35	179	8.777	9.478	0.052	2.442
11/7/2011 12:40	184	8.7776	9.48	0.052	2.442
11/7/2011 12:45	189	8.7769	9.477	0.053	2.443
11/7/2011 12:50	194	8.7761	9.471	0.053	2.443
11/7/2011 12:55	199	8.775	9.465	0.054	2.444
11/7/2011 13:00	204	8.774	9.458	0.055	2.445
11/7/2011 13:05	209	8.7739	9.453	0.056	2.446
11/7/2011 13:10	214	8.7738	9.448	0.056	2.446
11/7/2011 13:15	219	8.7091	9.556	0.120	2.510
11/7/2011 13:20	224	8.7661	9.634	0.063	2.453
11/7/2011 13:25	229	8.7713	9.621	0.058	2.448
11/7/2011 13:30	234	8.7723	9.603	0.057	2.447
11/7/2011 13:35	239	8.7708	9.598	0.059	2.449
11/7/2011 13:40	244	8.7707	9.586	0.059	2.449
11/7/2011 13:45	249	8.7713	9.572	0.058	2.448
11/7/2011 13:50	254	8.7696	9.56	0.060	2.450
<b>11/7/2011 13:55</b>	<b>259</b>	<b>8.756</b>	<b>9.598</b>	<b>0.073</b>	<b>2.463</b>
11/7/2011 14:00	264	8.7638	9.623	0.066	2.456

Golder Associates



<b>Notes</b>
Datalogger installed at 10 m below top of casing
Static WL 2.39 m below top of casing

<u>Date/Time</u>	<u>Time (min)</u>	<u>Datalogger Level (m)</u>	<u>Temperature (deg C)</u>	<u>Datalogger Drawdown (m)</u>	<u>Water Level (m btoc)</u>
11/7/2011 14:05	269	8.7665	9.637	0.063	2.453
11/7/2011 14:10	274	8.7675	9.609	0.062	2.452
11/7/2011 14:15	279	8.7683	9.603	0.061	2.451
11/7/2011 14:20	284	8.7683	9.589	0.061	2.451
11/7/2011 14:25	289	8.7681	9.576	0.061	2.451
11/7/2011 14:30	294	8.7681	9.563	0.061	2.451
11/7/2011 14:35	299	8.7683	9.554	0.061	2.451
11/7/2011 14:40	304	8.7667	9.544	0.063	2.453
11/7/2011 14:45	309	8.7652	9.533	0.064	2.454
11/7/2011 14:50	314	8.7658	9.519	0.064	2.454
11/7/2011 14:55	319	8.7667	9.51	0.063	2.453
11/7/2011 15:00	324	8.7665	9.501	0.063	2.453
11/7/2011 15:05	329	8.7683	9.49	0.061	2.451
11/7/2011 15:10	334	8.7686	9.483	0.061	2.451
11/7/2011 15:15	339	8.7699	9.475	0.059	2.450
11/7/2011 15:20	344	8.7694	9.467	0.060	2.450
11/7/2011 15:25	349	8.7686	9.459	0.061	2.451
11/7/2011 15:30	354	8.7679	9.451	0.062	2.452
11/7/2011 15:35	359	8.7676	9.445	0.062	2.452
11/7/2011 15:40	364	8.7679	9.438	0.062	2.452
11/7/2011 15:45	369	8.7679	9.431	0.062	2.452
11/7/2011 15:50	374	8.7679	9.425	0.062	2.452
11/7/2011 15:55	379	8.7687	9.419	0.061	2.451
11/7/2011 16:00	384	8.7741	9.412	0.055	2.445
11/7/2011 16:05	389	8.7791	9.406	0.050	2.440
11/7/2011 16:10	394	8.7851	9.4	0.044	2.434
11/7/2011 16:15	399	8.7909	9.394	0.038	2.429

## Bradley Bus Well

<b>Notes</b>
Datalogger installed at 11 m below top of casing
Static WL 2.204 m below top of casing

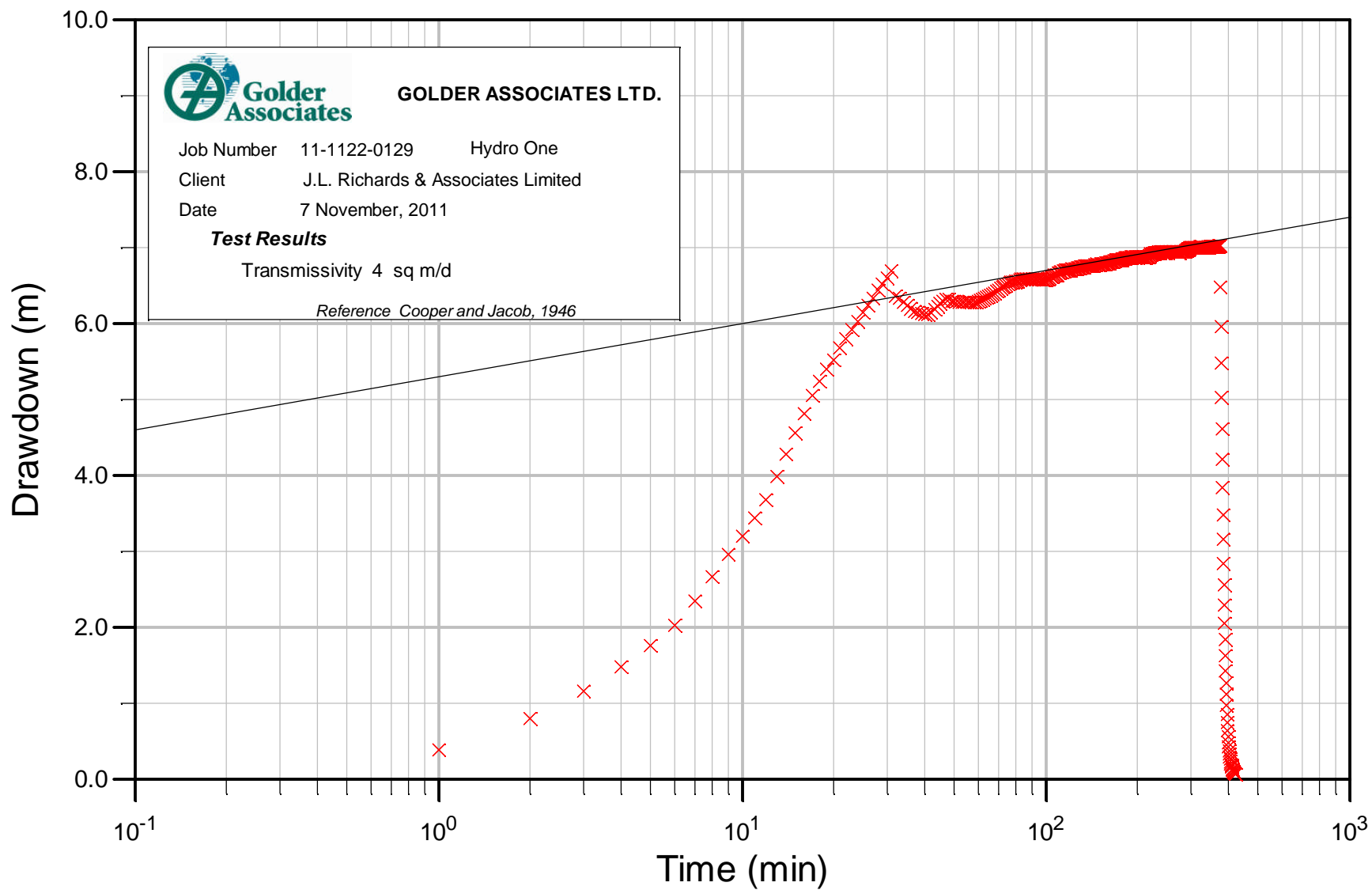
<u>Date/Time</u>	<u>Time (min)</u>	<u>Datalogger Level (m)</u>	<u>Temperature (deg C)</u>	<u>Datalogger Drawdown (m)</u>	<u>Water Level (m btoc)</u>
11/7/2011 9:25		7.9923	12.015		2.20
11/7/2011 9:30		7.9903	12.003		2.20
11/7/2011 9:35		7.5706	11.959	0	2.62
11/7/2011 9:40	4	7.9793	12.093	0.000	2.22
11/7/2011 9:45	9	7.9825	12.062	-0.003	2.21
11/7/2011 9:50	14	7.9816	12.049	-0.002	2.21
11/7/2011 9:55	19	7.9815	12.077	-0.002	2.21
11/7/2011 10:00	24	7.9807	12.066	-0.001	2.21
11/7/2011 10:05	29	7.979	11.995	0.000	2.22
11/7/2011 10:10	34	7.9786	11.966	0.001	2.22
11/7/2011 10:15	39	7.9768	11.945	0.003	2.22
11/7/2011 10:20	44	7.976	11.929	0.003	2.22
11/7/2011 10:25	49	7.9765	11.924	0.003	2.22
11/7/2011 10:30	54	7.9743	11.908	0.005	2.22
11/7/2011 10:35	59	7.9734	11.899	0.006	2.22
11/7/2011 10:40	64	7.9737	11.879	0.006	2.22
11/7/2011 10:45	69	7.9704	11.869	0.009	2.22
11/7/2011 10:50	74	7.969	11.862	0.010	2.23
11/7/2011 10:55	79	7.9689	11.855	0.010	2.23
11/7/2011 11:00	84	7.9687	11.847	0.011	2.23
11/7/2011 11:05	89	7.9665	11.841	0.013	2.23
11/7/2011 11:10	94	7.9664	11.83	0.013	2.23
11/7/2011 11:15	99	7.9653	11.822	0.014	2.23
11/7/2011 11:20	104	7.9644	11.818	0.015	2.23
11/7/2011 11:25	109	7.9647	11.814	0.015	2.23
11/7/2011 11:30	114	7.9637	11.806	0.016	2.23
11/7/2011 11:35	119	7.9641	11.804	0.015	2.23
11/7/2011 11:40	124	7.9636	11.799	0.016	2.23
11/7/2011 11:45	129	7.9635	11.795	0.016	2.23
11/7/2011 11:50	134	7.9624	11.788	0.017	2.23
11/7/2011 11:55	139	7.962	11.783	0.017	2.23
11/7/2011 12:00	144	7.96	11.78	0.019	2.23
11/7/2011 12:05	149	7.9599	11.774	0.019	2.23
11/7/2011 12:10	154	7.9604	11.769	0.019	2.23
11/7/2011 12:15	159	7.9582	11.764	0.021	2.24
11/7/2011 12:20	164	7.9591	11.757	0.020	2.24
11/7/2011 12:25	169	7.9578	11.749	0.022	2.24
11/7/2011 12:30	174	7.958	11.748	0.021	2.24
11/7/2011 12:35	179	7.9573	11.741	0.022	2.24
11/7/2011 12:40	184	7.9583	11.732	0.021	2.24
11/7/2011 12:45	189	7.9579	11.729	0.021	2.24
11/7/2011 12:50	194	7.9568	11.725	0.023	2.24
11/7/2011 12:55	199	7.948	11.783	0.031	2.25
11/7/2011 13:00	204	7.9555	11.838	0.024	2.24
11/7/2011 13:05	209	7.9567	11.803	0.023	2.24
11/7/2011 13:10	214	7.9579	11.801	0.021	2.24
11/7/2011 13:15	219	7.9558	11.813	0.024	2.24
11/7/2011 13:20	224	7.9564	11.798	0.023	2.24
11/7/2011 13:25	229	7.9566	11.794	0.023	2.24
11/7/2011 13:30	234	7.8888	11.788	0.091	2.31
11/7/2011 13:35	239	7.9467	11.849	0.033	2.25
11/7/2011 13:40	244	7.954	11.959	0.025	2.24
11/7/2011 13:45	249	7.5155	11.926	0.464	2.68
11/7/2011 13:50	254	7.9462	12.151	0.033	2.25

Golder Associates

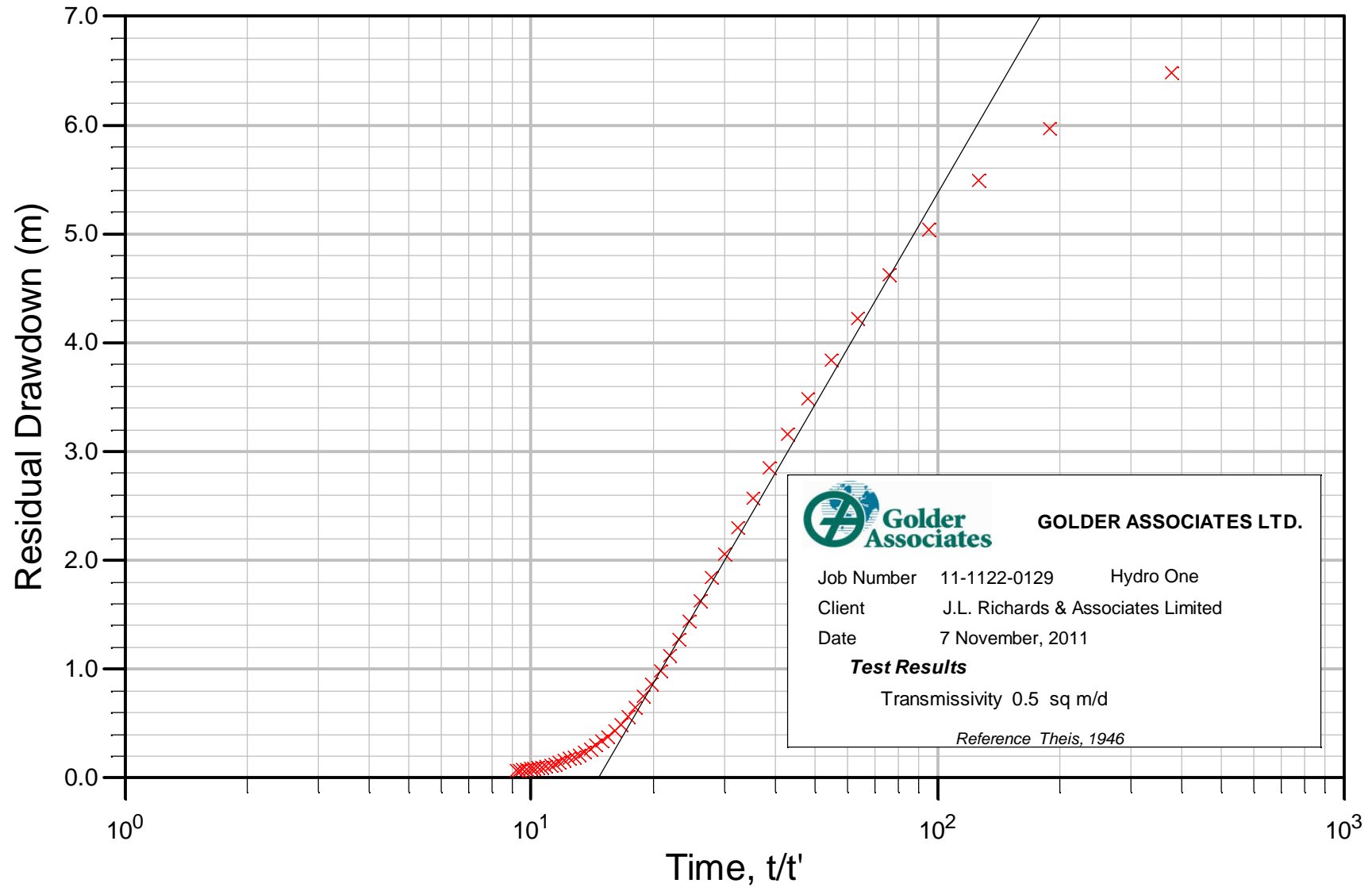
<b>Notes</b> Datalogger installed at 11 m below top of casing Static WL 2.204 m below top of casing
---

<u>Date/Time</u>	<u>Time (min)</u>	<u>Datalogger Level (m)</u>	<u>Temperature (deg C)</u>	<u>Datalogger Drawdown (m)</u>	<u>Water Level (m btoc)</u>
11/7/2011 13:55	259	7.9399	11.935	0.039	2.25
11/7/2011 14:00	264	7.9261	11.884	0.053	2.27
11/7/2011 14:05	269	7.9455	11.953	0.034	2.25
11/7/2011 14:10	274	7.9513	11.976	0.028	2.24
11/7/2011 14:15	279	7.9529	12.056	0.026	2.24
11/7/2011 14:20	284	7.9232	11.893	0.056	2.27
11/7/2011 14:25	289	7.9477	11.936	0.032	2.25
11/7/2011 14:30	294	7.9521	12.006	0.027	2.24
11/7/2011 14:35	299	7.9354	11.868	0.044	2.26
11/7/2011 14:40	304	7.5824	11.899	0.397	2.61
11/7/2011 14:45	309	7.9433	12.073	0.036	2.25
11/7/2011 14:50	314	7.9445	12.18	0.035	2.25
11/7/2011 14:55	319	7.9478	12.144	0.032	2.25
11/7/2011 15:00	324	7.9486	12.076	0.031	2.25
11/7/2011 15:05	329	7.9488	12.046	0.031	2.25
11/7/2011 15:10	334	7.9508	12.013	0.029	2.24
11/7/2011 15:15	339	7.9513	12.002	0.028	2.24
11/7/2011 15:20	344	7.9509	11.961	0.028	2.24
11/7/2011 15:25	349	7.9511	11.947	0.028	2.24
11/7/2011 15:30	354	7.9507	11.925	0.029	2.24
11/7/2011 15:35	359	7.9509	11.912	0.028	2.24
11/7/2011 15:40	364	7.9512	11.902	0.028	2.24
11/7/2011 15:45	369	7.9509	11.89	0.028	2.24
11/7/2011 15:50	374	7.9514	11.878	0.028	2.24
11/7/2011 15:55	379	7.9517	11.865	0.028	2.24
11/7/2011 16:00	384	7.9525	11.857	0.027	2.24
11/7/2011 16:05	389	7.9537	11.857	0.026	2.24
11/7/2011 16:10	394	7.9547	11.846	0.025	2.24
11/7/2011 16:15	399	7.9561	11.837	0.023	2.24
11/7/2011 16:20	404	7.9573	11.826	0.022	2.24
11/7/2011 16:25	409	7.9596	11.818	0.020	2.23
11/7/2011 16:30	414	7.9603	11.81	0.019	2.23
11/7/2011 16:35	419	7.9609	11.801	0.018	2.23
11/7/2011 16:40	424	7.9641	11.792	0.015	2.23
11/7/2011 16:45	429	7.963	11.79	0.016	2.23

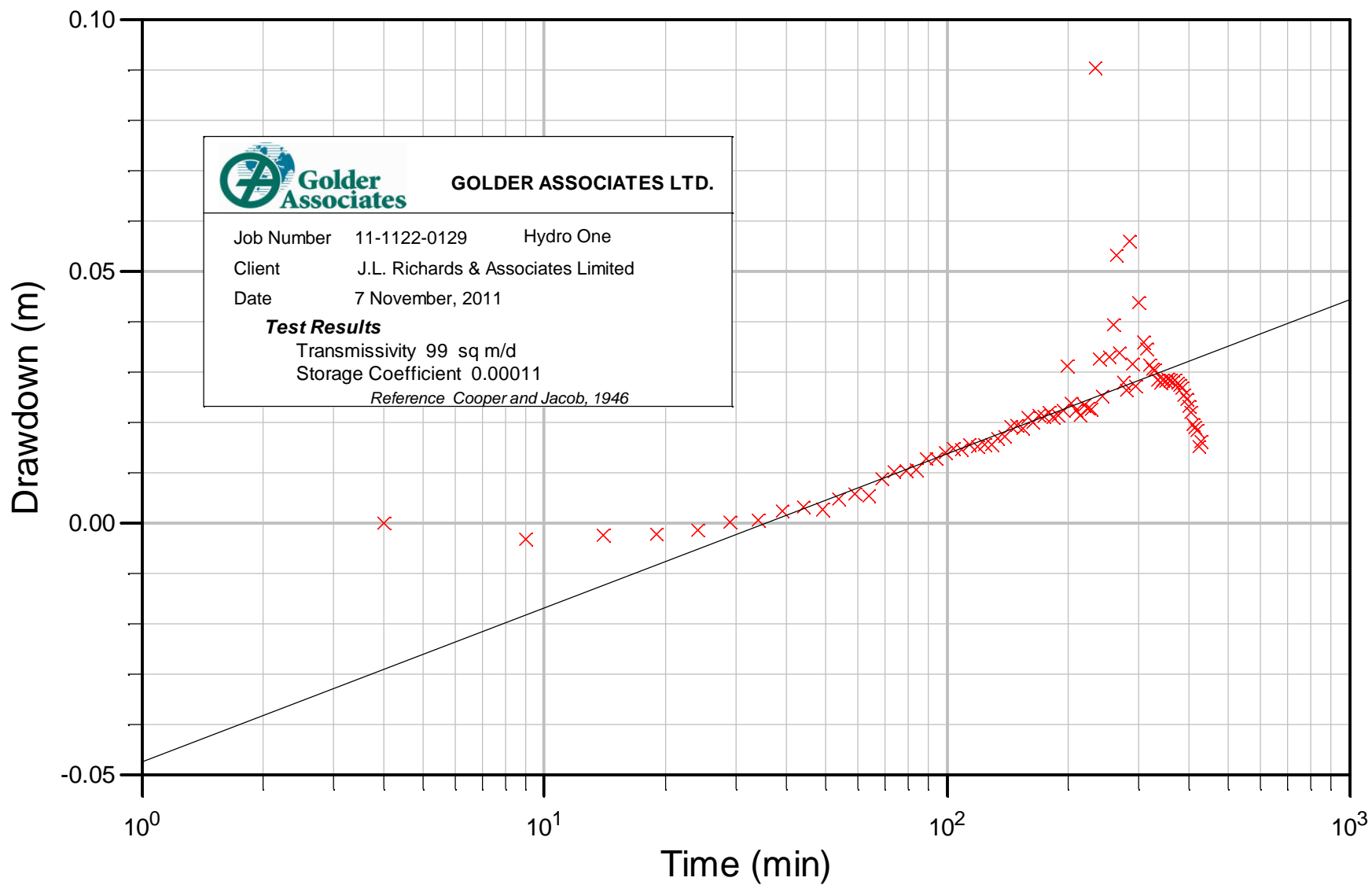
# PW11-1 Cooper and Jacob



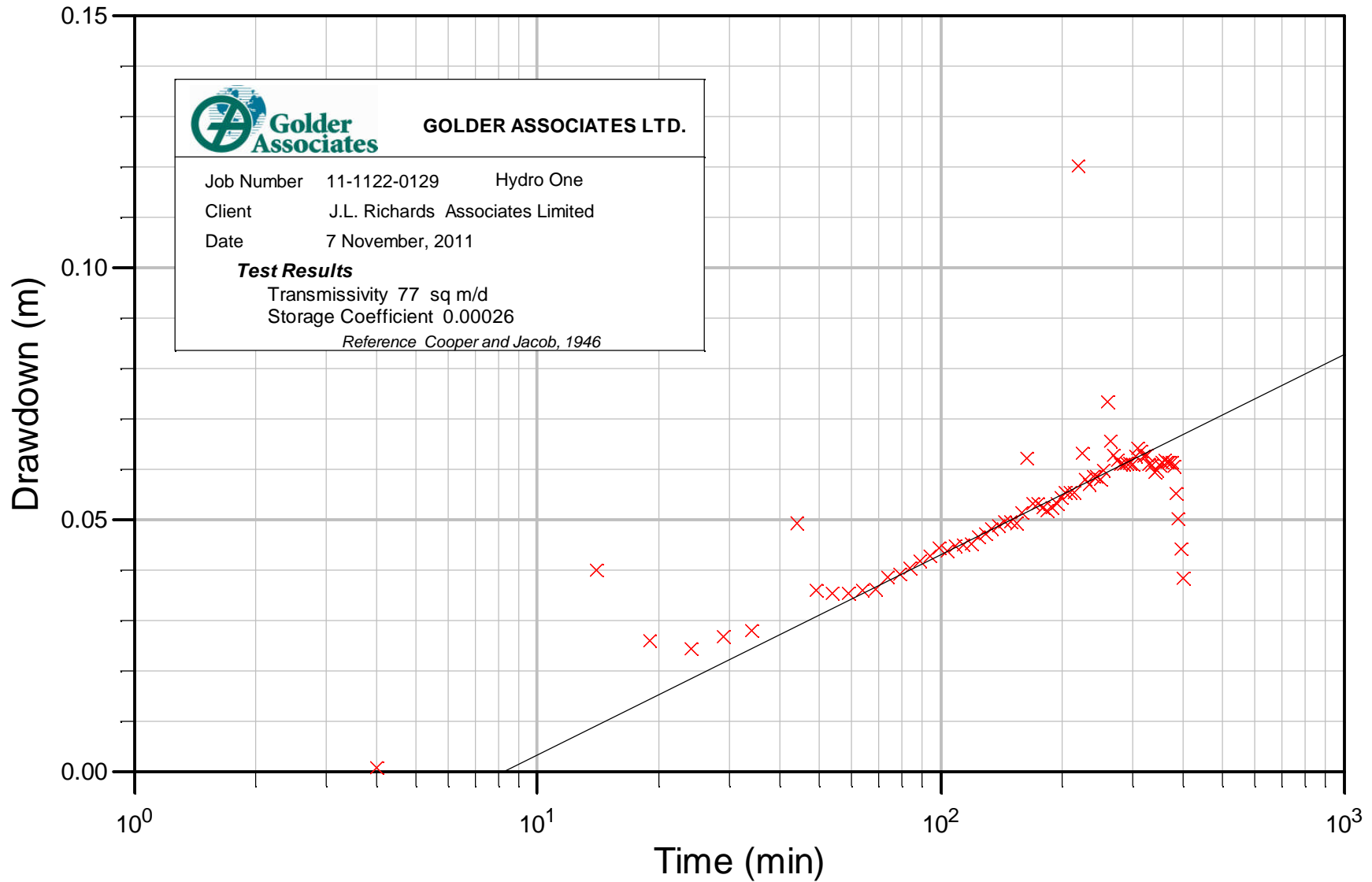
# PW11-1 Theis Recovery



# Bus Depot - Cooper and Jacob



# Residential Well - Cooper and Jacob





# APPENDIX F

## Laboratory Certificates of Analysis



**Client:** Golder Associates Ltd. (Ottawa)  
32 Steacie Drive

Kanata, ON  
K2K 2A9

**Attention:** Ms. Caitlin Cooke

**Report Number:** 1126039  
**Date:** 2011-11-10  
**Date Submitted:** 2011-11-07

**Project:** 11-1122-0129

**P.O. Number:**  
**Matrix:** Water

**Chain of Custody Number:** 155926

PARAMETER	UNITS	MRL	LAB ID:	923194	923195	923196	923197	GUIDELINE
			Sample Date:	2011-11-07	2011-11-07	2011-11-07	2011-11-07	
			Sample ID:	S-1	S-2	S-3	S-4	ODWSOG
Total Coliforms	CFU/100mL			5	12	0	2	MAC 0 CFU/100mL
Escherichia Coli	CFU/100mL			0	0	0	0	MAC 0 CFU/100mL
Heterotrophic Plate Count	CFU/1mL			12	5	18	12	
Faecal Coliforms	CFU/100mL			0	0	0	0	
Faecal Streptococcus	CFU/100mL			0	0	0	0	

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

Comment:

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

APPROVAL:   
Krsta Quantrill  
Microbiology Lab Supervisor

Client: Golder Associates Ltd. (Ottawa)  
32 Steacie Drive

Kanata, ON  
K2K 2A9

Attention: Ms. Caitlin Cooke

Report Number: 1128052  
Date: 2011-11-14  
Date Submitted: 2011-11-07

Project: 11-1122-0129

P.O. Number:  
Matrix: Water


Chain of Custody Number: 155926

PARAMETER	UNITS	MRL	LAB ID:	923239	923240	923241	923242	GUIDELINE		
			Sample Date:	2011-11-07	2011-11-07	2011-11-07	2011-11-07	ODWSOG		
			Sample ID:	S-1	S-2	S-3	S-4			
Alkalinity as CaCO3	mg/L	5	284	312	332	295	OG	500	mg/L	
Chloride	mg/L	1	89	80	104	90	AO	250	mg/L	
Colour	TCU	2	<2	<2	2	<2	AO	5	TCU	
Conductivity	uS/cm	5	848	992	1000	853				
Dissolved Organic Carbon	mg/L	0.5	1.5	1.3	1.6	1.2	AO	5	mg/L	
Fluoride	mg/L	0.1	0.29	0.11	<0.10	0.27	MAC	1.5	mg/L	
Hydrogen Sulphide	mg/L	0.01	2.88	0.14	<0.01	<0.10	AO	0.05	mg/L	
N-NH3 (Ammonia)	mg/L	0.02	0.76	0.14	0.07	0.70				
N-NO2 (Nitrite)	mg/L	0.1	<0.10	<0.10	<0.10	<0.10	MAC	1.0	mg/L	
N-NO3 (Nitrate)	mg/L	0.1	0.14	<0.10	<0.10	<0.10	MAC	10.0	mg/L	
pH			7.96	7.91	7.90	8.03		6.5-8.5		
Phenols	mg/L	0.001	0.002	<0.001	<0.001	<0.001				
Sulphate	mg/L	1	22	95	43	22	AO	500	mg/L	
Tannin & Lignin	mg/L	0.1	<0.1	<0.1	<0.1	<0.1				
Total Dissolved Solids (COND - CALC)	mg/L	1	551	645	650	554	AO	500	mg/L	
Total Kjeldahl Nitrogen	mg/L	0.1	0.74	0.26	<0.10	0.87				
Turbidity	NTU	0.1	102	28.4	7.6	37.1	MAC	1.0	NTU	
Hardness as CaCO3	mg/L	1	297	471	439	279	OG	100	mg/L	
Ion Balance		0.01	1.04	1.08	1.06	0.94				
Calcium	mg/L	1	76	169	156	74				
Magnesium	mg/L	1	26	12	12	23				
Potassium	mg/L	1	8	3	2	6				
Sodium	mg/L	2	66	41	51	60	AO	200	mg/L	
Iron	mg/L	0.03	1.48	1.86	0.82	0.35	AO	0.3	mg/L	
Manganese	mg/L	0.01	0.05	0.08	0.05	0.03	AO	0.05	mg/L	

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

Comment:

923242: H2S MRL elevated due to sample turbidity.

APPROVAL:   
Lorna Wilson  
Inorganic Lab Supervisor

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

Client: Golder Associates Ltd. (Ottawa)  
32 Steacie Drive

Kanata, ON  
K2K 2A9

Attention: Ms. Caitlin Cooke

Report Number: 1126052  
Date: 2011-11-14  
Date Submitted: 2011-11-07


Project: 11-1122-0129

P.O. Number:  
Matrix: Water

Chain of Custody Number: 155926

PARAMETER	UNITS	MRL	LAB ID:				GUIDELINE		
			LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED	ODWSOG		
							TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	<5	101	95-105	2011-11-09	OG	500	mg/L
Chloride	mg/L	1	<1	99	90-112	2011-11-10	AO	250	mg/L
Colour	TCU	2	<2	100	80-120	2011-11-09	AO	5	TCU
Conductivity	uS/cm	5	<5	99	95-105	2011-11-09			
Dissolved Organic Carbon	mg/L	0.5	<0.5	90	84-116	2011-11-10	AO	5	mg/L
Fluoride	mg/L	0.1	<0.10	100	90-110	2011-11-09	MAC	1.5	mg/L
Hydrogen Sulphide	mg/L	0.01	<0.01	84	33-166	2011-11-14	AO	0.05	mg/L
N-NH3 (Ammonia)	mg/L	0.02	<0.02	95	85-115	2011-11-08			
N-NO2 (Nitrite)	mg/L	0.1	<0.10	93	80-120	2011-11-10	MAC	1.0	mg/L
N-NO3 (Nitrate)	mg/L	0.1	<0.10	108	80-120	2011-11-10	MAC	10.0	mg/L
pH			5.78	99	90-110	2011-11-09		6.5-8.5	
Phenols	mg/L	0.001	<0.001	112	73-127	2011-11-11			
Sulphate	mg/L	1	<1	98	90-110	2011-11-10	AO	500	mg/L
Tannin & Lignin	mg/L	0.1	<0.1	94	80-120	2011-11-10			
Total Dissolved Solids (COND - CALC)	mg/L	1	<1		-	2011-11-14	AO	500	mg/L
Total Kjeldahl Nitrogen	mg/L	0.1	<0.10	97	77-123	2011-11-11			
Turbidity	NTU	0.1	<0.1	100	73-127	2011-11-08	MAC	1.0	NTU
Hardness as CaCO3	mg/L	1	<1		-	2011-11-14	OG	100	mg/L
Ion Balance		0.01	<0.01		-	2011-11-14			
Calcium	mg/L	1	<1	100	80-120	2011-11-09			
Magnesium	mg/L	1	<1	98	80-120	2011-11-09			
Potassium	mg/L	1	<1	100	80-120	2011-11-09			
Sodium	mg/L	2	<2	100	80-120	2011-11-09	AO	200	mg/L
Iron	mg/L	0.03	<0.03	108	88-112	2011-11-08	AO	0.3	mg/L
Manganese	mg/L	0.01	<0.01	100	91-109	2011-11-08	AO	0.05	mg/L

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

APPROVAL:   
Lorna Wilson  
Inorganic Lab Supervisor

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

Client: Golder Associates Ltd. (Ottawa)  
32 Steacie Drive

Kanata, ON  
K2K 2A9

Attention: Ms. Caitlin Cooke

Report Number: 1126582  
Date: 2011-11-16  
Date Submitted: 2011-11-14

Project: 11-1122-0124


P.O. Number:  
Matrix: Groundwater

Chain of Custody Number: 156190

			LAB ID:	924767					GUIDELINE		
			Sample Date:	2011-11-14					ODWSOG		
			Sample ID:	11-5							
PARAMETER	UNITS	MRL							TYPE	LIMIT	UNITS
N-NO3 (Nitrate)	mg/L	0.1	<0.10						MAC	10.0	mg/L

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

Comment:

APPROVAL:   
Lorna Wilson  
Inorganic Lab Supervisor

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

Client: **Golder Associates Ltd. (Ottawa)**  
32 Steacie Drive

Kanata, ON  
K2K 2A9

Attention: **Ms. Caitlin Cooke**

Report Number: 1126582  
Date: 2011-11-16  
Date Submitted: 2011-11-14


Project: 11-1122-0124

P.O. Number:  
Matrix: Groundwater

Chain of Custody Number: 156190

PARAMETER	UNITS	MRL	LAB ID:					GUIDELINE			
			Sample Date:	Sample ID:	LAB BLANK	LAB QC % RECOVERY	QC RECOVERY RANGE	DATE ANALYSED	ODWSOG		
								TYPE	LIMIT	UNITS	
N-NO3 (Nitrate)	mg/L	0.1			<0.10	97	80-120	2011-11-15	MAC	10.0	mg/L

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

APPROVAL:   
Lorna Wilson  
Inorganic Lab Supervisor

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



# APPENDIX G

## Nitrate Dilution Calculation

Input Parameters

Site Area	29,000 m <sup>2</sup>	(approximately 2.90 hectares)
Net Potential Infiltration (NPI)	180 mm/yr	
Nitrate strength in effluent	40 mg/L	
Water usage per employee	125 L/day	
Maximum number of employees	35	

Dilution Calculation

Annual infiltration across site	5.22E+06 L/yr	= NPI * site area
Septic Loading for 35 employees	1.60E+06 L/yr	= water usage * number of employees
Nitrate loading	6.39E+07 mg/L/yr	= septic loading * nitrate strength
Nitrate concentration at property boundary	9.37 mg/L	= (nitrate loading)/(annual infiltration + septic loading)

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

[solutions@golder.com](mailto:solutions@golder.com)  
[www.golder.com](http://www.golder.com)

**Golder Associates Ltd.**  
**32 Steacie Drive**  
**Kanata, Ontario, K2K 2A9**  
**Canada**  
**T: +1 (613) 592 9600**





**ATTACHMENT 2**

**Water Quality Summary and Lab  
Reports 1973087, 1976973,  
1985044 and 1987084**

Client: Golder Associates Ltd. (Ottawa)  
1931 Robertson Road  
Ottawa, ON  
K2H 5B7  
Attention: Ms. Caitlin Cooke  
PO#:  
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1973087  
Date Submitted: 2022-03-09  
Date Reported: 2022-03-16  
Project: 21493887  
COC #: 216712


Page 1 of 7

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**Dear Caitlin Cooke:**

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

Report Comments:

  
Addrine  
Thomas  
2022.03.16  
13:43:57 -04'00'

APPROVAL: \_\_\_\_\_  
Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <http://www.cala.ca/scopes/2602.pdf>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Client: Golder Associates Ltd. (Ottawa)  
 1931 Robertson Road  
 Ottawa, ON  
 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:   
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1973087  
 Date Submitted: 2022-03-09  
 Date Reported: 2022-03-16  
 Project: 21493887  
 COC #: 216712

Group	Analyte	MRL	Units	Guideline	Result
				Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1613861 Water  2022-03-09 Hydro
Anions	Cl	1	mg/L	AO 250	61
	F	0.10	mg/L	MAC 1.5	0.27
	N-NO2	0.10	mg/L	MAC 1.0	<0.10
	N-NO3	0.10	mg/L	MAC 10.0	<0.10
	SO4	1	mg/L	AO 500	35
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG 30-500	290
	Colour (Apparent)	2	TCU	AO 5	96*
	Conductivity	5	uS/cm		747
	DOC	0.5	mg/L	AO 5	1.6
	pH	1.00		6.5-8.5	7.82
	Phenols	0.001	mg/L		<0.001
	S2-	0.01	mg/L	AO 0.05	0.21*
	TDS (COND - CALC)	1	mg/L	AO 500	486
Turbidity	0.1	NTU	AO 5	13.2*	
Hardness	Hardness as CaCO3	1	mg/L	OG 80-100	305*
Indices/Calc	Ion Balance	0.01			1.00
Metals	Ca	1	mg/L		94
	Fe	0.03	mg/L	AO 0.3	1.63*
	K	1	mg/L		5
	Mg	1	mg/L		17
	Mn	0.01	mg/L	AO 0.05	0.06*
	Na	1	mg/L	AO 200	46
Microbiology	Escherichia Coli	0	ct/100mL	MAC 0	0
	Faecal Coliforms	0	ct/100mL		0
	Heterotrophic Plate Count	0	ct/1mL		0

Guideline = ODWSOG

\* = Guideline Exceedence

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**Certificate of Analysis**

Client: Golder Associates Ltd. (Ottawa)  
 1931 Robertson Road  
 Ottawa, ON  
 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:  
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1973087  
 Date Submitted: 2022-03-09  
 Date Reported: 2022-03-16  
 Project: 21493887  
 COC #: 216712

Lab I.D.  
 Sample Matrix  
 Sample Type  
 Sampling Date  
 Sample I.D.

1613861  
 Water  
 2022-03-09  
 Hydro

Group	Analyte	MRL	Units	Guideline	
Microbiology	Total Coliforms	0	ct/100mL	MAC 0	0
Nutrients	N-NH3	0.010	mg/L		0.502
	Total Kjeldahl Nitrogen	0.100	mg/L		0.629
Subcontract	Tannin & Lignin	1	mg/L		<1.0

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Report Number: 1973087  
 Date Submitted: 2022-03-09  
 Date Reported: 2022-03-16  
 Project: 21493887  
 COC #: 216712

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
<b>Run No 418290      Analysis/Extraction Date 2022-03-10      Analyst DRA</b> <b>Method AMBCOLM1</b>			
Escherichia Coli			
Faecal Coliforms			
Heterotrophic Plate Count			
Total Coliforms			
<b>Run No 418310      Analysis/Extraction Date 2022-03-10      Analyst AsA</b> <b>Method C SM4500-S2-D</b>			
S2-	<0.01 mg/L	84	80-120
<b>Run No 418351      Analysis/Extraction Date 2022-03-10      Analyst IP</b> <b>Method SM5530D/EPA420.2</b>			
Phenols	<0.001 mg/L	53	50-120
<b>Run No 418367      Analysis/Extraction Date 2022-03-10      Analyst SKH</b> <b>Method EPA 351.2</b>			
Total Kjeldahl Nitrogen	<0.100 mg/L	106	70-130
<b>Run No 418375      Analysis/Extraction Date 2022-03-11      Analyst AsA</b> <b>Method SM 5310B</b>			
DOC	<0.5 mg/L	93	80-120

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 1931 Robertson Road  
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 Attention: Ms. Caitlin Cooke  
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 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1973087  
 Date Submitted: 2022-03-09  
 Date Reported: 2022-03-16  
 Project: 21493887  
 COC #: 216712

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
<b>Run No</b> 418376 <b>Analysis/Extraction Date</b> 2022-03-11 <b>Analyst</b> AsA <b>Method</b> C SM2120C			
Colour (Apparent)	<2 TCU	106	90-110
<b>Run No</b> 418403 <b>Analysis/Extraction Date</b> 2022-03-11 <b>Analyst</b> AaN <b>Method</b> C SM2130B			
Turbidity	<0.1 NTU	100	70-130
<b>Run No</b> 418413 <b>Analysis/Extraction Date</b> 2022-03-11 <b>Analyst</b> SKH <b>Method</b> EPA 350.1			
N-NH3	<0.010 mg/L	100	80-120
<b>Run No</b> 418426 <b>Analysis/Extraction Date</b> 2022-03-14 <b>Analyst</b> AaN <b>Method</b> SM 4110			
Chloride	<1 mg/L	100	90-110
N-NO2	<0.10 mg/L	104	90-110
N-NO3	<0.10 mg/L	105	90-110
SO4	<1 mg/L	105	90-110
<b>Run No</b> 418447 <b>Analysis/Extraction Date</b> 2022-03-14 <b>Analyst</b> Z S <b>Method</b> M SM3120B-3500C			
Calcium	<1 mg/L	100	90-110
Potassium	<1 mg/L	100	87-113

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 1931 Robertson Road  
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 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:  
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1973087  
 Date Submitted: 2022-03-09  
 Date Reported: 2022-03-16  
 Project: 21493887  
 COC #: 216712

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
Magnesium	<1 mg/L	100	76-124
Sodium	<1 mg/L	106	82-118
<b>Run No</b> 418474 <b>Analysis/Extraction Date</b> 2022-03-14 <b>Analyst</b> SD <b>Method</b> EPA 200.8			
Iron	<0.03 mg/L	104	80-120
Manganese	<0.01 mg/L	103	80-120
<b>Run No</b> 418491 <b>Analysis/Extraction Date</b> 2022-03-14 <b>Analyst</b> AET <b>Method</b> SUBCONTRACT-A			
Tannin & Lignin	<1.0 mg/L	106	
<b>Run No</b> 418559 <b>Analysis/Extraction Date</b> 2022-03-15 <b>Analyst</b> AsA <b>Method</b> SM2320,2510,4500H/F			
Alkalinity (CaCO3)	<5 mg/L	98	90-110
Conductivity	<5 uS/cm	99	90-110
F	<0.10 mg/L	95	90-110
pH		98	90-110
<b>Run No</b> 418578 <b>Analysis/Extraction Date</b> 2022-03-16 <b>Analyst</b> AET <b>Method</b> C SM2340B			
Hardness as CaCO3			
Ion Balance			

**Guideline = ODWSOG**

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 1931 Robertson Road  
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 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:  
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1973087  
 Date Submitted: 2022-03-09  
 Date Reported: 2022-03-16  
 Project: 21493887  
 COC #: 216712

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
TDS (COND - CALC)			

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Client: Golder Associates Ltd. (Ottawa)  
1931 Robertson Road  
Ottawa, ON  
K2H 5B7  
Attention: Ms. Caitlin Cooke  
PO#:  
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1976973  
Date Submitted: 2022-05-09  
Date Reported: 2022-05-16  
Project: 21493887  
COC #: 216712

Page 1 of 4

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Dear Caitlin Cooke:

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

Report Comments:



Rebecca Koshy  
2022.05.17  
12:15:01 -04'00'

APPROVAL: \_\_\_\_\_

Rebecca Koshy, Project Manager

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**Certificate of Analysis**

Client: Golder Associates Ltd. (Ottawa)  
 1931 Robertson Road  
 Ottawa, ON  
 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:   
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1976973  
 Date Submitted: 2022-05-09  
 Date Reported: 2022-05-16  
 Project: 21493887  
 COC #: 216712

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	
Metals	Ag	0.0001	mg/L		1625012 GW	
	Al	0.01	mg/L	OG 0.1	2022-03-09 Hydro - Dissolved	
	As	0.001	mg/L	IMAC 0.01		
	B	0.01	mg/L	IMAC 5.0		
	Ba	0.01	mg/L	MAC 1.0		
	Be	0.0005	mg/L			
	Cd	0.0001	mg/L	MAC 0.005		
	Co	0.0002	mg/L			
	Cr	0.001	mg/L	MAC 0.05		
	Cu	0.001	mg/L	AO 1		
	Filtration			mg/L		y
	Mo	0.005	mg/L			
	Ni	0.005	mg/L			
	Pb	0.001	mg/L	MAC 0.010		
	Sb	0.0005	mg/L	IMAC 0.006		
	Se	0.001	mg/L	MAC 0.05		
	Sr	0.001	mg/L			
	Tl	0.0001	mg/L			
	U	0.001	mg/L	MAC 0.02		
	V	0.001	mg/L			
Zn	0.01	mg/L	AO 5			

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Client: Golder Associates Ltd. (Ottawa)  
 1931 Robertson Road  
 Ottawa, ON  
 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:  
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1976973  
 Date Submitted: 2022-05-09  
 Date Reported: 2022-05-16  
 Project: 21493887  
 COC #: 216712

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
<b>Run No 421951      Analysis/Extraction Date 2022-05-13      Analyst SD</b> <b>Method EPA 200.8</b>			
Silver	<0.0001 mg/L	91	80-120
Aluminum	<0.01 mg/L	116	80-120
Arsenic	<0.001 mg/L	100	80-120
Boron (total)	<0.01 mg/L	117	80-120
Barium	<0.01 mg/L	110	80-120
Beryllium	<0.0005 mg/L	113	80-120
Cadmium	<0.0001 mg/L	109	80-120
Cobalt	<0.0002 mg/L	103	80-120
Chromium Total	<0.001 mg/L	106	80-120
Copper	<0.001 mg/L	107	80-120
Filtration			
Molybdenum	<0.005 mg/L	99	80-120
Nickel	<0.005 mg/L	107	80-120
Lead	<0.001 mg/L	111	80-120
Antimony	<0.0005 mg/L	90	80-120
Selenium	<0.001 mg/L	109	80-120

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Client: Golder Associates Ltd. (Ottawa)  
 1931 Robertson Road  
 Ottawa, ON  
 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:  
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1976973  
 Date Submitted: 2022-05-09  
 Date Reported: 2022-05-16  
 Project: 21493887  
 COC #: 216712

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
Strontium	<0.001 mg/L	104	80-120
Thallium	<0.0001 mg/L	110	80-120
Uranium	<0.001 mg/L	103	80-120
Vanadium	<0.001 mg/L	104	80-120
Zinc	<0.01 mg/L	110	80-120

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Certificate of Analysis


Client: Golder Associates Ltd. (Ottawa)  
1931 Robertson Road  
Ottawa, ON  
K2H 5B7  
Attention: Ms. Caitlin Cooke  
PO#:  
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1985044  
Date Submitted: 2022-08-30  
Date Reported: 2022-08-31  
Project:  
COC #: 899423

Dear Caitlin Cooke:

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

Report Comments:

  
Emma-  
Dawn  
Ferguson  
2022.08.3  
1 16:47:51  
-04'00'

APPROVAL: \_\_\_\_\_  
Emma-Dawn Ferguson, Chemist

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

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 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:   
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1985044  
 Date Submitted: 2022-08-30  
 Date Reported: 2022-08-31  
 Project:   
 COC #: 899423

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.
VOCs Surrogates	1,2-dichloroethane-d4	0	%		1648217 Water
	4-bromofluorobenzene	0	%		2022-08-30 SA1
	Toluene-d8	0	%		
Volatiles	1,1-dichloroethylene	0.5	ug/L	MAC 14	<0.5
	1,2-dichlorobenzene	0.4	ug/L	MAC 200	<0.4
	1,2-dichloroethane	0.5	ug/L	IMAC 5	<0.5
	1,4-dichlorobenzene	0.4	ug/L	MAC 5	<0.4
	Benzene	0.5	ug/L	MAC 1	<0.5
	Bromodichloromethane	0.3	ug/L		<0.3
	Bromoform	0.4	ug/L		<0.4
	Carbon Tetrachloride	0.2	ug/L	MAC 2	<0.2
	Chloroform	0.5	ug/L		<0.5
	Dibromochloromethane	0.3	ug/L		<0.3
	Dichloromethane	4.0	ug/L	MAC 50	<4.0
	Ethylbenzene	0.5	ug/L	MAC 140	<0.5
	m/p-xylene	0.4	ug/L		<0.4
	Monochlorobenzene	0.5	ug/L	MAC 80	<0.5
	o-xylene	0.4	ug/L		<0.4
	Tetrachloroethylene	0.3	ug/L	MAC 10	<0.3
	Toluene	0.4	ug/L	MAC 60	<0.4
	Trichloroethylene	0.3	ug/L	MAC 5	<0.3
	Trihalomethanes (total)	1.5	ug/L		<1.5
	Vinyl Chloride	0.2	ug/L	MAC 1	<0.2
Xylene; total	0.5	ug/L	MAC 90	<0.5	

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 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1985044  
 Date Submitted: 2022-08-30  
 Date Reported: 2022-08-31  
 Project:   
 COC #: 899423

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
Run No 428649 Analysis/Extraction Date 2022-08-31 Analyst PJ			
Method EPA 8260			
Dichloroethylene, 1,1-	<0.5 ug/L	85	60-130
Dichlorobenzene, 1,2-	<0.4 ug/L	104	60-130
Dichloroethane, 1,2-	<0.5 ug/L	117	60-130
Dichlorobenzene, 1,4-	<0.4 ug/L	91	60-130
Benzene	<0.5 ug/L	106	60-130
Bromodichloromethane	<0.3 ug/L	104	60-130
Bromoform	<0.4 ug/L	100	60-130
Carbon Tetrachloride	<0.2 ug/L	102	60-130
Chloroform	<0.5 ug/L	112	60-130
Dibromochloromethane	<0.3 ug/L	102	60-130
Methylene Chloride	<4.0 ug/L	112	60-130
Ethylbenzene	<0.5 ug/L	117	60-130
m/p-xylene	<0.4 ug/L	120	60-130
Chlorobenzene	<0.5 ug/L	115	60-130
o-xylene	<0.4 ug/L	111	60-130
Tetrachloroethylene	<0.3 ug/L	102	60-130

Guideline = ODWSOG

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**Certificate of Analysis**

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 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1985044  
 Date Submitted: 2022-08-30  
 Date Reported: 2022-08-31  
 Project:  
 COC #: 899423

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
Toluene	<0.4 ug/L	108	60-130
Trichloroethylene	<0.3 ug/L	98	60-130
Vinyl Chloride	<0.2 ug/L	86	60-130
<b>Run No</b> 428665 <b>Analysis/Extraction Date</b> 2022-08-31 <b>Analyst</b> PJ <b>Method</b> EPA 8260			
Xylene Mixture			
<b>Run No</b> 428667 <b>Analysis/Extraction Date</b> 2022-08-31 <b>Analyst</b> PJ <b>Method</b> EPA 8260			
Trihalomethanes (total)			80-120

**Guideline = ODWSOG**

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Client: Golder Associates Ltd. (Ottawa)  
1931 Robertson Road  
Ottawa, ON  
K2H 5B7  
Attention: Ms. Caitlin Cooke  
PO#:  
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1987084  
Date Submitted: 2022-09-30  
Date Reported: 2022-10-03  
Project: 21493887  
COC #: 212766

Page 1 of 3

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Dear Caitlin Cooke:

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

Report Comments:



Addrine Thomas  
2022.10.03  
15:53:13 -04'00'

APPROVAL:

---

Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <https://directory.cala.ca/>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

**Certificate of Analysis**

Client: Golder Associates Ltd. (Ottawa)  
 1931 Robertson Road  
 Ottawa, ON  
 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:  
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1987084  
 Date Submitted: 2022-09-30  
 Date Reported: 2022-10-03  
 Project: 21493887  
 COC #: 212766

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.
General Chemistry	Colour (True)	2	TCU		1653930 GW 2022-09-30 S-1

**Guideline = ODWSOG**

**\* = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.  
 Methods references and/or additional QA/QC information available on request.

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

**Certificate of Analysis**

Client: Golder Associates Ltd. (Ottawa)  
 1931 Robertson Road  
 Ottawa, ON  
 K2H 5B7  
 Attention: Ms. Caitlin Cooke  
 PO#:  
 Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1987084  
 Date Submitted: 2022-09-30  
 Date Reported: 2022-10-03  
 Project: 21493887  
 COC #: 212766

**QC Summary**

Analyte	Blank	QC % Rec	QC Limits
Run No 430741      Analysis/Extraction Date 2022-10-03      Analyst ACG Method C SM2120C			
Colour (True)	<2 TCU	100	90-110

**Guideline = ODWSOG**

**\* = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.  
 Methods references and/or additional QA/QC information available on request.

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

**ATTACHMENT 3**

# Updated Nitrate Dilution Calculation

Input Parameters

Site Area	26,480 m <sup>2</sup>	(approximately 2.6 hectares)
Net Potential Infiltration (NPI)	180 mm/yr	
Daily effluent volume	10000 L/day	
Nitrate strength in effluent	40 mg/L	
Nitrate reduction via pre-treatment	50%	

Dilution Calculation

Annual infiltration across site	4.77E+06 L/yr	= NPI * site area
Septic Loading	3.65E+06 L/yr	= daily effluent volume * 365 days
Nitrate loading	7.30E+07 mg/L/yr	= septic loading * nitrate strength * nitrate reduction
Nitrate concentration at property boundary	8.7 mg/L	= (nitrate loading)/(annual infiltration + septic loading)

wsp

wsp.com

---

# Appendix D

Fire Protection Water Demand

# MEMORANDUM



**J.L. Richards  
& Associates Limited**  
864 Lady Ellen Place  
Ottawa, ON Canada  
K1Z 5M2  
Tel: 613 728 3571  
Fax: 613 728 6012

Page 1 of 2

To: City of Ottawa

Date: April 21, 2023

JLR No.: 31500-000

CC:

From: Kris Mierzejewski, P.Eng.

Re: HONI Orleans OPERATIONS CENTRE (OC) – FIRE  
PROTECTION WATER REQUIREMENTS\_REV 04

This technical memorandum has been prepared by J.L.Richards and Associates Limited (JLR) on behalf of Brookfield Global Integrated Solutions Canada LP (BGIS) to support the site Plan Control application of Hydro One Network Inc. (HONI) new Operations Centre (OC), at 3440 Frank Kenny Road, Ottawa, Ontario.

We have calculated the size of the required fire protection water, based on the current building size (1683 m sq.)

- 1) According to the OBC Section A.3.2.5.7. the required fire protection water supply would be:

$$Q = K \times V \times S \text{ (litres)}$$

Where:

K = 17 for F2 occupancy, where building is of noncombustible construction with fire separations and fire resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns, and arches.

V = total building volume in cubic meters (mean assumed building height at 6.4 m) = 10,771 m cubed.

S = Spatial Coefficient = 1.0

$$Q = 17 \times 10,771 \times 1.0 = \mathbf{183,110 \text{ litres.}}$$

From table 2 the required flow would be 5,400 l/min (1429 gpm)

- 2) According to Fire Underwriters Survey (FUS, 1999) design methodology, the fire flow required is determined by the formula:

$$F = 220 \times C \times (A^{1/2})$$

Where:

F = The required fire flow in litres per minute

C = coefficient related to the type of construction (0.8 for non-combustible construction – unprotected metal structural components, masonry or metal walls)

A = The total floor area in square metres in the building being considered.

Following assumptions have been applied:

- "Rapid Burning" occupancy – based on F2 category
- No sprinkler system
- Non-combustible construction (as above)
- 45m of separation to the nearest building on each side.



F = 9025 l/min (2388 gpm)

Based on the required flow rate, the required duration of fire flow is approx. 2 hrs.  
This results in the total required fire protection water supply of **1,083,000 litres**.

The discrepancy between methods is significant.

Use of OBC has been discussed with Ottawa Fire Services and Fire Protection Engineer Allan Evans has agreed to fire water protection of 183,000 L (see email dated 2023-04-14) attached. We understand this recommendation to accept this volume is only applicable for this location and building permit and the City's new method (or whatever one is in place at that time) for fire flows and water storage will be the one required in future applications.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:



Kris Mierzejewski, P.Eng.  
Mechanical Engineer

KM:km

# MEMORANDUM



**J.L. Richards  
& Associates Limited**  
343 Preston Street  
Tower II, Suite 1000  
Ottawa Ontario K1S 1N4  
Tel: 613 728 3571  
Fax: 613 728 6012

Page 1 of 3

To: Marie-France Duthilleul, P.Eng  
Senior Civil Engineer  
J.L. Richards & Associates Limited  
343 Preston Street  
Tower II, Suite 1000  
Ottawa, ON K1S 1N4

Date: March 17, 2023

JLR No.: 31500-000

CC: Brent Whaley, P.Eng  
Jason Olinski, P.Eng

From: Liam Irwin, EIT

Re: 31500-000 – HONI Orleans – Fire Water Tank Hold-  
Down Slab R3

## **Background**

J.L. Richards & Associates Limited (JLR) is currently providing architectural and engineering consultant services to Hydro One Networks Inc (HONI) for the design of a new Operations Centre in the Orleans suburb of Ottawa, ON. Included in the new site development are multiple 68500-litre fire water storage tanks, which are proposed to be located below grade between Frank Kenney Road and the new asphalt parking lot on the site. As these tanks will occupy a large volume below grade and have the potential to be empty following a fire event on site, it is necessary to evaluate the buoyancy potential of the empty tanks to ensure the tanks will not “float”.

The purpose of this memorandum is to outline the results of our assessment of the buoyancy potential and communicate our recommendations.

## **Available Information**

The following available information has been used in our assessment:

1. Geotechnical Investigation Report – prepared by Golder Associates, dated January 2012, revised December 2022
2. Hydrogeological Assessment Letter – Final Groundwater Level Monitoring – prepared by GHD Limited, dated November 2022
3. Civil site plan (drawings C-002 to C-010) – prepared by J.L. Richards and Associates Ltd., dated March 17, 2023
4. 68500-Litre Tank drawings – prepared by Power Precast Solutions, dated April 2022

## **Assumptions**

The following assumptions have been made for the buoyancy evaluation of the fire water storage tanks:

1. Design groundwater table elevation is at 86.0 mAMSL in accordance with the recommendations provided in the Hydrogeological Assessment Letter by GHD. (Monitoring activities observed groundwater levels between 84.22 and 85.62 mAMSL).
2. Elevations of the underside of tanks and the finished new grade are located at 84.0 and 87.65 mAMSL, respectively, in accordance with JLR drawing C-009.
3. Proposed cover above top of tanks consists of 100mm topsoil (weight neglected), minimum 350mm engineered fill (bulk weight included) and 150mm rigid insulation (weight neglected).
4. A factor of safety of 1.25 is applied to the buoyancy forces for global stability in accordance with reference design standards.
5. Tanks are empty, except for permanent tank components (i.e., no stored water within the tank).
6. Rated 12 kPa vehicle surcharge load is occasional and therefore, does not contribute to buoyancy resistance.

7. The following material unit weights have been assumed in our calculations:
  - a. Backfill materials: 20 kN/m<sup>3</sup> bulk weight for soils above measured groundwater table.
  - b. Weight of 68500 L precast concrete tank is provided by precast Manufacturer.
8. Buoyancy-inducing forces include:
  - a. Buoyancy of the 68500 L tanks due to groundwater level at measured elevation.
9. Buoyancy-resisting loads include:
  - a. Nominal dry weight of the tank sections as indicated on the manufacturer drawings,
  - b. Weight of 350mm thick engineered fill above the tank.
10. The geometry of the tanks is 9145mm x 3660mm x 3050mm high.

### **Procedure**

The full buoyancy calculations are provided in Appendix A. The calculations are summarized as follows:

Nominal dry weight of tank = 644 kN  
Weight of engineered fill above tank = 228 kN  
Combined weight of tank and fill above = 644 kN + 228 kN = 872 kN

Factored tank buoyancy force = 821 kN

Required hold-down force = 821 kN – 872 kN = -51 kN < 0 kN

Therefore, the proposed tanks are stable against buoyancy and a concrete hold-down slab is not required.

### **Discussion**

Based on the assumptions and calculations summarized above, a concrete hold-down slab is not required to resist buoyancy uplift of the proposed tanks. As the size of the proposed water storage tanks has been reduced from the previous design and the elevation of the tanks raised, the factored buoyancy force on the tanks is now less than the self-weight of the concrete tanks plus the weight of the soil cover above.

This buoyancy analysis has been completed in accordance with applicable engineering standards for consideration of buoyancy uplift, including ACI PCR 350.4-04 – *Design Considerations for Environmental Structures* and CSA S900.2:21 - *Structural Design of Wastewater Treatment Plants*. The design ground water table used for the analysis (as recommended by GHD) is elevated above the highest measured GWT level for the site. A factor of safety of 1.25 has further been applied to the calculated buoyancy forces.

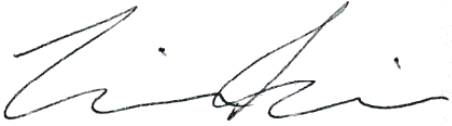
If you have any questions or concerns, please do not hesitate to contact the undersigned.

This memorandum has been prepared by J.L. Richards & Associates Limited for J.L Richards & Associates Limited's exclusive use. Its discussions and conclusions are summary in nature and cannot properly be used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This memorandum is based on information, drawings, data, or reports provided by the named client, its agents, and certain other suppliers or third parties, as applicable, and relies upon the accuracy and completeness of such information. Any inaccuracy or omissions in information provided, or changes to applications, designs, or materials may have a significant impact on the accuracy, reliability, findings, or conclusions of this memorandum.

This memorandum was prepared for the sole benefit and use of the named client and may not be used or relied on by any other party without the express written consent of J.L. Richards & Associates Limited, and anyone intending to rely upon this memorandum is advised to contact J.L. Richards & Associates Limited in order to obtain permission and to ensure that the memorandum is suitable for their purpose.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:



Liam Irwin, EIT  
Structural Engineering Intern

Reviewed by:



Jason Olinski, P.Eng. M.Eng.  
Associate  
Senior Structural Engineer

LSI/JMO:xx

Attachment: Appendix A – Buried Reservoir Buoyancy Calculations

## **BURIED RESERVOIR BUOYANCY**

**Designer:** Liam Irwin, EIT

**Date:** \_\_\_\_\_

**Engineer of Record:** Jason Olinski, P.Eng., M.Eng

**Date:** \_\_\_\_\_

**Peer Reviewer:** Brent Whaley, P.Eng

**Date:** \_\_\_\_\_

---

ITEMS HIGHLIGHTED IN YELLOW ARE REQUIRED USER INPUTS  
ITEMS HIGHLIGHTED IN PINK ARE CRITICAL USER CHECKS  
ITEMS HIGHLIGHTED IN BLUE ARE INTERIM RESULTS  
ITEMS HIGHLIGHTED IN GREEN ARE FINAL RESULTS

**Objective:** To check buoyancy requirements for proposed water storage tanks.

**Notes:**

- Design Calculation per the NBCC 2015 or OBC 2012
- See end of sheet for results.

### 1.0 - Tank Buoyancy

(Assumes GWT at 86.0 mAMSL)

68500L tanks, 9145mm x 3660mm x 3050mm high.  
 Top half = 28645 kg, Bottom half = 37025 kg

$$D_{tank} := (28645 \text{ kg} + 37025 \text{ kg}) \cdot 9.81 \frac{\text{m}}{\text{s}^2} = 644.223 \text{ kN} \quad \text{Dry weight of water storage tank}$$

$$l_{tank} := 9145 \text{ mm} \quad w_{tank} := 3660 \text{ mm} \quad h_{tank} := 3050 \text{ mm}$$

$$EL_{Grade} := 87.65 \text{ m} \quad EL_{GWT} := 86 \text{ m}$$

$$t_{topsoil} := 100 \text{ mm} \quad t_{engFill} := 350 \text{ mm} \quad t_{topInsulation} := 150 \text{ mm}$$

$$EL_{USTank} := EL_{Grade} - t_{topsoil} - t_{engFill} - t_{topInsulation} - h_{tank} = 84 \text{ m}$$

$$\gamma_{water} := 9.81 \frac{\text{kN}}{\text{m}^3} \quad \text{Unit weight of water}$$

$$\gamma_{sat} := 20 \frac{\text{kN}}{\text{m}^3} \quad \text{Bulk unit weight of earth fill (per geotech report)}$$

$$A_{tank} := l_{tank} \cdot w_{tank} = 33.471 \text{ m}^2 \quad \text{Footprint area of tank}$$

$$V_{tank} := A_{tank} \cdot h_{tank} = 102.086 \text{ m}^3 \quad \text{Volume of tank}$$

$$B_{tank} := 1.25 \cdot (A_{tank} \cdot (EL_{GWT} - EL_{USTank})) \cdot \gamma_{water} = 820.869 \text{ kN} \quad \text{Buoyancy force on tank}$$

$$A_{riser} := \frac{\pi \cdot (24 \text{ in})^2}{4} = 0.292 \text{ m}^2 \quad \text{Area of tank risers (reduction in soil cover volume)}$$

$$V_{fill} := (A_{tank} - 3 \cdot A_{riser}) \cdot t_{engFill} = 11.408 \text{ m}^3 \quad \text{Volume of soil fill above tank}$$

$$D_{fill} := V_{fill} \cdot \gamma_{sat} = 228.166 \text{ kN} \quad \text{Weight of soil fill above tank (GWT is below top of tank)}$$

$$D_{withFill} := D_{tank} + D_{fill} = 872.388 \text{ kN} \quad \text{Weight of tank with fill above assuming buoyant soil density}$$

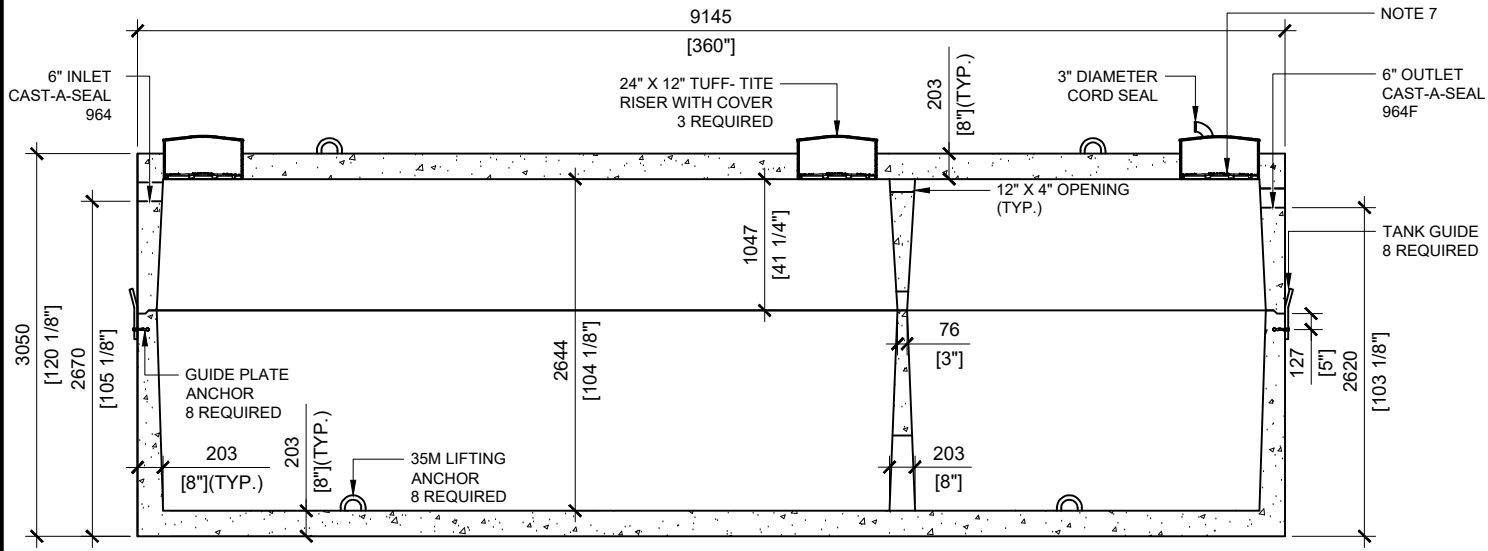
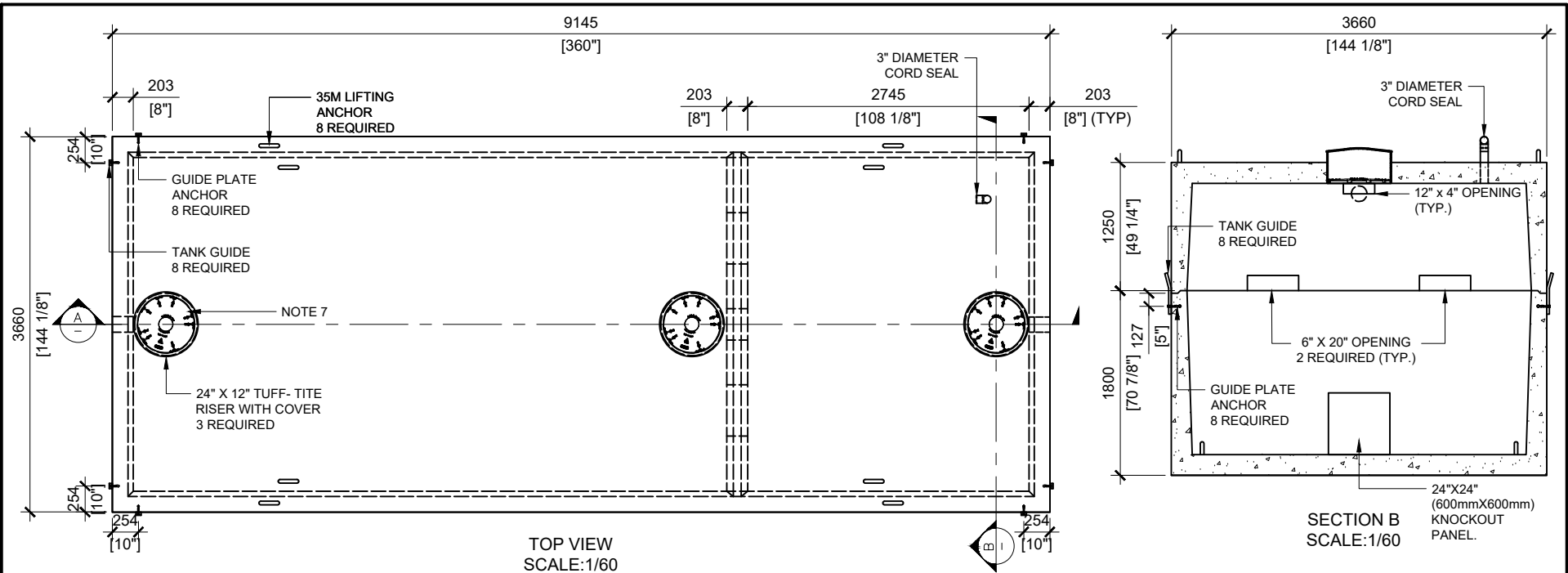
$$D_{reqWithFill} := B_{tank} - D_{withFill} = -51.52 \text{ kN} \quad \text{Required hold-down weight for tank with fill above assuming buoyant soil density}$$

Therefore the tanks are stable against buoyancy and a hold-down slab is not required

---

## **Appendix E**

Dry Hydrant Storage Tanks and  
Dry Hydrant Specifications



**GENERAL NOTES:**

1. UNITS ARE SEALED WITH BUTYL TAPE AT THE JOINTS
2. CONTRACTOR TO ENSURE CRANE IS ON-SITE TO OFFLOAD AND SET TANK
3. EXCAVATION MUST BE READY FOR INSTALL
4. MIN OVERHEAD CLEARANCE OF 18FT (5.5 METRES) IS REQUIRED
5. ALL UNITS MUST BE HANDLED WITH PROPER LIFTING EQUIPMENT
6. TANK DESIGNED FOR A MAXIMUM FILL COVER DEPTH OF 1000mm, NO MINIMUM FILL COVER DEPTH, AND 12 kPa VEHICLE LOADING
7. TUF-TITE SAFETY LIDS INSTALLED IN ALL OPENINGS AS PER CSA-B66-21



**MANUFACTURED:**  
OTTAWA, ON  
1-800-655-3430

**CONCRETE:** 40MPa / 5,800PSI  
**AIR ENTRAINMENT:** 5-8%  
**REINFORCEMENT:** MEETS G30.14-M1983

**WEIGHT:** 63,150lbs / 28,645kg (TOP)  
81,625lbs / 37,025kg (BOTTOM)  
MEETS CAN/CSA-B66  
**CSA APPROVED**  
"AGINP"

**DRAWN BY:**  
JAY PATEL

**DATE:**  
APRIL/2022

**68500 LITRES** **SINGLE CHAMBER**

**WORKING CAPACITY:** 70,735L TO INVERT OF INLET  
**TOTAL CAPACITY:** 75,681L TO UNDERSIDE OF CHAMBER LID





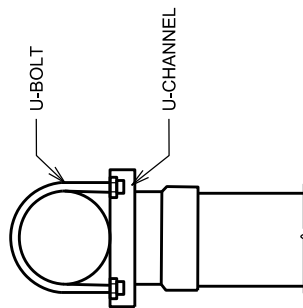
# UNDERGROUND WATER RESERVOIR DRAW PIPE DETAIL

DATE: MARCH 2016

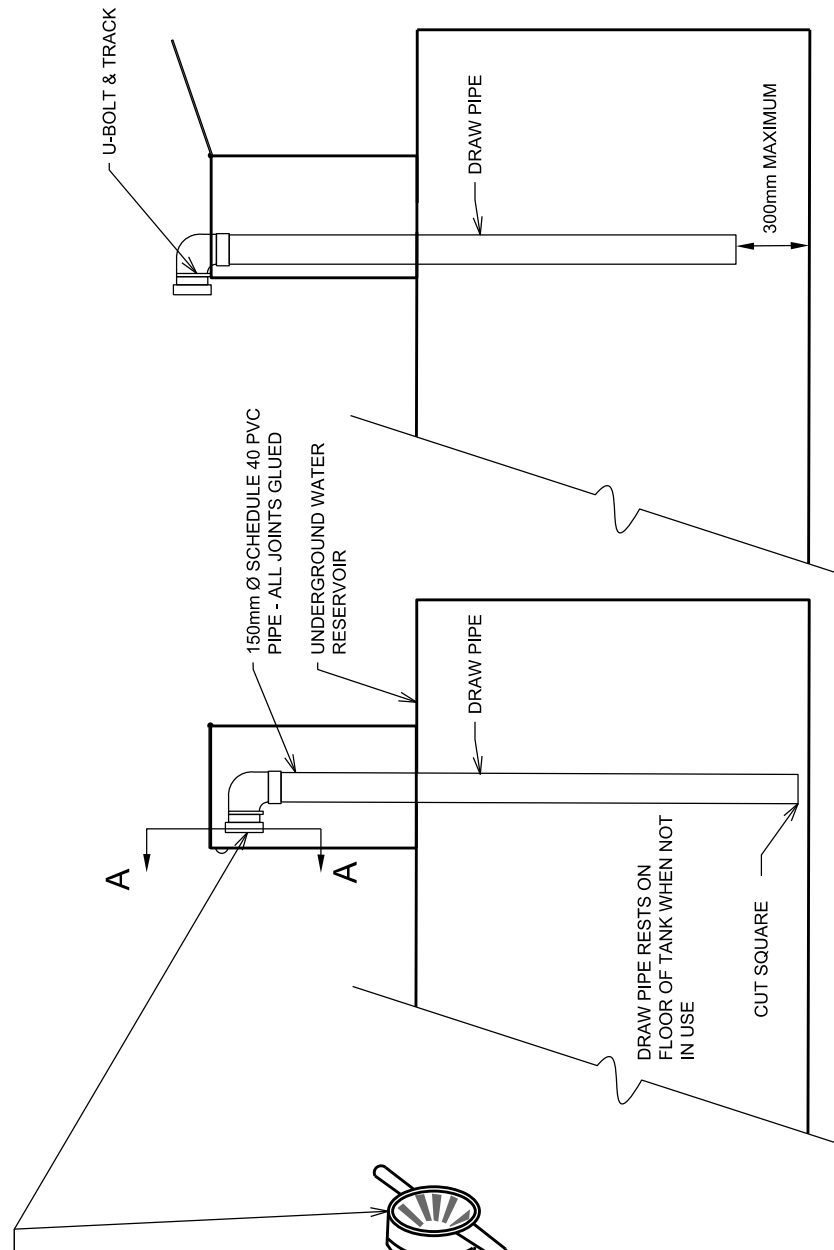
REV.  
DATE:

DWG. No.: W52

NORTHLINE SWIVEL 6NH FEMALE THREAD,  
INTERNAL STRAINER ROCKER LUG  
CONFIGURED IN A 90° SCHEDULE 40 PVC  
ELBOW



U-BOLT & TRACK DETAIL  
SECTION A-A



DRAW PIPE IN STORED POSITION

DRAW PIPE IN USED POSITION

---

## **Appendix F**

Consultation Record with Local  
Fire Chief

## Marc Rivet

---

**From:** Evans, Allan <Allan.Evans@ottawa.ca>  
**Sent:** April 14, 2023 12:16 PM  
**To:** Livingstone, Kelly; Marc Rivet; Kulyk, Derek  
**Cc:** Lee Jablonski; Kris Mierzejewski; Brown, Adam; Whittaker, Damien  
**Subject:** RE: Emailing: D.1 31500-000 FP Tanks Memorandum\_V03.pdf, FIRE Memorandum.docx, C-009 TANK DETAILS 1\_mark-ups.pdf, (01) 31500-000 HONI\_Orleans\_OC-Civil-SitePlan-stamped.pdf, F.1 Consultation Record with Local Fire Chief\_April2022.pdf

OFS agrees that 183000L is acceptable.

*Allan Evans*

Fire Protection Engineer / Ingénieur de Protection d'Incendies

Prevention Division / Prévention des Incendies

Ottawa Fire Services / Service des Incendies d'Ottawa

1445 Carling Avenue / 1445 Avenue Carling

Ottawa, ON K1Z 7L9

Allan.Evans@Ottawa.ca

☎ (613) 913-2747 | ☎ (613) 580-2424 x24119 | 📠 (613) 580-2866 | ✉ Mail Code: 25-102 | @OFSFPE



OTTAWA FIRE SERVICES  
SERVICE DES INCENDIES D'OTTAWA  
*Protecting Our Nation's Capital With Pride  
Protéger notre capitale nationale avec fierté*



An internationally accredited agency 2014-2019

---

**From:** Livingstone, Kelly <kelly.livingstone@ottawa.ca>  
**Sent:** April 14, 2023 11:49 AM  
**To:** Marc Rivet <mrivet@jlrichards.ca>; Kulyk, Derek <derek.kulyk@ottawa.ca>  
**Cc:** Evans, Allan <Allan.Evans@ottawa.ca>; Lee Jablonski <ljablonski@jlrichards.ca>; Kris Mierzejewski <kmierzejewski@jlrichards.ca>; Brown, Adam <Adam.Brown@ottawa.ca>; Whittaker, Damien <Damien.Whittaker@ottawa.ca>  
**Subject:** Re: Emailing: D.1 31500-000 FP Tanks Memorandum\_V03.pdf, FIRE Memorandum.docx, C-009 TANK DETAILS 1\_mark-ups.pdf, (01) 31500-000 HONI\_Orleans\_OC-Civil-SitePlan-stamped.pdf, F.1 Consultation Record with Local Fire Chief\_April2022.pdf

Hi Marc,

Yes, all the material was reviewed and addressed by Derek in his engineering comments.

As noted by Derek, among other comments: "Attached email from OFS (Allan Evans) does not confirm support for 183,000 L of water storage, it only makes a reference to a volume that had been previously discussed which is understood to be 220,000L – confirmation of OFS accepting the reduction from 220,000 L to 183,000 L needs to be provided to Development Review."

**Kelly Livingstone (he/him), RPP, MCIP**

Planner 2 | Urbaniste 2

City of Ottawa | Ville d'Ottawa

[kelly.livingstone@ottawa.ca](mailto:kelly.livingstone@ottawa.ca)

---

**From:** Marc Rivet <[mrivet@jlrichards.ca](mailto:mrivet@jlrichards.ca)>  
**Sent:** Thursday, April 13, 2023 9:00 AM  
**To:** Livingstone, Kelly <[kelly.livingstone@ottawa.ca](mailto:kelly.livingstone@ottawa.ca)>; Kulyk, Derek <[derek.kulyk@ottawa.ca](mailto:derek.kulyk@ottawa.ca)>  
**Cc:** Evans, Allan <[Allan.Evans@ottawa.ca](mailto:Allan.Evans@ottawa.ca)>; Lee Jablonski <[ljablonski@jlrichards.ca](mailto:ljablonski@jlrichards.ca)>; Kris Mierzejewski <[kmierzejewski@jlrichards.ca](mailto:kmierzejewski@jlrichards.ca)>; Brown, Adam <[Adam.Brown@ottawa.ca](mailto:Adam.Brown@ottawa.ca)>; Whittaker, Damien <[Damien.Whittaker@ottawa.ca](mailto:Damien.Whittaker@ottawa.ca)>  
**Subject:** FW: Emailing: D.1 31500-000 FP Tanks Memorandum\_V03.pdf, FIRE Memorandum.docx, C-009 TANK DETAILS 1\_mark-ups.pdf, (01) 31500-000 HONI\_Orleans\_OC-Civil-SitePlan-stamped.pdf, F.1 Consultation Record with Local Fire Chief\_April2022.pdf

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Hello,

I am still confused why the City is asking additional information on the use of OBC vs FUS for this specific project.

Memo summarizing design and calculations was prepared, reviewed, and concurred to by Ottawa Fire Services. Revised (signed and stamped) plans showing these design features and calculations was also submitted. See attached memo and email below from the City's Fire Protection Engineer.

I just want to confirm this material was received and reviewed?

We can discuss next Thursday – Kelly I can send you a separate email to confirm attendees and confirm a time?

Thanks.

Marc

**Marc Rivet**, RPP, MCIP  
Associate, Senior Planner  
Manager, Ottawa Planning Department

J.L. Richards & Associates Limited  
1000-343 Preston Street, Ottawa, ON K1S 1N4  
Direct: 343-803-4533 Cell: 613-867-8528



**J.L. Richards  
& Associates Limited**  
ENGINEERS • ARCHITECTS • PLANNERS



Platinum  
member

---

**From:** Evans, Allan <[Allan.Evans@ottawa.ca](mailto:Allan.Evans@ottawa.ca)>  
**Sent:** March 13, 2023 4:16 PM  
**To:** Marc Rivet <[mrivet@jlrichards.ca](mailto:mrivet@jlrichards.ca)>  
**Cc:** Kris Mierzejewski <[kmierzejewski@jlrichards.ca](mailto:kmierzejewski@jlrichards.ca)>; Marie Duthilleul <[mduthilleul@jlrichards.ca](mailto:mduthilleul@jlrichards.ca)>; Marsh Frère <[mfrere@jlrichards.ca](mailto:mfrere@jlrichards.ca)>; Correy Collins <[ccollins@jlrichards.ca](mailto:ccollins@jlrichards.ca)>  
**Subject:** RE: Emailing: D.1 31500-000 FP Tanks Memorandum\_V03.pdf, FIRE Memorandum.docx, C-009 TANK DETAILS

1\_mark-ups.pdf, (01) 31500-000 HONI\_Orleans\_OC-Civil-SitePlan-stamped.pdf, F.1 Consultation Record with Local Fire Chief\_April2022.pdf

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Hi - I have reviewed the documentation. As this was initiated under the older conditions for determining water supply, I still support the storage volume we had discussed previously.

Please note that my recommendation to accept this volume is only applicable for this location and build permit and our new method (or whatever one is in place at that time) for fire flows and water storage will be the one required in future applications.

Regards,

Allan Evans  
Fire Protection Engineer / Ingénieur de Protection d'Incendies  
Prevention Division / Prévention des Incendies  
Ottawa Fire Services / Service des Incendies d'Ottawa  
1445 Carling Avenue / 1445 Avenue Carling  
Ottawa, ON K1Z 7L9  
[Allan.Evans@Ottawa.ca](mailto:Allan.Evans@Ottawa.ca)  
@ (613) 913-2747 | | (613) 580-2424 x24119 | 6 (613) 580-2866 | | Mail Code: 25-102 | @OFSFPE

-----Original Message-----

From: Marc Rivet <[mrivet@jlrichards.ca](mailto:mrivet@jlrichards.ca)>  
Sent: March 09, 2023 1:48 PM  
To: Evans, Allan <[Allan.Evans@ottawa.ca](mailto:Allan.Evans@ottawa.ca)>  
Cc: Kris Mierzejewski <[kmierzejewski@jlrichards.ca](mailto:kmierzejewski@jlrichards.ca)>; Marie Duthilleul <[mduthilleul@jlrichards.ca](mailto:mduthilleul@jlrichards.ca)>; Marsh Frère <[mfrere@jlrichards.ca](mailto:mfrere@jlrichards.ca)>; Correy Collins <[ccollins@jlrichards.ca](mailto:ccollins@jlrichards.ca)>  
Subject: Emailing: D.1 31500-000 FP Tanks Memorandum\_V03.pdf, FIRE Memorandum.docx, C-009 TANK DETAILS 1\_mark-ups.pdf, (01) 31500-000 HONI\_Orleans\_OC-Civil-SitePlan-stamped.pdf, F.1 Consultation Record with Local Fire Chief\_April2022.pdf  
Importance: High

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Hi Allan,

Per our last conversation the City is looking for us to compile past correspondence and justification on the use of OBC vs FUS as part of our Site Plan approval. I have put together this memo for our review and signatures with accompanying plans / memos.

Can you please review and provide any comments.

Would then finalize for our combined signatures.

Thanks.

Marc

Your message is ready to be sent with the following file or link attachments:

D.1 31500-000 FP Tanks Memorandum\_V03.pdf  
FIRE Memorandum.docx  
C-009 TANK DETAILS 1\_mark-ups.pdf  
(01) 31500-000 HONI\_Orleans\_OC-Civil-SitePlan-stamped.pdf  
F.1 Consultation Record with Local Fire Chief\_April2022.pdf

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Marc Rivet, RPP, MCIP  
Associate  
Senior Planner

J.L. Richards & Associates Limited  
1000-343 Preston Street, Ottawa, ON K1S 1N4  
Direct: 343-803-4533 Cell: 613-867-8528

<https://can01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.jlrichards.ca%2F&data=05%7C01%7CAllan.evans%40ottawa.ca%7Ccb2a1c5744894379ba6708db20cec796%7Cdfcc033ddf874c6ea1b88eaa73f1b72e%7C0%7C0%7C638139845054349873%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAilLCjQljoiv2luMzliLCJBTiI6Ikk1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=lxWzSAYupcvwuWNWzm%2BD5N%2BMju%2FH6wvqCTAFBbISlyc%3D&reserved=0>

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## **Appendix G**

WSP Technical Memorandum –  
New Septic System





## TECHNICAL MEMORANDUM

**DATE** May 5, 2023

**Project No.** 21493887

**TO** City of Ottawa

**FROM** Scott Taylor, PEng

**EMAIL** scott.a.taylor@wsp.com

### **NEW SEPTIC SYSTEM HYDRO ONE OPERATIONS CENTRE, PHASE 2 3440 FRANK KENNY ROAD, OTTAWA, ONTARIO**

WSP Canada Inc. (WSP) was retained by J.L. Richards & Associates Limited (JLR) to design the new sewage system at the proposed Hydro One Networks Inc. (HONI) Operations Centre (OC), Phase 2, located at 3440 Frank Kenny Road in Ottawa, Ontario. This technical memorandum has been prepared to support the Site Plan Approval application with the City of Ottawa.

### **Sewage System Design Flows**

HONI has provided the following information for the proposed building use:

- Office staff will consist of 5 employees on one (1) 8-hour shift during normal operations and 10 employees constantly occupying the building over a 24-hour duration during emergency operations.
- Field staff will consist of 30 employees on an 8-hour shift during normal operations and 30 employees on a 16-hour shift during emergency operations.
- There is one (1) loading dock and deliveries to the warehouse will occur once per week or once every two weeks.
- Vehicle washing will be limited to removal of mud from the wheels of the vehicles and will be completed outside of the building.

WSP has pre-consulted with the Ottawa Septic System Office regarding the sewage system design flows as well as the groundwater elevations (refer to Appendix C). The following was determined during the pre-consultation:

- The building is split into multiple uses. The uses are separated by Gridlines as indicated below (Refer to Appendix A). Each area of the building will be calculated separately as follows:
  - Office (Gridlines 9 to 11): The office will be based on the number of employees and the floor area of the office portion of the building.
  - Warehouse (Gridlines 5 to 9): The common facilities (washrooms, locker rooms, etc.) and warehouse space will be calculated as a warehouse.
  - Vehicle Storage Canopy and Indoor Vehicle Storage (Gridlines 1 to 5): No additional flows have been considered from the vehicle storage areas of the building, as vehicle washing is to be completed outside of the building.

Based on the above, the total daily design sanitary sewage flow (Q) has been calculated as follows, in accordance with Table 8.2.1.3.B of the Ontario Building Code (OBC):

#### Normal Operations

Office (Staff) = 5 employees \* 75 L/d/employee (8-hour shift) = 375 L/d

Office (Floor Space) = 295 m<sup>2</sup> \* 75 L/d/9.3 m<sup>2</sup> = 2,379 L/d

Warehouse (Loading Dock) = 1 \* 150 L/d = 150 L/d

Warehouse (Water Closets) = 4 \* 950 L/d = 3,800 L/d

Q = 2,379 L/d<sup>1</sup> + 150 L/d + 3,800 L/d

Q = 6,329 L/d

<sup>1</sup> The total daily design sanitary sewage flow includes the highest flow from the office area.

#### Emergency Operations

Office (Staff) = 10 employees \* 75 L/d/employee (8-hour shift) \* 3 shifts = 2,250 L/d

Office (Floor Space) = 295 m<sup>2</sup> \* 75 L/d/9.3 m<sup>2</sup> = 2,379 L/d

Warehouse (Loading Dock) = 1 \* 150 L/d = 150 L/d

Warehouse (Water Closets) = 4 \* 950 L/d = 3,800 L/d

Q = 2,379 L/d<sup>1</sup> + 150 L/d + 3,800 L/d

Q = 6,329 L/d

<sup>1</sup> The total daily design sanitary sewage flow includes the highest flow from the office area.

The total daily design sanitary sewage flow has been calculated to be 6,329 L/d for both normal and emergency operations as the floor area of the office governs the calculations, and also since the staffing for field staff has not been included directly, but instead assessed based on the warehouse facilities.

### **Treatment Units**

A Class 4 Sewage System, as per Section 8.6 of the OBC, is proposed to service the new building and will consist of a Waterloo Biofilter basket tank system, model number BT-15500. The system will also consist of an anaerobic digester (septic tank) with a volume of 13,625 L (model number 13625AD), followed by a separate 6,000 L pump tank that will be used to dose the final 15,500 L Biofilter basket tank. Refer to Sewage System Plan, Figure 1 and Detail Sheet, Figure 2 in Appendix B.

Due to the anticipated elevations of the tanks and leaching bed, a second alternating duplex pump system will be required to dose the leaching bed. Waterloo Biofilter has confirmed that these pumps can be installed within the Biofilter basket tank.

In accordance with the terrain analysis calculations included in the Technical Memorandum titled "Resampling Results, Well PW11-1 and Updated Terrain Analysis", prepared by WSP Canada Inc., dated May 2, 2023, a 50% reduction in nitrogen will be required for the site. Therefore, the treatment unit will be constructed as a double-

pass system for denitrification, which requires recirculation to the anaerobic digester. As per the literature from Waterloo Biofilter, a double-pass system can achieve between 50 to 65% nitrogen reduction. The 32 mm diameter recirculation forcemain will provide approximately 50% recirculation of treated effluent back to the anaerobic digester, in accordance with the requirements from Waterloo Biofilter.

The treatment units have been located on the site to conform with the minimum clearance distances as set out in Table 8.2.1.6.A of the OBC.

### Leaching Bed

The previous geotechnical investigation (completed in 2011) included a test pit (Test Pit 11-3) in the vicinity of the proposed leaching bed. This geotechnical investigation has been updated to include recent site investigations and current standards. Refer to Geotechnical Investigation, Proposed Hydro One Operations Facility, 3440 Frank Kenny Road, Ottawa, Ontario, prepared by WSP Canada Inc., Dated May 4, 2023. The existing soils at the proposed location of the leaching bed consist of grey brown silty clay (weathered crust), as indicated in Test Pit 11-3. Groundwater seepage was noted in Test Pit 11-3 at 2.0 m below ground surface (elevation 83.90 m). Groundwater was observed in Boreholes 11-3 and 11-5 between 1.1 and 1.3 m below ground surface (elevation of 84.40 m for both). A groundwater elevation of 85.60 m was measured in monitoring well DBW001 during GHD's investigation. Conservatively, an elevation of 85.60 m has been assumed in the vicinity of the leaching bed, which is below the maximum excavation depth.

Based on the existing soils, a percolation rate (T) has been estimated at 50 min/cm. Since this is the maximum value used in determining the size of the proposed leaching bed, it is considered a conservative estimate.

Due to space restrictions on the site, a Type A Dispersal Bed is proposed to be used as the leaching bed. The contact area (overall footprint) of the Type A Dispersal Bed has been sized in accordance with 8.7.7.1.(5) of the OBC as follows:

$$\text{Contact Area (A)} = Q * T / 400$$

$$A = 6,329 * 50 / 400$$

$$A = 791 \text{ m}^2$$

Therefore, the system will require a contact area of 791 m<sup>2</sup>. A contact area measuring 25.0 m x 31.7 m has been provided, which provides a contact area of 792.5 m<sup>2</sup>. Refer to Sewage System Plan, Figure 1 in Appendix B.

The stone layer for the Type A Dispersal Bed has been sized in accordance with 8.7.7.1.(6) of the OBC as follows:

$$\text{Stone Area (A}_s\text{)} = Q / 50$$

$$A_s = 6,329 / 50$$

$$A_s = 127 \text{ m}^2$$

Therefore, the system will require a stone area of 127 m<sup>2</sup>. A stone area measuring 6 m x 21.2 m has been provided, which provides a contact area of 127 m<sup>2</sup>. Refer to Sewage System Plan, Figure 1 in Appendix B.

The effluent will be evenly distributed throughout the stone area by use of distribution piping installed to within 600 mm of the edge of stone layer, in accordance with 8.7.7.1.(8) of the OBC.

The stone layer has been located on the site to conform with the minimum clearance distances as set out in Table 8.2.1.6.B (and increased by Sentence 8.7.4.2.(11) for a raised system) of the OBC.

The leaching bed is proposed over the existing gravel parking lot for the Phase 1 building. Therefore, the gravel for the parking lot is proposed to be removed down to the native soils. The area under the contact area for the leaching bed will be scarified to a depth of 300 mm to loosen up the compacted subgrade and promote infiltration. Imported sand fill will be used to build up the area to the base of the leaching bed. As well, to prevent lateral movement of effluent through the gravel fill, an additional area extending 2.0 m around the perimeter of the leaching bed on three sides will be removed and replaced with compacted clay. This compacted clay barrier will direct the effluent in the direction of the 15 m mantle.

We trust that the above is sufficient for your purposes. If you have any questions or comments, please contact the undersigned.

Yours truly,

**WSP Canada Inc.**



Scott Taylor, PEng  
*Lead Civil Engineer*



Douglas Kerr, PEng  
*Principal Civil Engineer*

SWT/DVK/sg

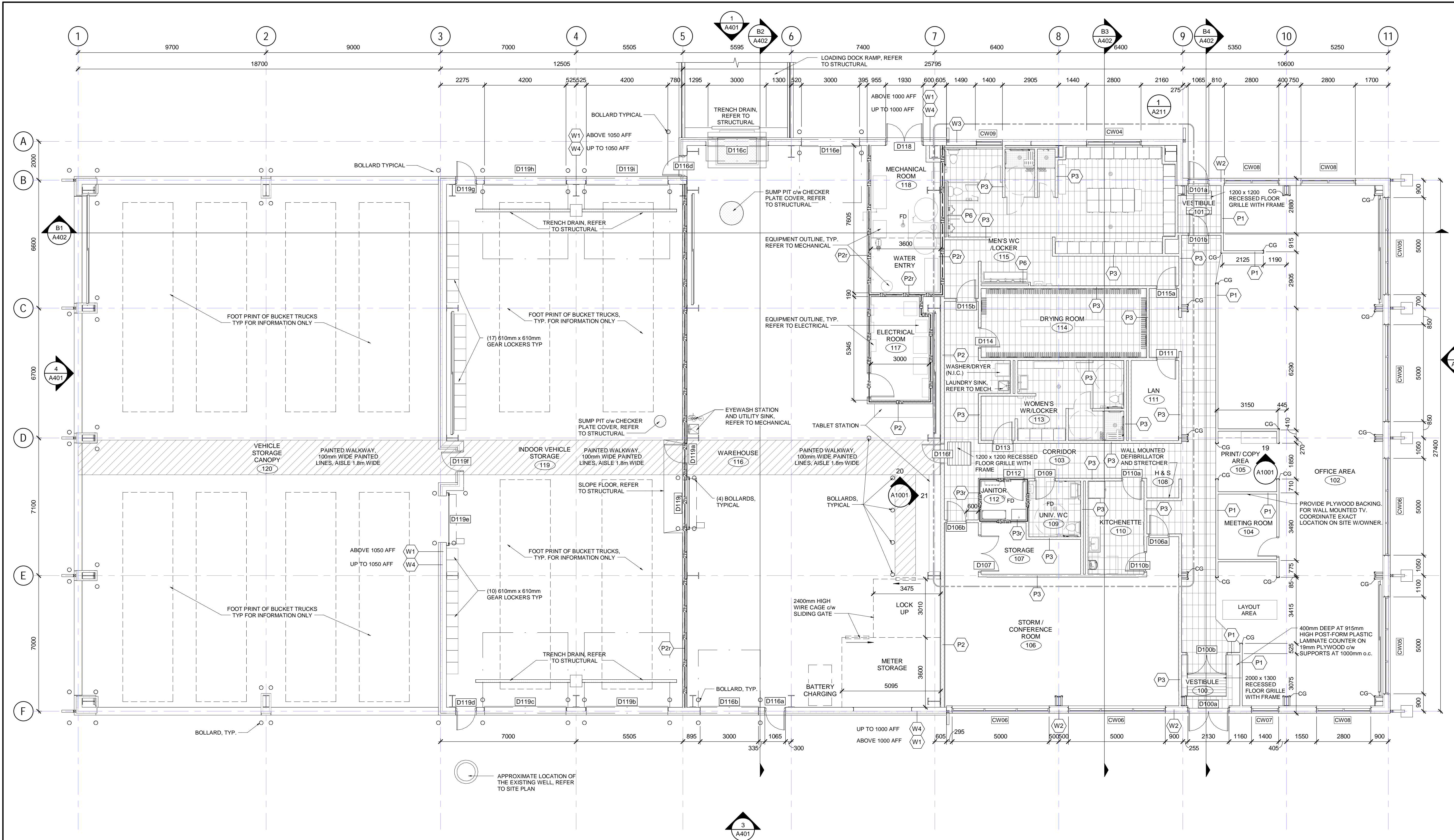
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Attachments: Appendix A – Floor Plan  
Appendix B – Figures  
Appendix C – OSSO Consultation

**APPENDIX A**

**Floor Plan**





1  
A201  
**GROUND FLOOR PLAN**  
SCALE: 1:100

**PRELIMINARY DESIGN**  
THESE DOCUMENTS ARE NOT COMPLETE IN ALL DETAILS AND MAY BE SUBJECT TO CHANGE AS DESIGN DEVELOPMENT AND CODE REVIEW IS ADVANCED.

No.	ISSUE / REVISION	DD/MM/YY
G	ISSUED FOR 60% CLIENT REVIEW	27/04/22
F	RE-ISSUED FOR 60% COST CONSULTANT	22/04/22
E	ISSUED FOR 60% EXTERNAL PEER REVIEW	19/04/22
D	ISSUED FOR 60% COST CONSULTANT	14/04/22
C	ISSUED FOR 30% CLIENT REVIEW	04/04/22
B	ISSUED FOR 30% COST CONSULTANT	22/03/22
A	ISSUED FOR EXTERNAL PEER REVIEW	22/03/22

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VERIFY SHEET SIZE AND SCALES. THE BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING.  
SCALE: 1:100

CLIENT:  
**hydro one** **BGIS**

CONSULTANT:  
**JLR J.L. Richards**  
ENGINEERS - ARCHITECTS - PLANNERS

CONSULTANT:

PROFESSIONAL STAMP  
PROJECT NORTH

PROJECT:  
**HYDRO ONE OPERATIONS CENTRE, ORLEANS**  
3440 FRANK KENNY ROAD, NAVAN ONTARIO

DRAWING:  
**ARCHITECTURAL**  
**GROUND FLOOR PLAN**

DESIGN: AE  
DRAWN: JG  
CHECKED: MF/AE  
JLR #: 31500-000

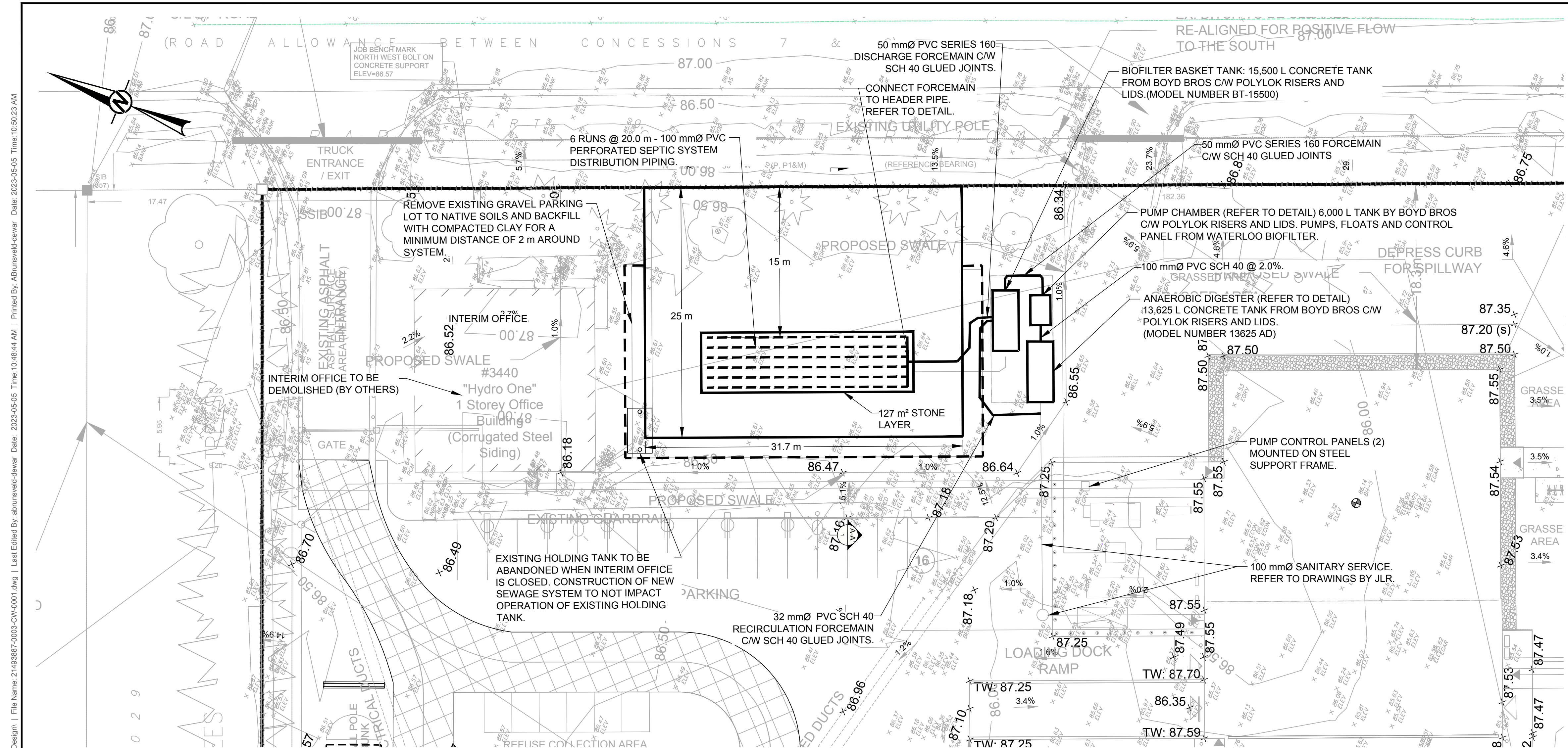
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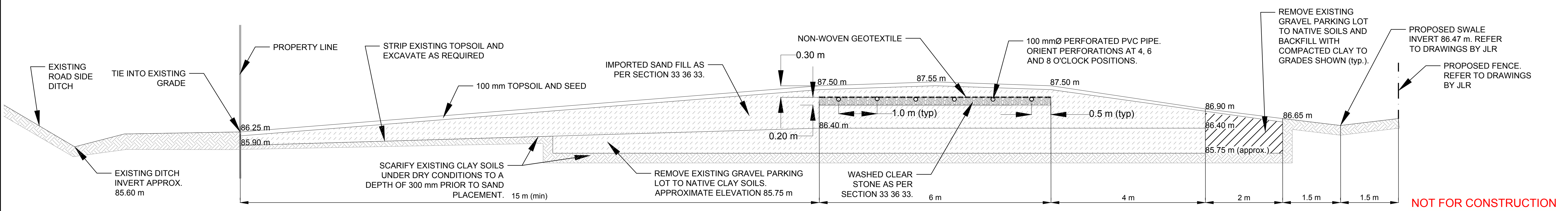
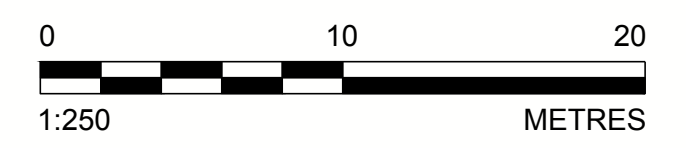
**APPENDIX B**

**Figures**





- NOTE(S)**
- PROJECT COORDINATE IS UTM NAD83 ZONE 18.
- REFERENCE(S)**
- TOPOGRAPHIC SURVEY BY FAIRHALL MOFFATT & WOODLAND LIMITED. DRAWING TP\_ac169.dwg. JUNE 10, 2022
- GENERAL NOTES**
- CONSTRUCTION SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS AND ONTARIO PROVINCIAL STANDARD DRAWINGS AND SPECIFICATIONS WHERE APPLICABLE. ONTARIO PROVINCIAL STANDARDS SHALL APPLY WHERE NO CITY STANDARDS ARE AVAILABLE. ALL DRAWINGS TO BE CHECKED FOR CONFORMANCE WITH APPLICABLE BUILDING CODES. NO ALTERATION OR GRADING OF SITE IS TO OCCUR PRIOR TO APPROVAL BY CITY.
  - THE CONTRACTOR IS RESPONSIBLE FOR ALL REMOVALS NECESSARY TO SATISFY ENGINEERING AND LANDSCAPE WORKS. CONTRACTOR TO VISIT SITE PRIOR TO TENDERING AND CONFIRM SITE CONDITIONS. CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL PERMITS REQUIRED AND BEAR COST OF SAME.
  - LOCATION OF SERVICES ARE NOT ALL SHOWN. LOCATION OF UTILITIES AND UNDERGROUND WORKS THAT ARE SHOWN ARE APPROXIMATE. CONTRACTOR TO VERIFY LOCATION AND ELEVATION OF ALL SERVICES, UTILITIES AND UNDERGROUND STRUCTURES PRIOR TO ANY CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTION AND REINSTATEMENT.
  - THE CONTRACTOR SHALL CONSTRUCT SANITARY SEWERS IN ACCORDANCE WITH OPSD 802.010, 802.013 AND 802.014. DURING CONSTRUCTION, PROTECT PIPES FROM HEAVY CONSTRUCTION EQUIPMENT AS PER OPSD 808.01. BEDDING AND BACKFILL SHALL BE COMPACTED TO 95% SPMD. CONTRACTOR SHALL REFER TO THE GEOTECHNICAL REPORT FOR ANY FURTHER RECOMMENDATIONS. PROPOSED SEWER TRENCHES TO BE EXCAVATED TO REACH UNDISTURBED SOIL AND REPLACED WITH GRANULAR 'A' CRUSHED STONE BEDDING AND INITIAL BACKFILL TO 300MM ABOVE PIPE COMPACTED TO A MIN. OF 95% SPMD.
  - THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR PROTECTION OF THE RECEIVING STORM SEWER DURING CONSTRUCTION ACTIVITIES. THESE PRACTICES ARE REQUIRED TO ENSURE NO SEDIMENT AND/OR ASSOCIATED POLLUTANTS ARE RELEASED TO THE RECEIVING WATERCOURSE. THESE PRACTICES INCLUDE INSTALLATION OF SEDIMENT BARRIERS ON ALL CATCH BASIN AND MAINTENANCE HOLES AND A SILT FENCE BARRIER (AS PER OPSD 219.110 AND ASSOCIATED SPECIFICATIONS) ALONG ALL OTHER AREAS THAT SHEET DRAIN OFF SITE. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
  - ALL DISTURBED AREAS TO BE REINSTATED TO EQUAL OR BETTER CONDITION. PAVEMENT REINSTATEMENT FOR UTILITY CUTS SHALL BE IN ACCORDANCE WITH R10. ALL NEW WORK SHALL BLEND INTO EXISTING (TO BE APPROVED BY CONSULTANT).
  - ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED. DRAWINGS SHOULD NOT BE SCALED BY THE CONTRACTOR. ANY MISSING OR QUESTIONABLE DIMENSIONS ARE TO BE CONFIRMED WITH THE CONSULTANT IN WRITING.
  - STRIPPING AND SUBGRADE PREPARATION SHALL BE PERFORMED WITH AN EXCAVATOR EQUIPPED WITH A SMOOTH MOUTHED BUCKET TO MINIMIZE DISTURBANCE. EXPOSED SUBGRADE SOIL SHALL BE GRADED TO ALLOW EFFECTIVE DRAINAGE DURING CONSTRUCTION. REFER TO THE GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
  - SIDE SLOPE OF EXCAVATIONS SHOULD BE SLOPED IN ACCORDANCE WITH THE REQUIREMENTS OF ONT. REG. 213/91 UNDER THE OCCUPATIONAL HEALTH AND SAFETY ACT. REFER TO GEOTECHNICAL REPORT FOR CONSTRUCTION DETAILS.
  - NOTE THAT THE EXISTING GRADES AND WORKS SHOWN MAY NOT REFLECT ACTUAL SITE CONDITIONS DUE TO THE OVERLAPPING DEMOLITION AND NEW CONSTRUCTION. THE BIDDING CONTRACTORS ARE TO VERIFY ALL EXISTING UNDERGROUND AND ABOVE GROUND SITE CONDITIONS AND MAKE ALLOWANCE IN THE BID PRICE. NO EXTRAS WILL BE CONSIDERED FOR ANY VARIATION OR CONFLICTS TO CONSTRUCT THE WORKS AS PER THE DESIGN DRAWINGS.
  - REFER TO LANDSCAPE AND ARCHITECTURAL PLAN FOR FINISHES AND FENCING DETAILS AND LOCATIONS.



0	2023-05-05	ISSUED FOR OSSO PERMIT	SWT	ABD	SWT	DVK
REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED

SEAL

CLIENT  
J.L. RICHARDS & ASSOCIATES LTD.

CONSULTANT

WSP CANADA INC.  
1931 ROBERTSON ROAD  
OTTAWA, ONTARIO  
CANADA  
[+1] (613) 592 9600

PROJECT  
HYDRO ONE ORLEANS OC, PHASE 2  
3440 FRANK KENNY ROAD, OTTAWA,  
ONTARIO

TITLE  
**SEWAGE SYSTEM PLAN**

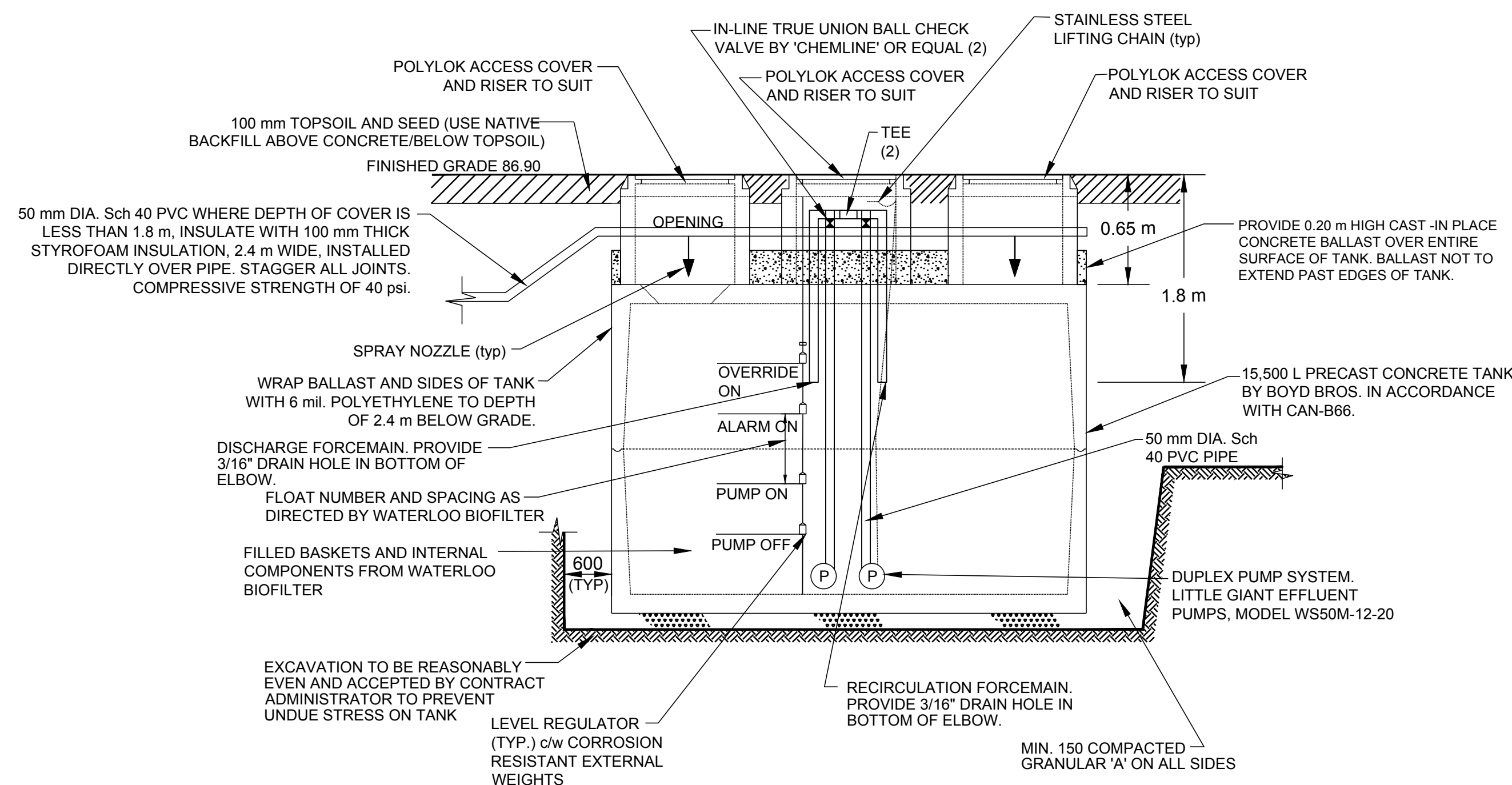
PROJECT NO. 21493887      CONTROL 0003      REV. 0 of 1      FIGURE 1

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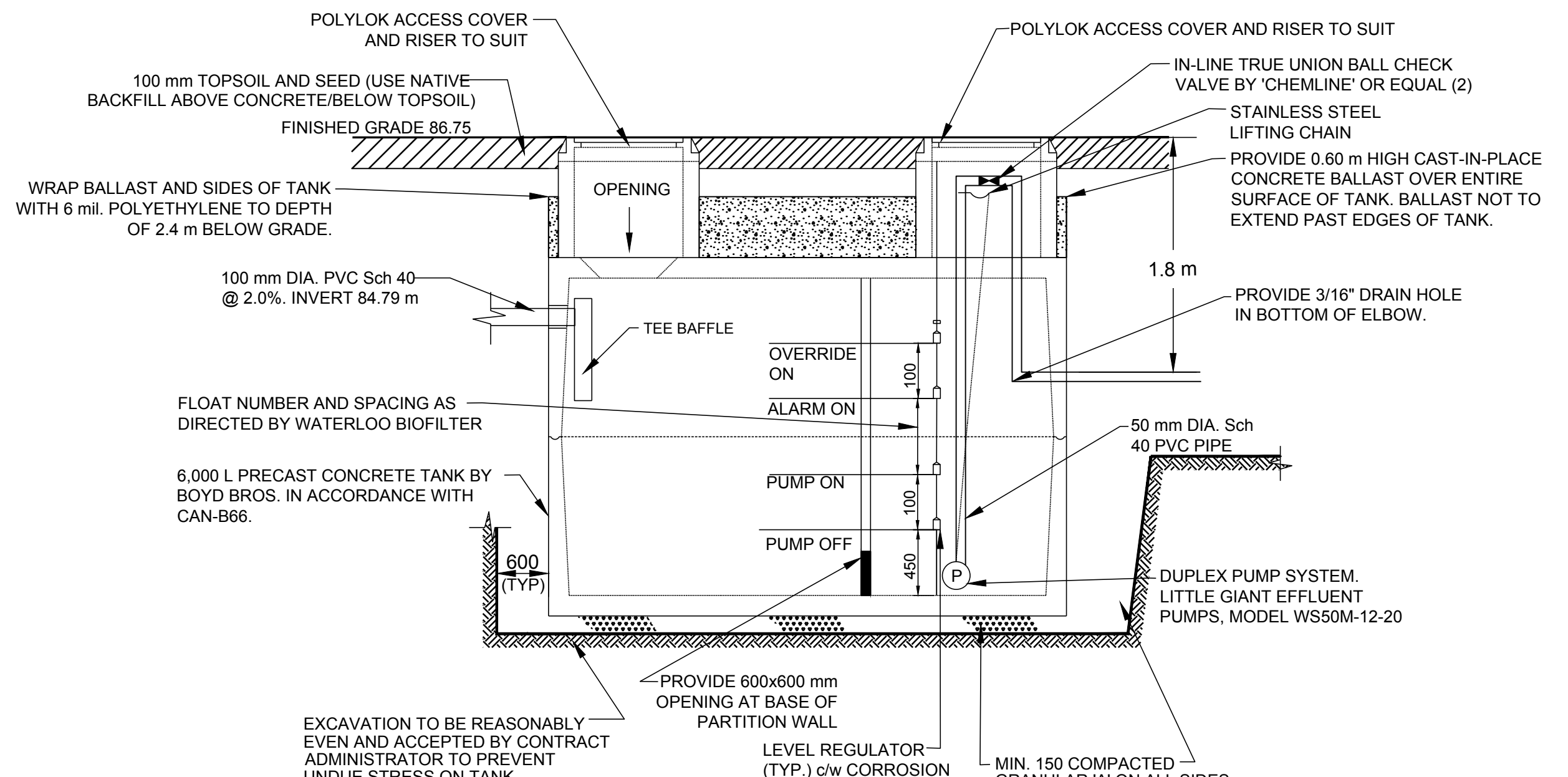
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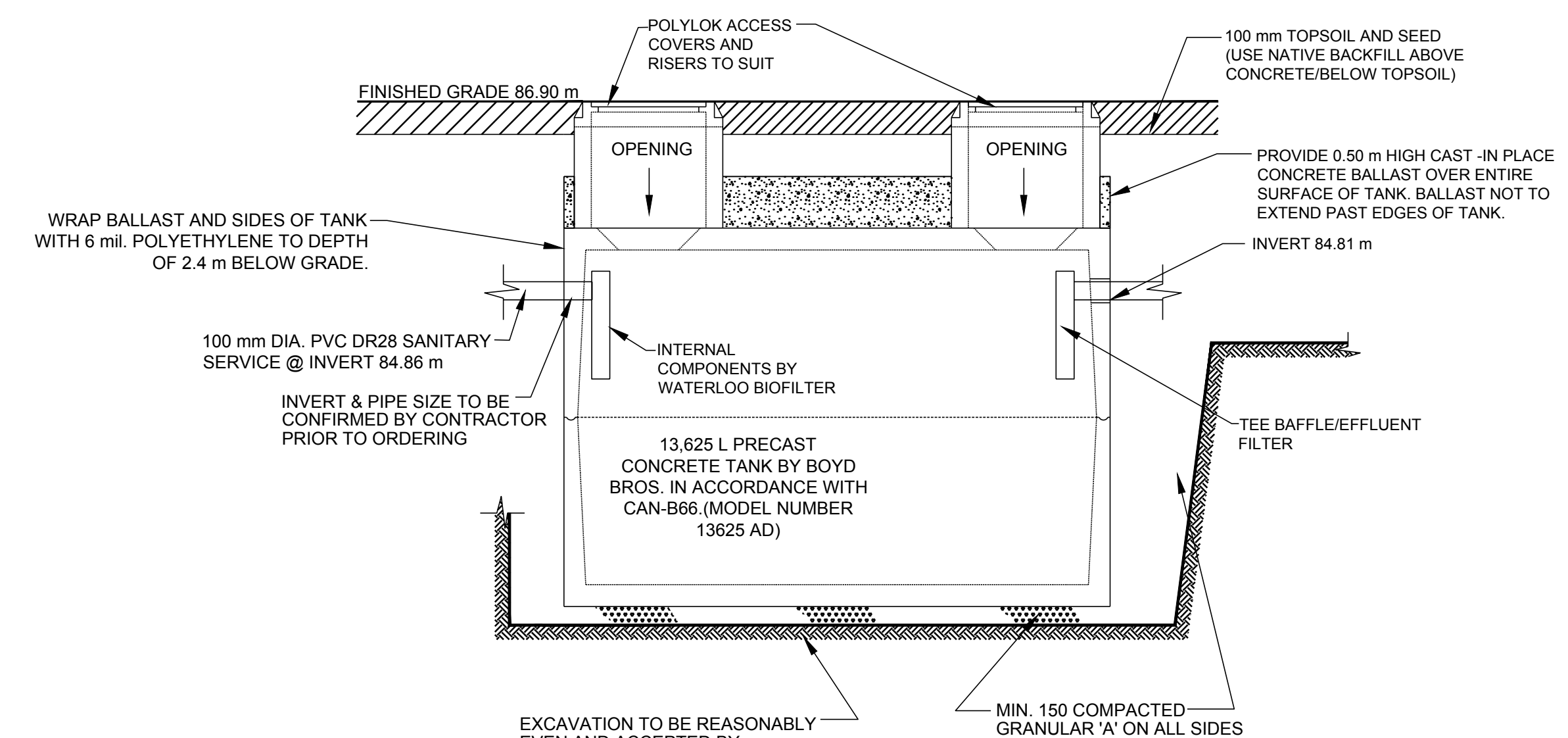
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 2023-05-05 Time: 10:49:13 AM | Printed By: aburns@jldesign.com | Date: 2023-05-05 Time: 10:50:39 AM



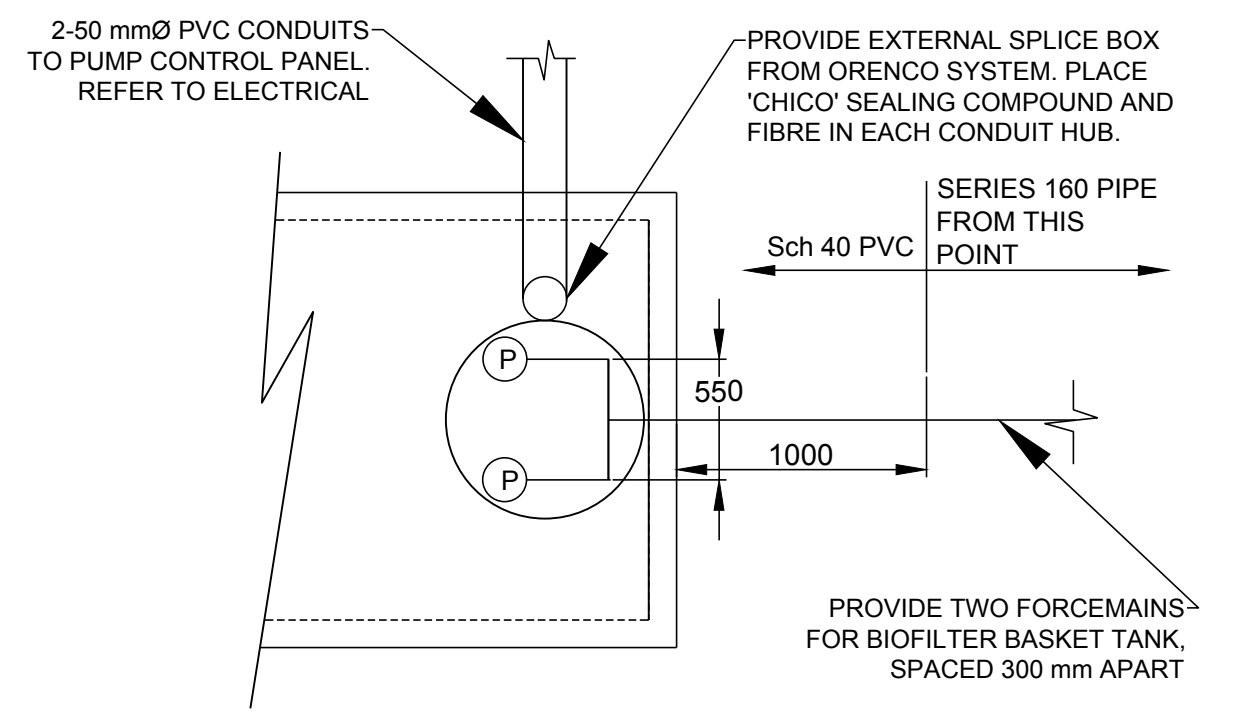
**BIOFILTER BASKET TANK SECTION VIEW**  
SCALE: N.T.S.



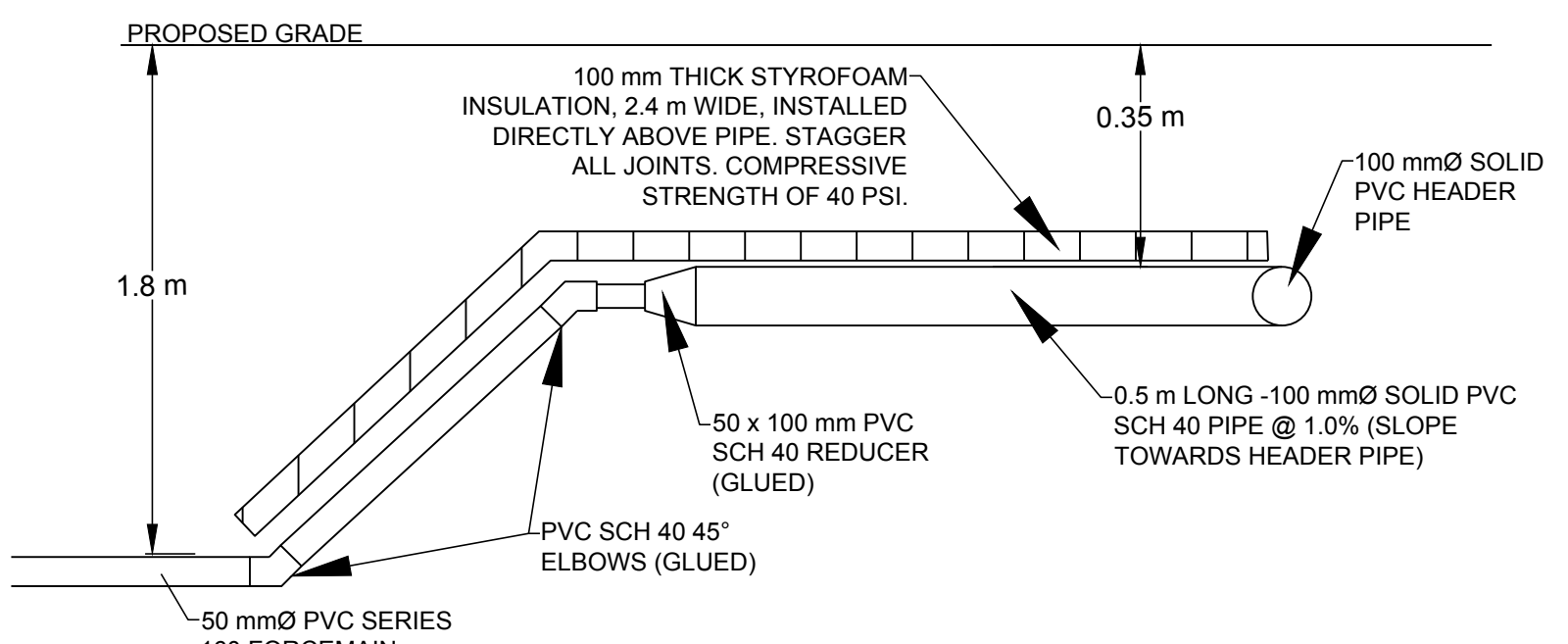
**PUMP CHAMBER SECTION VIEW**  
SCALE: N.T.S.



**ANAEROBIC DIGESTER**  
SCALE: N.T.S.



**PUMP CHAMBER/BIOFILTER BASKET TANK PLAN VIEW**  
SCALE: N.T.S.



**FORCEMAIN CONNECTION DETAIL**  
SCALE: N.T.S.

- CONCRETE TANK NOTE(S)**
- SUBMERSIBLE PUMPS TO BE 208V, 1 PHASE c/w CORD LENGTH TO SUIT. VOLTAGE AND PHASE TO BE CONFIRMED. CONTRACTOR TO ENSURE CONSTRUCTION MEETS ELECTRICAL AND PLUMBING CODE REQUIREMENTS.
  - CONTROL PANELS TO BE PROVIDED BY WATERLOO BIOFILTER FOR DUPLEX PUMP SYSTEM. PROVIDE LOCKABLE CIRCUIT BREAKER ON POWER FEED TO PANEL. MOUNT CONTROL PANELS ON STEEL SUPPORT STRUCTURE AT LOCATION AS INDICATED.
  - ONCE ALL COMPONENTS INSTALLED, CONTRACTOR TO CARRY OUT STATIC TEST WITH PIPES SEALED AND WATER LEVEL TO TOP OF PIPE. TEST OVER 48 HOURS WITH NO DROP IN WATER LEVEL PERMITTED. CONTRACTOR TO CONFIRM NO LEAKAGE AFTER 24 HOURS. TANK SEAMS TO BE EXPOSED DURING TEST. CONSULTANT WILL PERFORM MEASUREMENTS FOR FINAL 24 HOURS.
  - ALL WIRING SHALL BE SPLICE FREE FROM PUMP CHAMBER TO SPLICE BOX AND FROM SPLICE BOX TO CONTROL PANEL.
  - ALL PIPING INSIDE PUMP CHAMBER SHALL BE SCHEDULE 40 PVC OR EQUAL.
  - ALL VOIDS AND ANY UNUSED KNOCKOUTS TO BE FILLED AND MADE WATERTIGHT WITH 'SIKAFLEX 2cns' EXPANDABLE GROUT OR APPROVED EQUAL.
  - CONTRACTOR TO BE RESPONSIBLE FOR COMPLETE COORDINATION OF ELECTRICAL AND MECHANICAL SUB-CONTRACTORS INCLUDING CONNECTION IN ELECTRICAL ROOM, OBTAINING HYDRO INSPECTION AND APPROVAL, DELIVERY AND INSTALLATION OF DUPLEX PUMP ASSEMBLY IN WORKING ORDER, AND PERFORMANCE TEST AFTER INSTALLATION.
  - ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE INDICATED.
  - TANK TO BE CERTIFIED BY SUPPLIER TO WITHSTAND BALLAST WEIGHT, DEPTH OF BURIAL AND SOIL CONDITIONS. CERTIFICATION TO BE STAMPED AND SIGNED BY ENGINEER PRIOR TO DELIVERY OF TANK TO SITE. ASSUME HYDROSTATIC PRESSURE TO SURFACE.
  - GRANULARS TO BE COMPACTED TO 95% PROCTOR DENSITY.
  - AFTER EXCAVATING FOR TANKS, THE REQUIREMENT FOR TANK BALLAST IS TO BE RE-EXAMINED BY ENGINEER BASED ON HIGH WATER TABLE ELEVATIONS. GROUNDWATER ELEVATION ASSUMED TO BE 84.85 m.

**NOT FOR CONSTRUCTION**

0	2023-05-05	ISSUED FOR OSSO PERMIT	SWT	ABD	SWT	DVK
REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED

SEAL

CLIENT  
**J.L. RICHARDS & ASSOCIATES LTD.**

CONSULTANT

**WSP**

WSP CANADA INC.  
1931 ROBERTSON ROAD  
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CANADA  
[+1] (613) 592 9600

**S.A.W. TAYLOR**  
100078983  
PROVINCE OF ONTARIO

PROJECT  
**HYDRO ONE ORLEANS OC, PHASE 2**  
3440 FRANK KENNY ROAD, OTTAWA,  
ONTARIO

TITLE  
**DETAIL SHEET**

PROJECT NO.	CONTROL	REV.	of	FIGURE
21493887	0003	0		2

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**APPENDIX C**

**OSSO Consultation**

---

**From:** Alex Dekleine <alex.dekleine@rvca.ca>  
**Sent:** December 14, 2022 1:05 PM  
**To:** Taylor, Scott  
**Subject:** RE: HONI, 3440 Frank Kenny Road, Ottawa, 21493887

Hi Scott,

The following is a response to the City of Ottawa comments on the septic design elevations with respect to GWT.

The base of the stone layer has been set at an elevation of 87.00 m; approx. 1.4 m above the high groundwater elevation observed in April 2022 as per WSP/GOLDER. The requirement under the OBC is 0.6 m above the high groundwater elevation as per Sentence 8.7.7.1.(6). It is common that an excavation for a septic bed be greater than the design to remove any organic or fill material such a gravel parking lot. The excavation will then be raised using select sand fill to the proposed design elevation for the septic bed to maintain and exceed the separation distance of the noted GWT. WSP/GOLDER is proposing a clay 2 m wide clay barrier around the sewage system to direct the effluent to the sand area to reduce short circuiting. OSSO supports this proposal.

Should you have any questions, feel free to contact me.

Thank you.

**Alex DeKleine**

Regulations Inspector | Septic

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**From:** Taylor, Scott <scott.a.taylor@wsp.com>  
**Sent:** Wednesday, December 7, 2022 4:43 PM  
**To:** Alex Dekleine <alex.dekleine@rvca.ca>; Terry Davidson <terry.davidson@rvca.ca>  
**Subject:** RE: HONI, 3440 Frank Kenny Road, Ottawa, 21493887

Hello Alex,

We are currently working through the Site Plan Approval process with the City of Ottawa and they have included the following comment on our design, which they have indicated requires consultation with your office:

*It has been noted that the considered GWT elevation, in direct proximity to the leaching bed, was found to be 85.6m. The proposed depth of excavation for the leaching bed placement is at elevation of 85.75. Only 0.15 m above the GWT. Please confirm that this condition is acceptable, especially with a highly vulnerable aquifer on-site and the water table likely reaching the surface in the Spring. Please provide proof of communication of this matter with OSSO.*

Please find below our proposed response:

*The base of the stone layer has been set at an elevation of 87.00 m; approx. 1.4 m above the high groundwater elevation observed in April 2022. The requirement under the OBC is 0.6 m above the high groundwater elevation as per Sentence 8.7.7.1.(6).*

*The additional excavation shown on the design is to remove the underlying granular materials from the existing parking lot down to the native clay soils. The underlying granular materials are being removed, and a 2.0 m wide clay barrier is proposed around the sewage system (in the area of the existing parking lot), to reduce the likelihood of short circuiting of the effluent and to direct it towards the mantle. This will help to protect the highly vulnerable aquifer. All excavations are proposed above the high groundwater elevation. The geotechnical report indicates that the native clay soils extend down to an elevation of 83.73 m at the closest monitoring well (DBW001) and 83.36 m at the closest borehole (BH 11-4), both located approx. 15 m south and southwest of the proposed sewage system. Therefore, there will be approx. 2 m of native clay soils beneath the proposed excavation depth of 85.75 m.*

*The GHD memo (which is the reference of “the water table likely reaching the surface in the Spring”) states that the groundwater elevation in the vicinity of the proposed sewage system is 85.62 m on April 19, 2022 (0.98 m below the existing ground surface). We do note that in other areas of the site, that are approx. 1 m lower in elevation than the area of the proposed sewage system, the high groundwater table is within 0.12 m of the ground surface; at an elevation of 85.46 m. However, this has no impact on the proposed sewage system.*

The drawings previously submitted to the City of Ottawa are attached for your reference. As previously discussed, we will apply separately for an approval under the OBC through your office once the Site Plan Approval process has been advanced.

Please let us know if you have any concerns with the proposed design, in relation to the native clay soils and high groundwater elevation of 85.62 m.

Thanks,

**Scott Taylor, P.Eng.**  
Lead Civil Engineer

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