

REPORT ON

Hydrogeological Information Review and Assessment Russell Findlay Lands 940 Old Montreal Road Ottawa, Ontario

Submitted to:

Attention: Mr. Jim Burghout Claridge Homes 2001-210 Gladstone Avenue Ottawa, Ontario K2P 0Y6



Report Number:

09-1127-0086

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Table of Contents

1.0	BACK	GROUND	1
	1.1	Information Sources	1
2.0	SITE D	ESCRIPTION	3
	2.1	Surficial Geology	3
	2.2	Bedrock Geology	3
	2.2.1	Karst Features	4
	2.3	Groundwater Conditions.	4
	2.3.1	Private Wells	4
	2.4	Site Servicing	5
3.0	POSSII	BLE IMPACTS TO SURROUNDING PROPERTIES	6
	3.1	Potential Causes of Impacts to Surrounding Properties	6
	3.1.1	Groundwater control activities during site servicing	6
	3.1.2	Alteration of the existing hydrogeological flow regime	6
	3.2	Impairment to Groundwater Quantity or Quality	7
	3.3	Impacts to Septic Systems	7
	3.4	Structure Settlement	7
4.0	CONCL	.usions	8
5.0	LIMITA	TIONS	9
REF	ERENCE	≣S	1

FIGURES

Figure 1 - Key Plan

Figure 2 - Site Plan

Figure 3 - Surficial Geology

Figure 4 - Trends in Drift Thickness

Figure 5 - Bedrock Geology

APPENDICES

APPENDIX A

Borehole Records, Previous Golder Associates Ltd. Investigations



1.0 BACKGROUND

As part of the approval process for a proposed subdivision to be located at 940 Old Montreal Road, also known at the Russell Findlay lands (hereafter referred to as "the site"), the City of Ottawa has requested that a "well interference study" be undertaken by the proponents. Formal terms of reference for this study have not been provided, but it is understood that the report is to demonstrate "the impact that the proposed development may have on the neighbouring private wells (well interference) and septic systems of those residences situated on both Gerald Street and Trim Road". The report is to be completed by a professional hydrogeologist licensed in the province of Ontario.

Potential impacts to private wells would include the impairment of the quality and/or quantity of the water available to the residents. Impacts to septic systems would be restricted to issues associated with drainage.

1.1 Information Sources

Existing information sources were reviewed in order to gather relevant geological and hydrogeological data to help determine the potential for interference with the water supply servicing the adjacent houses on Gerald Street. These sources included topographic and geology maps, the Ministry of the Environment (MOE) water well record database, drawings of the proposed development and previously issued geotechnical reports for the site and nearby locations.

The following reports previously issued by Golder Associates Ltd. (Golder Associates) were reviewed:

- Golder Associates Ltd., September 2004. Geotechnical Investigation, Proposed Residential Development, Russell Findlay Lands, Trim Road, Queen Street, Watters Road, Ottawa, Ontario. Report 04-1120-146.
- Golder Associates Ltd., April 2004. Karst Assessment, Proposed Residential Lots 59 to 62, Springridge Subdivision, Watters Road, Ottawa, Ontario. Report 04-1120-021.
- Golder Associates Ltd., December 2003. Geotechnical Investigation, Proposed Watermain and Reconstruction of Watters Road, Ottawa, Ontario. Report 03-1120-186.
- Golder Associates Ltd., August 2002. Geotechnical Investigation, Karst Area Assessment, Proposed Housing Development, Cardinal Creek and Watters Road, Ottawa, Ontario. Report 021-2110.
- Golder Associates Ltd., July 2002. Preliminary Geotechnical Assessment, Trim Road Realignment, Ottawa, Ontario. Report 011-2224.
- Golder Associates Ltd., December 2001. Geotechnical Planning Map, Trim Road Realignment, Ottawa, Ontario. Letter Report 011-2224.
- Golder Associates Ltd., June 1995. Preliminary Geotechnical Investigation, Proposed Trim Road Trunk and Ottawa River Subtrunk Sewers, Township of Cumberland, Ontario. Report 951-2025.
- Golder Associates Ltd., July 1991. Soil Survey, Proposed Widening of Regional Road 57, South of Regional Road 34, Township of Cumberland, Ontario. Report 911-2082.
- Golder Associates Ltd., June 1991. Geotechnical Evaluation, Cardinal Creek Karst Area, Watters Road, Township of Cumber land, Ontario. Report 901-2063.





- Golder Associates Ltd., January 1990. Geotechnical Investigation, Proposed Storm Sewer, Watters Road, Township of Cumberland, Ontario. Report 891-2310.
- Golder Associates Ltd., July 1988. Preliminary Geotechnical Investigation, Proposed Reconstruction of Regional Road 57, Cumberland, Ontario. Report 881-2108.
- Golder Associates Ltd., October 1984. Subsurface Investigation, Proposed Residential Development, Brothers Property, Twp. Of Cumberland, Ontario. Report 841-2393.





2.0 SITE DESCRIPTION

The proposed subdivision is located to the southeast of the intersection of Trim Road and Old Montreal Road (Figures 1 and 2). The topography of the northern part of the site is quite steep, and the elevation rises towards the south from about 67 masl at Old Montreal Road to about 74 masl at a distance of 75 metres south of Old Montreal Road. The remaining southern part of the site rises more gently to about 86 masl at the southern property boundary. A ravine is located along the southern border of the site.

2.1 Surficial Geology

Available mapping of the area indicates that the surficial geology of the site consists primarily of offshore marine deposits of geotechnical sensitive silty clay (Figure 3). Mapping indicates landslide areas at the north end of the site and along Cardinal Creek, east of the site. Bedrock is indicated to be at ground surface in an area surrounding the south end of Gerald Street and trending northeast towards Old Montreal Road.

A review of boreholes, test pits and auger holes completed during previous Golder Associates investigations in the area indicates that the surficial geology generally consists of a weathered crust of sensitive silty clay underlain by unweathered silty clay, glacial till and bedrock.

Six test pits were put down across the site as described in Golder Associates report 04-1120-146. The test pits were excavated to depths of 3.5 to 3.9 metres and the material encountered was stiff to very stiff silty day with a weathered crust. Occasional silty sand pockets within the weathered crust were observed in the southernmost test pits (TP04-4, TP04-5 and TP04-6).

The top of the glacial till deposit was encountered at about 8-9 metres below ground surface in two boreholes completed in the central part of the site (951-2025 BH95-3 and 881-2108 BH-1).

In several nearby boreholes along Watters Road and just west of Trim Road, the silty clay deposit is weathered for its entire depth to the top of the glacial till deposit. Fine sand seams within the weathered and unweathered silty clay were noted in several boreholes located across the area; between the weathered and unweathered silty clay deposits, sand deposits of 0.4 metres to 1.5 metres in thickness were encountered in three boreholes located along Watters Road.

2.2 Bedrock Geology

Available bedrock mapping of the area indicates that the site is underlain by limestone of the Bobcaygeon Formation and interbedded limestone and dolomite of the Gull River Formation. Bedrock is indicated to be exposed at ground surface in an area surrounding the south end of Gerald Street and trending northeast towards Old Montreal Road. Apart from this area, the depth to bedrock is mapped to range from 10 to 50 metres across the site (Figure 4).

A bedrock fault is mapped passing approximately east-west across the site.

Of the nearby boreholes completed during previous Golder Associates investigations, four were completed through the overburden into the bedrock. In BH95-3 completed for project 951-2025, located in the central part





of the site, the bedrock is described as fine grained thinly bedded limestone and was found at a depth of 11.7 metres. In boreholes 04-201, 04-202 and 04-203 completed for report 04-1120-021, located along Watters Road near Cardinal Creek, the bedrock is described as highly weathered to fresh fine crystalline limestone with occasional mud seams and was found at a depth of 9.2 to 10.5 metres.

2.2.1 Karst Features

The presence of an area of karst features (i.e., underground voids/caves, formed by the dissolution of the limestone bedrock by flowing groundwater) was noted in the Golder Associates reports dated June 1991, August 2002 and April 2004. Sinkhole areas and subterranean channels are found within a subsurface bedrock escarpment. The delineated area of karst is located from about 100 metres south to about 150 metres north of Watters Road and is bounded to the east by Cardinal Creek, as shown on Figure 5. Karst features were not observed on the proposal development site.

2.3 Groundwater Conditions

Water table depths measured in boreholes and auger holes completed during previous Golder Associates investigations ranged from 1.1 metres to 5.5 metres below ground surface in the weathered crust and silty clay deposits, and 4.6 metres to more than 11.7 metres below ground surface in the glacial till deposits. Only two multilevel groundwater monitors were found in the information review; in both, the vertical hydraulic gradient was indicated to be downwards through the silty clay.

Regional groundwater flow is anticipated to be northwestwards towards the Ottawa River.

Deposits of coarse and permeable overburden, capable of supplying sufficient quantities of groundwater for domestic use, are not prevalent in the vicinity of the site. For this reason, the bedrock aquifer is considered the principal aquifer for water supply.

2.3.1 Private Wells

Existing homes near the development site (i.e. along Gerald Street and Old Montreal Road) are primarily serviced by private wells and septic systems. The MOE Water Well Information System (WWIS) had information on 28 wells on and near the development site. The version of the MOE WWIS referenced for the study included information on wells drilled up to June 2003.

One overburden well was identified near the development site, and the remaining 27 water supply wells were completed into the bedrock. The following table summarizes the distribution of the water supply well depths:

Well Depth (metres) Number of Water Supply Wells	
0 – 10 0	
10.1 - 20 0	
20.1 - 30 6	
30.1 - 40 12	



Well Depth (metres)	Nur	nber c	of W	ater Supply Wells
40.1 - 50				9
50.1:-60	Ş.	100 100 100	. 4	
Total				28

The above table indicates that all of the water supply wells near the development site are completed to a depth between 20 metres and 60 metres below ground surface. With the exception of the one overburden well, all of these wells are interpreted to obtain groundwater from the Gull River Formation aquifer. The depth to water-bearing zones ranged from about 20 metres to 50 metres depth in these wells. The single identified overburden well is interpreted to draw water from a deep sand and gravel deposit found at a depth of about 37 metres below ground surface, beneath a thick clay deposit.

Information provided in the MOE WWIS indicates that wells completed along Gerald Street are capable of supplying enough water for domestic purposes (i.e., recommended pumping rates are typically above 18 L/min).

No information was available for review on the groundwater quality of the wells along Gerald Street.

2.4 Site Servicing

The deepest service proposed for the site is the sanitary sewer, which will outlet to the existing sanitary sewer at Old Montreal Road. The sanitary sewer inverts generally range from about 2 metres to 7 metres below existing grade, and more typically range from about 3 metres to 5 metres below existing grade. The deepest sewer invert below existing grade is found along the steep slope in the northern part of the site; the sewer invert is proposed at 7 metres below existing grade, and surficial materials would be removed so that the final road surface is at about 3 metres below existing grade.

A deep watermain connection is proposed at Trim Road, about 125 metres south of Old Montreal Road. The watermain invert is proposed at about 8 metres below existing grade.

A centralized underground storage facility is proposed to handle stormwater flow. The location of the facility is along the entrance road to the development, about 80 metres south of Old Montreal Road and adjacent to the eastern site boundary. The bottom of the tank is proposed at an elevation of 67.2 masl, about 7 metres below existing grade.

Clay seals are proposed to be installed in the sewer and watermain trenches as per the City of Ottawa standard S-8, consisting of 1.0 m wide weathered dry silty clay compacted in thin lifts to 95% standard Proctor density. The seals will extend from trench wall to trench wall, and from sewer/watermain subgrade level to terminate either within the native soil backfill or the top of the existing subsurface rock. These seepage barriers will be installed across the site at an approximate spacing of 35-150 metres along the main site road (Street No. 1) and at the ends of each of the side roads (Streets Nos. 2 and 3).





3.0 POSSIBLE IMPACTS TO SURROUNDING PROPERTIES

3.1 Potential Causes of Impacts to Surrounding Properties

The potential causes of impacts to the surrounding properties are:

- Groundwater control activities during site servicing; and,
- Alteration of the existing hydrogeological flow regime due to the presence of site services.

3.1.1 Groundwater control activities during site servicing

The sewer and watermain servicing trenches proposed for the site are expected to be completed mainly in the silty clay layer and in the northern half of the site are unlikely to encounter the underlying bedrock. Groundwater control activities for the proposed development would therefore likely be conducted in the weathered and unweathered silty clay layers. Due to the typically low hydraulic conductivity of silty clay, the groundwater control requirements during site servicing activities in the northern part of the site are expected to be minor.

Bedrock may be encountered in servicing trenches proposed in the southern part of the site where available mapping indicates bedrock at or near ground surface (Figure 3). No information is available on the hydraulic conductivity of the bedrock in this area; groundwater control requirements are likely to be more significant in this area.

During groundwater control activities in sewer and watermain servicing trenches proposed to be constructed in the silty clay, groundwater level drawdown is expected in the immediate vicinity of the trenches. The thick silty clay overburden on the site is expected to prevent the horizontal migration of groundwater level drawdown far beyond the trenches. Although scattered fine sand seams within the weathered and unweathered silty clay were noted in several boreholes located across the area, the seams are unlikely to be well-connected to one another and are not expected to significantly increase the horizontal extent of groundwater level drawdown.

Sand deposits of 0.4 metres to 1.5 metres in thickness were found within the silty clay in three previous boreholes located along Watters Road; site services are not planned to be installed in this area. Since these deposits are larger in thickness than the above-noted scattered sand seams, groundwater control in this area could have the potential to affect off-site groundwater levels. Since no site servicing is proposed in this area, no impacts to groundwater levels are expected.

The horizontal extent of groundwater level drawdown may be more significant if servicing trenches are constructed through bedrock in the southern part of the site.

3.1.2 Alteration of the existing hydrogeological flow regime

In the Golder Associates report dated September 2004, it was recommended that impervious dykes or cut-offs should be constructed in the service trenches at about 150 metre intervals to reduce groundwater lowering at the site due to the "french drain" effect of the granular bedding and surround for the service pipes. This groundwater lowering would have the potential to affect groundwater levels off-site. It is important that these barriers extend from trench wall to trench wall and that they fully penetrate the granular materials to the trench bottom. As noted



in Section 2.4, clay seals are proposed to be installed in the sewer and watermain trenches at an approximate spacing of 35-150 metres. The clay seals will minimize the potential for drainage to occur along this potential pathway and therefore minimize potential groundwater level lowering by drainage along the granular bedding and backfilling.

3.2 Impairment to Groundwater Quantity or Quality

The vast majority of the water wells identified near the site are completed into the bedrock, and draw water from depths of about 20 metres to 50 metres below ground surface. Since all site servicing is expected to be completed in the upper 7 to 8 metres of subsurface materials, no impairment to groundwater quantity is expected due to site servicing.

Site servicing activities are not anticipated to cause changes to groundwater quality.

3.3 Impacts to Septic Systems

Since groundwater control requirements during site servicing are expected to be of a short-term nature and the extent of groundwater drawdown in the silty clay is expected to be small, the groundwater control activities are not expected to cause impacts to groundwater levels off-site. Due to the installation of clay plugs in the sewer bedding and backfill, permanent groundwater level lowering in the overburden is not expected off-site. No impacts to nearby septic systems are expected.

3.4 Structure Settlement

Due to the presence of sensitive silty clay in the study area and beneath nearby homes on Gerald Street, there exists the potential for structure settlement if groundwater levels are lowered across the area.

Since groundwater control requirements during site servicing are expected to be of a short-term nature and the extent of groundwater drawdown in the silty clay is expected to be small, the groundwater control activities are not expected to cause impacts to groundwater levels off-site. Due to the installation of clay plugs in the sewer bedding and backfill, permanent groundwater level lowering in the overburden is not expected off-site. No impacts to nearby structures are expected.





4.0 CONCLUSIONS

A hydrogeological review has been undertaken to assess the potential impact that a proposed development on the Russell Findlay lands may have on neighbouring private wells and septic systems of those residences situated on both Gerald Street and Trim Road. Potential impacts to private wells could include the impairment of the quality and/or quantity of the water available to the residents. Impacts to septic systems would be restricted to issues associated with drainage. The potential causes of impacts to the surrounding properties are:

- Groundwater control activities during site servicing; and,
- Alteration of the existing hydrogeological flow regime due to the presence of site services.

Due to the typically low hydraulic conductivity of silty clay, the groundwater control requirements during site servicing activities in the northern part of the site are expected to be relatively low. Bedrock may be encountered in servicing trenches proposed in the southern part of the site where available mapping indicates bedrock at or near ground surface (Figure 3). No information is available on the hydraulic conductivity of the bedrock in this area; groundwater control requirements may be more significant in this area.

The vast majority of the water wells identified near the site are completed into the bedrock, and draw water from depths of about 20 metres to 50 metres below ground surface. Since all site servicing is expected to be completed in the upper 7 to 8 metres of subsurface materials, no impairment to groundwater quantity is expected due to site servicing. Site servicing activities are not anticipated to cause changes to groundwater quality that would affect potability.

Due to the installation of clay plugs in the sewer bedding and backfill, permanent groundwater level lowering in the overburden is not expected off-site. No impacts to nearby septic systems are expected. No impacts to nearby structures due to settlement are expected.





5.0 LIMITATIONS

This report was prepared for the exclusive use of Claridge Homes. The report, which specifically includes all tables, figures and appendices, is based on data gathered by Golder Associates Ltd., and information provided to Golder Associates Ltd. by others. The information provided by others has not been independently verified or otherwise examined by Golder Associates Ltd. to determine the accuracy or completeness. Golder Associates Ltd. has relied in good faith on this information and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the information as a result of omissions, misinterpretation or fraudulent acts.

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The services performed as described in this 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.

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This report provides a professional opinion in light of the information available at the time of this report and therefore no warranty is either expressed, implied, or made as to the conclusions, advice, or recommendations offered in this report.





Report Signature Page

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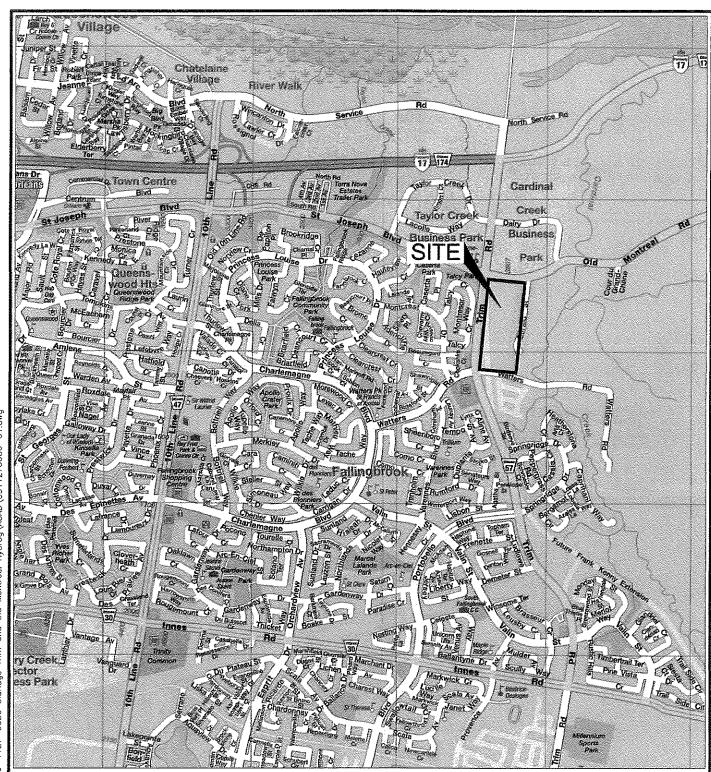
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- Golder Associates Ltd., April 2004. Karst Assessment, Proposed Residential Lots 59 to 62, Springridge Subdivision, Watters Road, Ottawa, Ontario. Report 04-1120-021.
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NOTE

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 09-1127-0086

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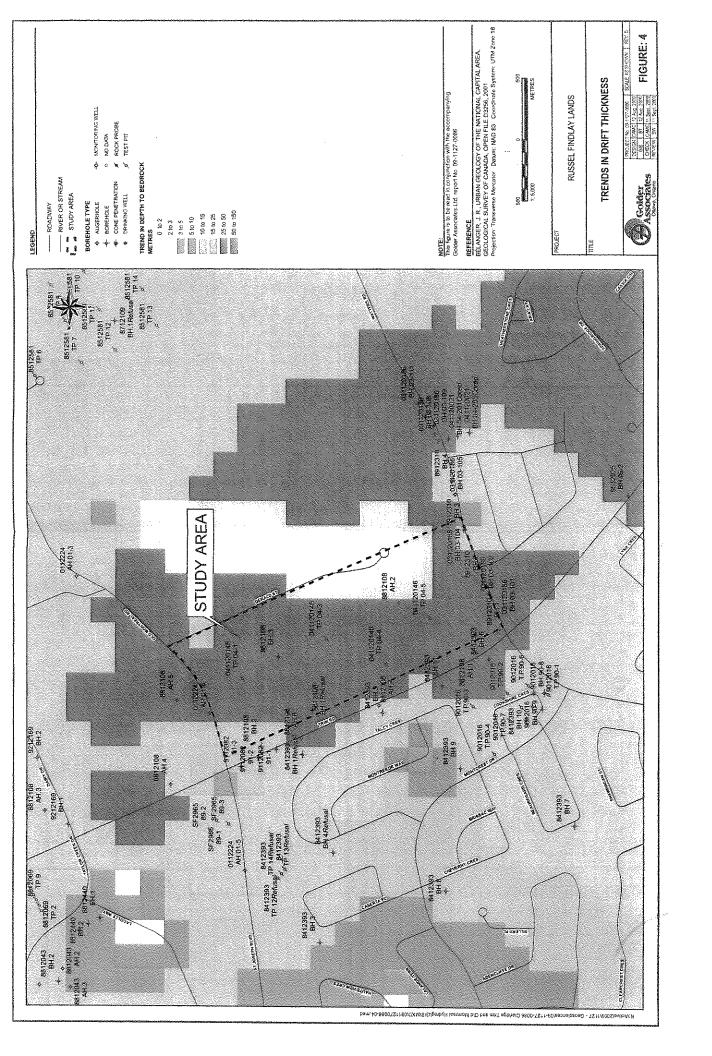
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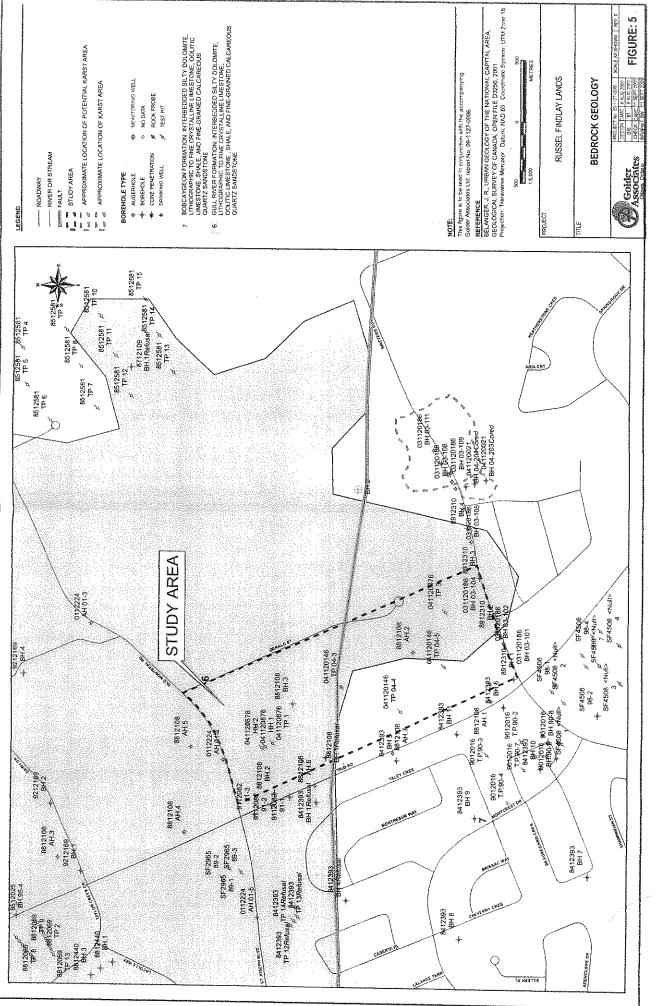
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KEY PLAN

RUSSELL FINDLAY LANDS





APPENDIX A

Borehole Records, Previous Golder Associates Ltd. Investigations



LOCATION See Figure

2

BORING DATE SEPT. 17, 1994

DATUM GEODETIC

SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

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LOCATION See Figure

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BORING DATE SEPT (5 #/5) 1954

DATUM GEOPETIC

SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

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LOCATION See Figure

BORING DATE SEPT. 19, 1984 DATUM GEODETIC

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PENETRATION TEST HAMMER, 63.5 kg., DROP, 760 mm

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LOCATION See Figure

3 - 50

BORING DATE SEPT. 20, 984 DATUM GEODETIC

SAMPLER HAMMER, 63.5 kg.; DROP, 760 mm

PENETRATION TEST HAMMER, 63.5 kg.; DROP, 760 mm

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BORING DATE May.5,1988

SHEET 1 of 1

DATUM GEODETIC



SAMPLER HAMMER, 83.6kg, DROP, 780mm

LOCATION See Figure 2

PENETRATION TEST HAMMER, 83.5kg, DROP, 780mm

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LOCATION See Figure 2 BORING DATE May.9,1988 SAMPLER HAMMER, 83.5kg, DROP, 780mm PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm SOIL PROFILE DYNAMIC PENETRATION BORING METHOD SAMPLES . HYDRAULIC CONDUCTIVITY, k, CM/SEC DEPTH SCALE METRES RESISTANCE, BLOWS/0.3m ADDITIONAL LAB. TESTING PLOT PIEZOMETER NUMBER TYPE ELEV. SHEAR STRENGTH DESCRIPTION WATER CONTENT, PERCENT STANDPIPE nat.V.- + Q.- • DEPTH (M) Cu, kPa INSTALLATION rem.V.- ⊕ U.- O 20 20 40 60 Ground Surface 72.60 0 0.00 881-2108 Brown sand and gravel Seal (Roadway FIII) 72.05 0.55 Backfill 1 1 50 4 Very stiff to stiff grey brown and red brown 2 50 4 SILTY CLAY (Weathered Crust) 2 0 3 Bentonite Seal 3 50 DO Backfill 4 68.94 3.66 Standpipe B + Bentonite Seal Dlam (Hollow Power Auger 4 50 1 0 50 DO 2 Stiff grey SILTY CLAY 0 0 50 DO в 1 Bentonite Seal 50 DO 7 1 10 Standpipe ⊕ + 82.24 End of Hole 63 10.36 11 ₩.L.in Standplpe A al Elev.68.87 Standpipe B - 12 at Elev.71.50 May.9,1988 6 PERCENT AXIAL STRAIN AT FAILURE DEPTH SCALE LOGGED S.L 1: 60 Golder Associates CHECKED CX

SHEET 1 61-1

LOCATION See Figure 2

SAMPLER HAMMER, 63.6kg, DROP, 780mm

BORING DATE: Apr.22&25,1988

SHEET 1 of 2

DATUM GEODETIC



PENETRATION TEST HAMMER, 83.6kg, DROP, 780mm

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SHEET 2 of 2

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 780mm

LOCATION See Figure 2

BORING DATE Apr.22&25,1988

PENETRATION TEST HAMMER, 63.5kg. DROP, 760mm

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F BOREHOLE AH-1

SHEET 1 of 1

DATUM: GEODETIC

LOCATION See Figure 2

SAMPLER HAMMER, 83.6kg, DROP, 780mm

BORING DATE April 22,1988

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm



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AH-2

SHEET 1 of 1

DATUM GEODETIC

LOCATION See Figure 2

SAMPLER HAMMER, 63.6kg, DROP, 760mm

BORING DATE April 22,1988

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

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RECORD OF BOREHOLE AH-4

BORING DATE May.9,1988

SHEET 1 of 1

DATUM GEODETIC



SAMPLER HAMMER, 83.5kg, DROP, 780mm

LOCATION See Figure 2

PENETRATION TEST HAMMER, 83.5kg, DROP, 780mm

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KECORD OF BOREHOLE AH-5

SHEET 1 of 1

DATUM GEODETIC

LOCATION See Figure 2 BORING DATE May.9,1988 SAMPLER HAMMER, 63.6kg, DROP, 780mm PENETRATION TEST HAMMER, 63.6kg DROP, 760mm

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SHEET 1 of 1

DATUM GEODETIC

LOCATION See Figure 2 SAMPLER HAMMER, 83.5kg, DROP, 780mm

BORING DATE May.9,1988

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm



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SHEET 1 of 1

LOCATION: See Figure 2 SAMPLER HAMMER, 63.5kg, DROP, 760mm BORING DATE May.9,1988

DATUM GEODETIC

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

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RECORD OF BOREHOLE 1 SHEET 1 of 1

LOCATION See Figure 2

SAMPLER HAMMER, 83.5kg, DROP, 760mm

BORING DATE Aug 24,1989

PENETRATION TEST HAMMER, 63.6kg, DROP, 760mm

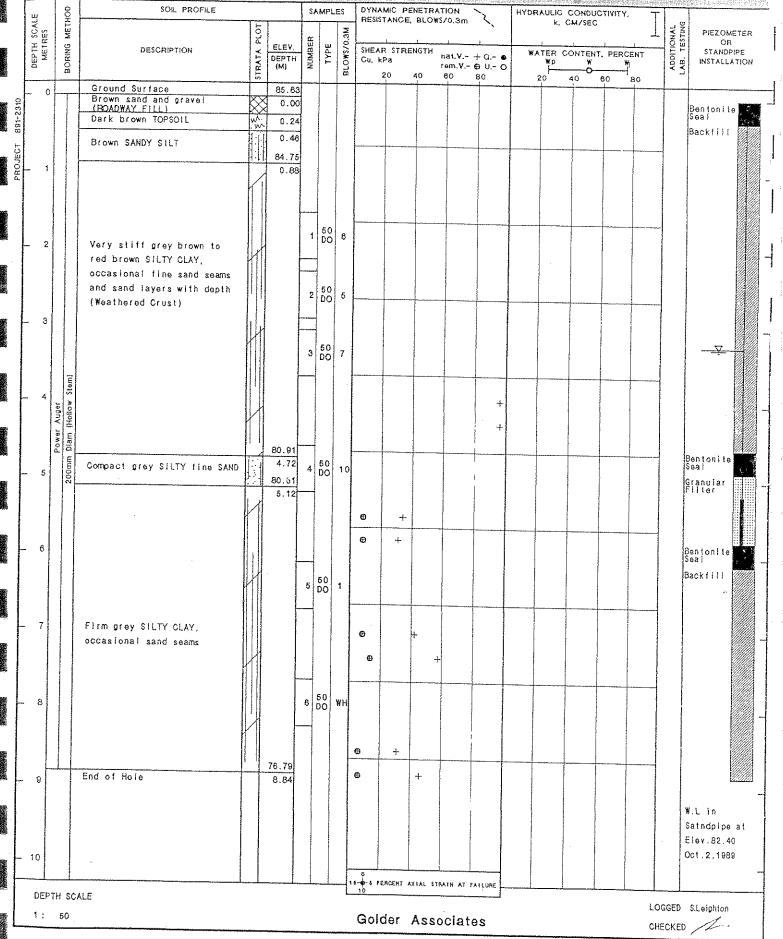
DATUM GEODETIC

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H SC	E E	Z		PLOT	ELEV.	8	1	BLOWS/0,3M		1					1		,	, 4	ADDITIONAL LAB. TESTING	PIEZOMETER OR
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\ -	0 -		Ground Surface	Ţ	85.78	~	1	1			-			 	 	 	-	1-	 	
			Grey crushed stone (ROADWAY FILL) Dark brown TOPSOIL, some grave	\mathbb{X}	0.00]														Bentonite Seal
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<u> </u>	2		Very stiff red brown			1	50 DO	12		—	1		-		0	 	·			
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LOCATION See Figure 2

SAMPLER HAMMER, 63.6kg. DROP, 760mm

RECORD OF BOREHOLE 2 SHEET 1 of 1 BORING DATE Aug.24,1989 DATUM GEODETIC PENETRATION TEST HAMMER, 83.5kg DROP, 760mm



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SHEET 1 of 1

DATUM GEODETIC

SAMPLER HAMMER, 63.5kg, DROP, 760mm

LOCATION See Figure 2

BORING DATE: Aug.24,1989

PENETRATION TEST HAMMER, 83.5kg, DROP, 780mm

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S	DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0.3M	SHEAI Cu, k	L R STRE Pa	ENGTH	nat.V	+ Q •	1	ATER C	ONTENT		i	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
i	_ (Ground Surface	- io	82.87		-	-		20	40	60	80		20	40 (во .	80		
PHOJECT 891-2310			Brown SANDY SILT, occasional silty sand seam									and the first second se	THE PRESENTAL MINISTER AND PRINCIPLES.						l	Bentonite Seal Backfill
	_ 2	Power Auger Diam Hollow Stems			0.70	1 2	500 500 500 500	5	-						0					<u>-</u> ▼
530	- 5	200mm	Firm grey SILTY CLAY, occasional sand seam		78.60		50 DO	WH-	Ф Ф	+	+			-		0			100	Bentonite Seal Granular Filter Bentonite Seal
	7		End of Hole		75.55 7.32	The state of the s		•	9	+										-
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SHEET 1 of 1

DATUM GEODETIC

CHECKED

LOCATION See Figure 2

SAMPLER HAMMER, 83.6kg, DROP, 780mm

BORING DATE Aug.25,1989

PENETRATION TEST HAMMER, 63.5kg. DROP, 760mm

	SOIL PROFILE		Γ.	MPL	ere.	DYNAMIC BENETOLTON			
THOO THOO	ANT CHOUSE	15	5/	MPL		DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	٦,	HYDRAULIC CONDUCTIVITY, k. CM/SEC	
DEPTH SCALE METRES BORING METHOD	DESCRIPTION	STRATA PLOT		TYPE	BLOWS/0.3M	SHEAR STRENGTH nat.V Cu, kPa rem.V 20 40 60 8	+ Q • ∌ U O	WATER CONTENT, PERCENT WD W W W W W W W W W W W W W W W W W W	PIEZOMETER OR STANDPIPE INSTALLATION
_ o	Ground Surface Brown sand and gravel	84.					<u> </u>		
723	(ROADWAY FILL) Dark brown TOPSOIL	~ 0.:							Bentonite Seal
PROJECT 894-2810	,	0.	13	500 DO	13				Backfill -
			2	50 DO	8				
Stem)	Very stiff grey brown and red brown silty clay,				-	To the state of th			
A. Power Auger 200mm Dläm (Hollow	occasional fine sand seam (Weathered Crust)		3	50 DO	8				
200mm							+		
5		1000 mm	4	50	5				
6				1/4/4mm/4W-1/4			+		Bentonite Seal V Granular Filter
			5 5	50	4				
7	End of Hole	76.88					+		Bentoni te Seal
	VI 11018	7.32	4,000				+		
- 8 - 9									W.L in Standpipe at Elev. 78. 79 Oct. 2, 1989
				With the second	***************************************				
- 10									
DEPTH SCAL	E				-1 t 6~	0 6 PERCENT AXIAL STRAIN AT FALL 10	LURE		
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Golder Associates

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PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

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(BOCATION See Figure 2 SAMPLER HAMMER, 83.6kg, DROP, 760mm

BORING DATE Aug.25,1989

DATUM GEODETIC

	c	, T	SOIL PROFILE			SA	MPL	ES.	DYNAMIC PENETR	ATION .		HYDRAULIC CONDUCTIVITY.	T	
DEPTH SCALE METRES	BORING METHOD	SORING MEIN	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	NUMBER	TYPE	BLOWS/0,3M	- RESISTANCE, BLO	nat.V		WATER CONTENT, PERCEI	- γ ₀ γ ₀ γ ₀ γ ₀ γ ₀ γ ₀ γ ₀ γ ₀	PIEZOMETER OR STANDPIPE INSTALLATION
0		7	Ground Surface Brown sand and gravel (FOADWAY FILL) Grey brown silty clay, trace gravel (FILL) Dark brown TOPSOIL		85.89 0.00 0.15 85.08 0.61 0.85			The state of the s						Bentonite Seal Backfill
_ 2						1	50 ĐO	8				0		
3			Very stiff grey brown SILTY CLAY (Weathered Crust)			2	50 DO	7						
	Diam (Hollow Stem)	am (Hollow stem)	· · ·			3	50 DO	€			7	0		-
_ 5	700mm Di					4	50 DO	5			+		1 1	Bentonite Seal
6 6 6 6 7 8 8				***	80.05 5.64						+			Backfill Filter
7		8	Pery dense brown sandy silt, come gravel, clay and cobbles GLACIAL TILL)	0 X C 6-1	-	5	50	58			c			
			End of Hole Auger Refusal	1 N	78.10 7.59	***************************************							Advantage of the state of the s	
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10						-		16	O 6 PERCENT AXIAL S	BAIN AT FA	LURE			-
DEPTI	96170		E 40	···				L	Golder Ass					S.Leighton

PROJECT: 911-2082 "DECODD OF BODELIOLE 91-1" SHEELIUM BORING DATE: JUNE 3, 1991 Geodetic LOCATION: See Figure 2 PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm SAMPLER HAMMER, 63.5kg; DROP, 760mm HYDRAULIC CONDUCTIVITY, DYNAMIC PENETRATION SOIL PROFILE SAMPLES BORING METHOD RESISTANCE, BLOWS/0.3m ADDITIONAL LAB. TESTING DEPTH SCALE METRES PIEZOMETER OR NUMBER STANDPIPE ELEV. WATER CONTENT, PERCENT SHEAR STRENGTH nacV -DESCRIPTION INSTALLATION DEPTH Cu, kPa rem.V · ⊕ U · O Wp 60 80 20 60 80 74.32 0.00 Ground Surface **ASPHALT** 74.10 Brown sand and gravel, trace silt (FILL) GS Brown silty clay, some sand and gravel (FILL) 73.79 50 7 DO 7 Dam. Stiff to very stiff brown SILTY CLAY (Weathered Crust) 50 6 72.80 1.52 End of Hole 5 FERCENT AXIAL STRAIN AT FAILURE LOGGED: A.C.H. DEPTH SCALE CHECKED: ACH Golder Associates 1 to 25

PROJECT: 911-2082 LOCATION: See Figure 2

1 to 25

RECORD OF BOREHOLE 91-2

SHEET 1 OF 1

BORING DATE: JUNE 3, 1991

Geodetic

CHECKED: ACA

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

		SOIL PROFILE			T 6.4	MPL	FS	DYNAMIC PENETRA	пом	HYDRAULIC CONDUCTIVITY, T		
ALE	THO:	SOIL PHOFILE	Τ⊨	1	 			RESISTANCE, BLOW	\$/0.3m	k, cm/s	TING	PIEZOMETER
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa 20 40	nat.V - + Q - 6 rem.V - ⊕ U - O 60 80		ADDITIONAL LAB, TESTING	OR STANDPIPE INSTALLATION
- 0	П	Ground Surface		70.21 0,00								
		ASPHALT		70.04								
ŀ		Brown sand and gravel, trace silt (FILL)	- 💹	0.17 69.91 0.30	1	GS					М	
ŀ	Ē	Brown sand and gravel and silty clay (FILL)		69.68 0,53								
1	Power Auger	Stiff to very stiff brown		V,53	2	50 DO	5					
	200 Oct	Stiff to very stiff brown SILTY CLAY (Weathered Crust)		68.69	3	50 DO	3					
	П	End of Hole		1.52								
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Golder Associates

PROJECT: 911-2082 LOCATION: See Figure 2

1 to 25

RECORD OF ROHEHOLE 81-3

SHEET 1 OF 1

Geodetic

CHECKED: ACA

SAMPLER HAMMER, 63.5kg; DROP, 760mm

BORING DATE: JUNE 3, 1991 PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DESCRIPTION Stround Surface ASPHALT Strown sand and gravel, race silt (FILL) Compact brown to grey sand and sravel, trace silt (FILL) Mottled silty clay and sand and gravel (FILL) Stiff grey brown SILTY CLAY Weathered crust)	STRATA PLOT	ELEV. DEPTH (m) 66.53 0.00 66.41 0.12 66.23 0.30 65.77 0.76 65.57 0.96	EEEMINN 1	3dAL 98 500 500)18 11	Cu, ki	°a.			+ C. ● D U. ○	W,	ATER CC	^	Υ	ENT (W) 60	S S ADDITIONAL LAB. TESTING	PIEZOMETE OR STANDPIPI INSTALLATI
ASPHALT frown sand and gravel, race silt (FILL) Compact brown to grey sand and fravel, trace silt (FILL) Mottled silty clay and sand and gravel (FILL) stiff grey brown SILTY CLAY Weathered crust)		65.01 65.01	v	90 30	11												
compact brown to grey sand and gravel, trace silt (FILL) compact brown to grey sand and gravel, trace silt (FILL) Anottled silty clay and sand and gravel (FILL) stiff grey brown SILTY CLAY Weathered crust)		66.41 0.12 66.23 6.30 65.77 0.76 65.57 0.96	v	90 30	11									T PER PER PER PER PER PER PER PER PER PER			
Compact brown to grey sand and sravel, trace sit (FILL) Mottled sitty clay and sand and gravel (FILL) Stiff grey brown SILTY CLAY Weathered crust)		- 65.77 0.76 65.57 0.96	v	90 30	11												
Anottied sitty clay and sand and gravel (FILL) stiff grey brown SILTY CLAY Weathered crust)		65.57 0.96 65.01		AND THE PROPERTY AND THE PROPERTY OF THE PROPE										Market and the second s		X	
Nottled sitty clay and sand and gravel (FILL) stiff grey brown SILTY CLAY Weathered crust)		65.57 0.96 65.01	3	500	4		Andrew Company of the	TOTAL PROPERTY THE WAY AND THE TIME AND PROPERTY OF THE TIME AND THE T						A CONTRACTOR OF THE CONTRACTOR			
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Golder Associates

PROJECT: 951-2025 LOCATION: See Plan

RECORD OF BOREHOLE 95-3

SHEET 1 OF 1

DATUM: Geodetic

SAMPLER HAMMER, 21.1kg; DROP, 760mm

BORING DATE: Mar. 30, 1995

PENETRATION TEST HAMMER, 21.1kg; DROP, 760mm

ш	9	2	SOIL PROFILE	T	1	SA	MPL	,	DYNAMIC PENI RESISTANCE, I	ETPIATIO BLOWS/	ON 0.3m	1	HYDRAULI k	C CONDUC , cm/s	IIVITY,	Z V	PIEZOMETE
DEPTH SCALE METRES	OCHLEW SMBOB	SOURING ME!	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	J J SHEAR STREN Cu, kPa 20 4		i i nat,V - + rem.V - + + + + + + + + + + + + + + + + + +	Q- ● U-O	WATE Wp - 20	CONTENT O W	PERCENT W	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
- 0			Ground Surface TOPSOIL		80.83												777
1 2					0.07	1	\$ 0	12									Native Backfili
3			Very stiff to stiff brown to grey brown SILTY CLAY (Weathered Crust), trace sand			2	50 DO	9								Management and an article and a second and a	
5	nger	ollow Stem)				3	50 DO	2	⊕	<u> </u>	4-						
6	Power Auger	150mm Diam (Hollow Stem)				4	50 DO	РМ	&	+							
8			Stiff grey SILTY CLAY		73.21 7.62	5	50 DO	PM:	H	+			W 100 100 100 100 100 100 100 100 100 10				
10			Dense grey-brown silty sand and gravel, occasional cobbles (GLACIAL TILL)		71,46 9,37	6	50 DO										Bentonite Seal :
11					69.15 11.68	7	50 DO	35					A PART OF THE PART				Granular Fitter Standpipe Bentonite
12	Rotary Drill	2	Fresh grey fine grained thinly bedded LIMESTONE		67.76	8	NO FIC	r	T.C.R. 100% S.C.R. 74% R.Q.D. 74%	THINK BOTT ME						начения — — — — — — — — — — — — — — — — — — —	Seal
14			End of Hole		13.07												Standpipe Dry to Elev.70.47m Mar. 31, 1995

1 to 75

Golder Associates

LOGGED: D.W.M CHECKED: //A

TABLE 1 RECORD OF AUGERHOLES

Auger Hole <u>Number</u>	Depth (metres)	Description	Sample (metres)
AH 01-2	0.00-0.22 0.22-0.39	Asphaltic Concrete Grey crushed stone base, trace silt (FILL)	0.22 - 0.39
	0.39-1.15 1.15-1.50	Grey crushed stone subbase, trace silt (FILL) Grey brown SILTY CLAY (Weathered Crust)	1.20 - 1.50
	1.50	End of Auger Hole	2.20
		Note: Auger hole dry upon completion	
AH 01-3	0.00-0.45	Asphaltic Concrete	0.50.000
	0.45-0.94 0.94-1.50 1.50	Coarse grey crushed stone subbase material (FILL) Very stiff grey brown SILTY CLAY (Weathered Crust) End of Auger Hole	0.50- 0.90 1.20-1.50
		Note: Auger hole dry upon completion	
AH 01-4	0.00-0.22	Asphaltic Concrete	0.22-0.40
	0.22-0.41 0.41-1.30	Grey brown sand and gravel, inferred crushed pit run (FILL) Grey brown SILTY CLAY, trace organic material, some gravel,	1.10-1.30
·	1.30-1.50	some red clay tile at 1.2-1.3m (FILL). Grey brown SILTY CLAY (Weathered crust)	
	1.50	End of Auger Hole	
		Note: Auger hole dry upon completion	
AH 01-5	0.00-0.40	Asphaltic Concrete	0.40.0.50
	0.40-0.50 0.50-0.76	Mix of clay and gravel with asphaltic coating (FILL) Grey crushed stone subbase (FILL).	0.40-0.50
	0.76-1.11	Grey brown, SILTY CLAY (Weathered crust)	
	1.11-1.50 1.50	Weathered shaley limestone bedrock End of Auger Hole	
		Note: Auger hole dry upon completion	
AH 01-6	0.00-0.20	Asphaltic Concrete	
	0.20-0.40 0.40-0.70	Brown sand and gravel with fragments of recycled asphalt (FILL) Mix of crushed stone and silty clay (FILL)	0.20-0.40 0.40-0.70
	0.70-0.79	Asphalt	0.40-0.70
	0.79-1.05 1.05-1.50	Crushed stone, sand and gravel (FILL) Very stiff, grey brown SILTY CLAY (Weathered Crust)	1.20-1.50
	1.50	End of Auger Hole	1.20.1.20
		Note: Auger hole dry upon completion	

RECORD OF BOREHOLE: 03-101

SHEET 1 OF 1 DATUM: Geodetic

LOCATION: See Site Plan SAMPLER HAMMER, 64kg; DROP, 760mm BORING DATE: Oct. 3, 2003

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	H H	SOIL PROFILE	1.		SA	MPL	, -	DYNAMIC I RESISTAN	CE, BLOV	/S/0.3m		HYDRAUI k,		DUCT	V 1111,	T	녹ô	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	BER	골	BLOWS/0.3m	20 SHEAR STI	40 RENGTH	<u> </u>	80 °	10° WATI	10° ER CON	10 TENT F		O3 1	ADDITIONAL LAB, TESTING	OR STANDPIPE
Ξ	SOR IN	DESCRIPTION	TRAT/	DEPTH (m)	NC NC NC	TYPE	COWS	SHEAR STI Cu, kPa				Wp⊩					ADD LAB.	INSTALLATION
		GROUND SURFACE	is	86.17	-	-	1	20	40	60	80	10	20	30 		<u> </u>	 	
0		Grey crushed stone (FILL)	***	0.00						1	1					<u> </u>		
			₩															
		Very stiff grey brown silty clay trace	-888	85.50 0.67														
1	ŀ	Very stiff grey brown sifty clay, trace gravel, organic matter and brown sand pockets (FILL)	₩															
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	w Sten				_									į				
	Power Auger 200 mm Diam. (Hollow Stern)		₩		1	50 DO	5											
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Golder Associates

RECORD OF BOREHOLE: 03-102

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 3, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Ţ.		SOIL PROFILE			SA	MPL	ES	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	HYDRAULIC CONDUCTIVITY, T , k, cm/s	PIEZOMETER
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.		TYPE	BLOWS/0.3m	20 40 50 80 SHEAR STRENGTH nat V. + Q. Cu, kPa rem V. & U.	10° 10° 101 10° 10° 10° 10° 10° 10° 10°	PIEZOMETER OR STANDPIPE INSTALLATION
DE	BOR		STRAI	DEPTI (m)	'\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	۴	BLOW	Cu, kPa rem V. ⊕ U- 20 40 60 80	0 Wp → 0W + W ₹	A INSTALLATION
- 0	:	GROUND SURFACE Grey crushed stone (FILL) Brown sand and gravel (FILL) Brown silty clay (FILL)		86.1 0.0 0.1 85.8 0.3	0 26					
- 1	. (1	Dark brown silty TOPSOIL Light brown CLAYEY SILT Very stiff grey brown and red brown SILTY CLAY, occasional sandy silt sear (Weathered Crust)		0.4 0.6 85.3 0.8	1					
- 2	Power Auger 200 mm Diam. (Hollow Stem)				1	SO DO	8			
- 3						50 DO	2			
- 4		End of Borehole		82.5 3.6	3					
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RECORD OF BOREHOLE: 03-103

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 5, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

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2	ž		l F	ELEV.	띭	μļ	70.3	20	40 TRENC			BO `			1		103	TEE	OR STANDPIPE
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	DEPTH	NUMBER	TYPE	BLOWS/0.3m	SHEAR S Cu, kPa	ORENG	ו חו	natv. ∱ em V. e9	u- ©	\ \	ATER C	ONTEN	i PERCI		ADDITIONAL LAB. TESTING	INSTALLATION
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-1		GROUND SURFACE	1	1		[一	<u> </u>			30 (90		10 2	20 T	30	40		
٥		Grey crushed stone (FILL) Brown sand and gravel (FILL)	XXX	84.71 0.00			-			·	 	 	_		 	┼──	+	+	<u> </u>
		Brown sand and gravel (FILL)	\mathbb{R}	0.12				1	Ì						İ				
			₩	84.25 0.46		- [ı	İ					1		ļ			ĺ	
		Very stiff to stiff grey brown and red brown SiLTY CLAY (Weathered Crust)		0.46			- 1						Į						
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BOREHOLE 03-1120-186.GPJ GLDR CAN.GDT 11/11/03



RECORD OF BOREHOLE: 03-104

SHEET 1 OF 1

LOCATION: See Site Plan

BOREHOLE 03-1120-186.GPJ GLDR_CAN.GDT 6/11/03

BORING DATE: Oct. 3, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

w	99	SOIL PROFILE			SA	MPL	EŞ	DYNAMIC PE RESISTANCE	NETRA	TION /S/0.3m	7	HYDRAUL k,	IC CONDUCTI	IVITY,	TI .o	
DEPTH SCALE METRES	BORING METHOD		LOT.		g		.3m		40	60	80 '	10-€	10-5 10	⁴ 10 ⁻³	ADDITIONAL LAB. TESTING	PIEZOMETER OR
MET H	SING	DESCRIPTION	STRATA PLOT	ELEV. DEPTH	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRI Cu, kPa	ENGTH	nat V. rem V.	+ Q-● ⊕ U-O	WATE	R CONTENT		NODITE AB. TE	STANDPIPE INSTALLATION
۵	BO		STR	(m)	z		B.C	20	40	60	80	Wp ⊢ 10	20 30	I WI 1 40	1,2	
- 0		GROUND SURFACE ASPHALTIC CONCRETE	1000	83.64	<u> </u>											6.840
F		Grey crushed stone (FILL) Brown sand and gravel (FILL)	₩	0.03 0.12												Asphalt Seal
E		Very stiff grey brown and red brown SILTY CLAY (Weathered Crust)	X	83.21 0.43												
F		SILTY CLAY (Weathered Crust)												.		l
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E				3						***************************************					i	Native Backfill
-	Stem)					£0				***************************************						INABAG DACKIN
_ ,	Power Auger 200 mm Diam, (Hollow Stem)				1	50 DO	5									
- ^	Power Auger Diam, (Hollor				<u> </u>											
	P P															l _‱
-	200			80.90 2.74												\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
- - - 3		Firm to stiff grey SILTY CLAY with occasional red brown layer		2.74				-								Silica Sand
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				1	2	50 DO	WH				and the second					Standpipe
-													***************************************	a de la composição de l		
		Probably grey SILTY CLAY with silt		79.74 3.90							+		***************************************			Native Backfill
		layers		79.37						4						
		End of Borehole		4.27						1						
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-																Elev. 81.04 m Oct. 14, 2003
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RECORD OF BOREHOLE: 03-105

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 3, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

₹,,	욷	SOIL PROFILE	7		34	MPLI		i			10N S/0.3m	ί.	4			CTIVITY,		₹ 2 \ 2 \ 2 \ 2 \ 2 \ 2 \ 3 \ 4 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5	PIEZOMETER
DEPTH SCALE METRES	BORING METHOD		STRATA PLOT	ELEV.	Ä	μ.	BLOWS/0.3m		20	40	60	80	. 1	10-6	10"5		10 ⁻³	ADDITIONAL LAB, TESTING	OR STANDPIPE
EPT MA	RING	DESCRIPTION	YATA	DEPTH	NUMBER	TYPE	OWS	Cu, ki	28 28	NGIH	rem V. (+ Q- ● ⊕ U- O	,	VATER √p I— -	CONTE	NT PERCI	ENT I WI	ABD T	INSTALLATION
	8	,	15	(m)	_		E E		20	40	60	80	1	10	20		40		
_ 0		GROUND SURFACE		83.76					<u> </u>	<u> </u>		<u> </u>					1		
		ASPHALTIC CONCRETE Grey crushed stone (FILL) Brown sand and gravel (FILL)	1	0.06 0.15															
				83,30 0.46					1										
		Dark grey brown silty clay, some gravel, organic matter and crushed limestone, occasional cobble (FILL)	₩	U.40															
_ 1		occasional copple (FILL)	***																
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l	Power Auger mm Diam. (Hollow Stem)		₩		1	50 DO	87					İ							,
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ĺ	200 m	Very stiff grey brown SILTY CLAY	***	81.47 2.29													l		
ĺ		Very stiff grey brown SILTY CLAY (Weathered Crust)										Ì					}		
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RECORD OF BOREHOLE: 03-106

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm PENETRATION TEST HAMMER, 64kg; DROP, 760mm

ALE.	0	9	SOIL PROFILE	T:-	· · · · · · · · · · · · · · · · · · ·	SA	MPI		DYNAMIC PENETR RESISTANCE, BLO	ATION WS/D.3m	}	HYDRAULIC CO	ONDUCTIVITY,	TI.	PIEZOMETE
DEPTH SCALE METRES		OKING ME	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	BLOWS/0.3m	20 40 SHEAR STRENGTH Cu, kPa	nat V. rem V.	⊕ U-O	10° 10 WATER CC	ONTENT PERCEN	T AMOUNT	PIEZOMETE OR STANDPIPE INSTALLATIO
	ì	_	GROUND SURFACE	STI	(m)	-	-	<u></u>	20 40	60	80	10 20			(3)
o	\vdash			- XXX	84.78 8.00		-	-			_				
		N	Grey crushed stone (FILL) Brown sand and gravel (FILL) Brown silty clay, some gravel (FILL) Grey brown silty clay, trace organic		0.15 64.41	1								-	
- -			Grey brown silty clay, trace organic matter (FILL)		0.37										
		1	,	- 💥	84.02 0.76										77
- 1		1	Very stiff grey brown and red brown SILTY CLAY (Weathered Crust)										****		
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	Power Auger	me.			82.49										
	ď	ĒΙ	Loose brown fine SAND, trace silt	13	2.29										
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- 4		h	Very stiff grey brown SILTY CLAY Weathered Crust)		80.94 3.64	3	50 DO	6							
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PROJECT: 03-1120-186

LOCATION: See Site Plan

03-1120-186.GPJ GLDR CAN.GDT 6/11/03

1:50

RECORD OF BOREHOLE: 03-107

BORING DATE: Oct. 2, 2003

SHEET 1 OF 1
DATUM: Geodelic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

CHECKED: ---

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METRES	BORING METHOD	SOIL PROFILE		-	SA	MPL.	.ES	DYNAMIC PENE RESISTANCE, B	TRAT	ON /0.3m	1	HYDRAU k,	IC COND	UCTIVITY	<u>′</u> 1	-]	DIE 701
TRES	WE W		STRATA PLOT		يم		.3m	20 40			80 1	106	105	10*	10,3 7	ADDITIONAL LAB. TESTING	PIEZOMETER OR
¥	NING.	DESCRIPTION	TAF	ELEV. DEPTH	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENG Cu, kPa	eTH.	nat V. +	Q- •	WAT	R CONT		CENT	그들 [™]	STANDPIPE INSTALLATION
	l g		TRA A	(m)	₹	-	[g					l ∧∧b ⊢			⊣ W	88	
	 	GROUND SURFACE	160	 	┨	\dashv	-	20 40		50	80	10	20	30	40		
0	 	ASPHALTIC CONCRETE	***	85.23		\dashv	\vdash			 	 	 -				-	
		Grey crushed stone (FILL) Brown sand and gravel (FILL) Grey brown silty clay, some gravel, trace		84.93						}				-	'		
		Grey brown silty clay, some gravel, trace	₩	0.30		- [
		organic matter (FILL)		8		Í											
			***	84.29													
1		Very stiff grey brown SiLTY CLAY, occasional very thin silt seam (Weathered Crust)		0.94													
		(Weathered Crust)				١								ł			
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Golder Associates

RECORD OF BOREHOLE: 03-108

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Щ.	皇	SOIL PROFILE		, ——ļ	SA,	MPL		DYNAMIC PENETRA RESISTANCE, BLOW	S/0.3m	<u> </u>	k, cm				일일	PIEZOMETER
DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	BLOWS/0.3m	20 40 SHEAR STRENGTH Cu, kPa	60 80 nat V. +	1	10° WATER	10° 10 CONTENT		3 <u>T</u>	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATION
OE Z	BORIN	armany(NE CEMPS	STRAT	DEPTH (m)	Š	~	BLOW	Cu, kPa 20 40	rem V. ⊕ 60 80			20 3	t N		ADI LAB	INSTALLATION
		GROUND SURFACE	T -	85.52		\neg	\dashv		T		T T	Ť i	- 40	' 		
- 0		ASPHALTIC CONCRETE Grey crushed stone (FILL)		6.09			7							$\neg \uparrow$		Asphalt Seal
		NBrown sand and_gravel_(FILL) Brown sitly day, some gravel, trace wood and cobbles (FILL)		0.24 84.51												Aspiral Geal
- 1	Power Auger mm Dism. (Hollow Stem)	Very stiff grey brown and red brown SILTY CLAY (Weathered Crust)		1,01	1	50 DO	8									Native Backfill
- 2	Pow 200 mm Dias															
- 3					2	50 DO	7									Silica Sand
		End of Borehole	1882	81,86 3,66		- 1	-									文图
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RECORD OF BOREHOLE: 03-109

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Oct. 2, 2003

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

u l	8	SOIL PROFILE			SA	MPL	ES	DYNAM RESIST	C PEN	ETRAT	ION	١	HYDRAU k	LIC CC	NDUC	TIVITY,	Т	-	
DEPTH SCALE METRES	BORING METHOD		E	T								- <	1					ADDITIONAL LAB. TESTING	PIEZOMETER
호본	X.		STRATA PLOT	grienz	NUMBER	[,,]	BLOWS/0.3m	20		5	5	80	10.0				10.3	ĮŠĘ.	OR STANDPIPE
7.5	2	DESCRIPTION	Ā	ELEV.	MBI	TYPE	Ş	SHEAR	STREN	VGTH	nat V. +	- Q - ©	WAT	ER CC	NTENT	PERCE	ENT	<u> </u>	INSTALLATION
5	Ö		Ϋ́	DEPTH (m)	N	۱	3	Cu, Kra			rem v. u	9 0 - 0	Wph				W	88	
	<u> </u>		S	(""/	L.		œ l	20	4	10	60	80	10	20			40		
0		GROUND SURFACE	_[85.86			[[
٦		ASPHALTIC CONCRETE	388				T			T		1						1	
		Grey crushed stone (FILL) Brown sand and gravel (FILL) Brown sand and gravel with clay (FILL)	ЖЖ	0.12 0.24			- 1					1	1	- 1			ļ		
		Brown sand and gravel with clay (FILL)	′‱	a	l i		- 1				l	1							1
- 1		Dark brown silty clay TOPSOIL		85.31 0.55			- 1						!!					1	
- 1		Very stiff grey brown Sti TV CLAV	100	0.70			- 1			-								1	
		Very stiff grey brown SILTY CLAY (Weathered Crust)	W	3 ""			- 1						1						
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BOREHOLE 03-1120-186.GPJ GLDR CAN.GDT 11/11/03

Golder Associates

LOGGED: D.J.S.

RECORD OF BOREHOLE: 03-110

BORING DATE: Oct. 2, 2003

SHEET 1 OF 1 DATUM: Geodetic

LOGGED: D.J.S.

CHECKED: ---

LOCATION: See Site Plan

BOREHOLE 03-1120-186.GPJ GLDR CAN.GDT 6/11/03

DEPTH SCALE

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SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

SOIL PROFILE				SA	MPL	ES.	DYNAMIC PENETRA RESISTANCE, BLOV	TION \	HYDRAULIC CONDUC	-1			
METRES	BORING METHOD		5	T					`,	ł		ADDITIONAL LAB. TESTING	PIEZOMETER
E	_ნ	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	ļμ.	BLOWS/0.3m		60 80	1	10-4 10-3	EST	OR STANDPIPE
2	<u> </u>	DESCRIPTION	₹A.	DEPTH	NO.	TYPE	ő	SHEAR STRENGTH Cu, kPa	rem V. D U - O	WATER CONTEN	/ W	90.9	INSTALLATION
	ä		STF	(m)	_		ם	20 40	60 80		30 40	1,2	
٥		GROUND SURFACE		85.47						ŤŤ		1	
		Dark grey treated sand and gravel (FILL)		0.06	1						+	+	
j		Red brown silty clay (FILL) Brown sand and gravel with clay (FILL) Grey brown SILTY CLAY (Weathered	***	0.21 0.30									
-		Grey brown SILTY CLAY (Weathered Crust)		3 0.30									
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ľ	Power Auger Diam, (Hollo		1889										
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2	Power Auger 200 mm Diem. (Hollow Stern)							land to the same of the same o					
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		Brown sandy silt with cobbles and boulders (GLACIAL TILL)		83.03 2.44		***************************************						1 1	
-		boulders (GLACIAL TILL)	HI			-							
L				82.36			╛						
	ĺ	End of Borehole Auger Refusal		3,11		T							
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PROJECT: 03-1120-186 LOCATION: See Site Plan

RECORD OF BOREHOLE: 03-111

SHEET 1 OF 1

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

BORING DATE: Oct. 2, 2003

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

	T -	1			·											T/MVIVI	IER, 64kg; DROP, 760mm
<u> </u>	BORING METHOD	SOIL PROFILE			ـــــ	MPL		DYNAMIC PENET RESISTANCE, BL	RATION OWS/0.3m	,)	H	YDRAULIC k, cn	CONDU	ICTIVITY	/ ,	Т	(0)
DEPTH SCALE METRES	MET ■		STRATA PLOT		œ	TYPE	æ,	20 40	60	80 '		10°		10	10 ⁻³	ADDITIONAL	PIEZOMETER OR
MET T	NS.	DESCRIPTION	ΑĀ	ELEV.	NUMBER	뜐	0,0	SHEAR STRENG	TH nat V.	+ 0-4	,	WATER		1		귀일	STANDPIPE
ä	Mg Mg		R.	DEPTH (m)	2	1	ĝ	Cu, kPa	rem V	∵⊕ U-C	7	Wp #			⊣ W	Ą.	INSTALLATION
-	╀╌	GROUND SURFACE	Š	 ` '	ļ.,.	_	<u></u>	20 40		80	1_	10	20	30	40		
- 0	\vdash	_Dark grey treated sand and grayel (FILL)	1888	84.03 0.00	_		\vdash				_						
-	1	Dark gray Ireated sand and gravel (FILL) Grey crushed stone (FILL) Grey brown sitty clay (FILL) Brown sand and gravel (FILL) Very stiff grey brown SILTY CLAY,	₩	0.15					1			İ					~
E		Brown sand and gravel (FILL)	****	0,30									Ì	Į	İ		
-		Very stiff grey brown SILTY CLAY, occasional very fine sand seam		0.46								ļ					
E		(Weathered Crust)										ļ					
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LOGGED: D.J.S.

RECORD OF BOREHOLE: 04-201

SHEET 1 OF 1

DATUM: Geodetic

LOCATION:

INCLINATION: -90°

AZIMUTH: —

DRILLING DATE: 2/13/2004

DRILL RIG:

DRILLING CONTRACTOR:

SCALE RES	RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN NO.	(min)		CL-C SH-S VN-V		VAG R	ξE	J-J P-F			SID	: ED !	7-R(51-S PL-P	DUG TEF	PPEC	UE-UNEVEN D W-WAVY C-CURVED	M 8-	:B-₩ -BE	ROKEN CORE ECH, BREAK DOING				DIAMETRAL POINT LOAD INDEX (MP3)		NOTES WATER LEVELS INSTRUMENTATION	
DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBO	DEPTH (m)	RUN NO.	/m)		TOT TOT SORI		SC	OLID PRE 9	١.	R.O. %	٠	PEI S		3 ci	OIF W	V.I.I. ZIXA	CONTINUITY DATA TYPE AND SURFACE DESCRIPTION			AYDF NOU k, c		F IAILA I'C	ĺ	POIN	- [INSTRUMENTATION	
 		GROUND SURFACE		85.74				Ш	Ш			Ш		Ш	Ц	Щ	Ш		Ш		4	_	_	4	_	1		1		
0 2 4 6 8 8 10	POWER AUGER	Possibly Clay		77.51 8.23		AND STOPPED TO THE TOTAL STATE		the factor of th															The control of the co	The state of the s	A A A A A A A A A A A A A A A A A A A			The Hiller of the Control of the Con	Native Backfill	
10		Possibly Glacial Till		75,74			8																	ALL DESCRIPTION OF THE PERSON						
		Moderately weathered to fresh grey medium to fine crystaline LIMESTONE BEDROCK		10.00	2		100																						TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT	
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24		End of Borehole		61.90 23.84			1							Marke Print					Annual Property and											
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	EP.T : 150	HISCALE .					(6	io Se	old OC	iei 2i2	: ite	`S													OGGED: W.C. HECKED: J.F.B.	

RECORD OF BOREHOLE: 04-202 PROJECT: 04-1120-021 SHEET 1 OF 1 DRILLING DATE: 2/13/2004 DATUM: Geodetic LOCATION: DRILL RIG: INCLINATION: -90° AZIMUTH: ---DRILLING CONTRACTOR: R-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE DRILLING RECORD CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH, BREAK DEPTH SCALE METRES ST-STEPPED B-BEDDING SH-SHEAR P-POLISHED W-WAVY NOTES WATER LEVELS PENETRATION (m/min) ELEV. VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED DESCRIPTION DIAMET POINT LI N. DEPTH DISCONTINUITY DATA INSTRUMENTATION R.O.D. (m) INDEX PER 0.3 TYPE AND SURFACE DESCRIPTION 9 9 9 8848 GROUND SURFACE 86.24 Possibly Silty Clay Native Backfill Possibly Glacial Till 10 Moderately weathered grey LIMESTONE BEDROCK with vertical mud seams 74.72 11.52 3 Fresh grey medium to fine crystaline LIMESTONE BEDROCK with occasion 5 Bentonite Seal 20 10 22 11 End of Borehole 24 26 GPJ GLDR 28 DEPTH SCALE LOGGED: W.C. Golder 1:150 CHECKED: J.F.B.

RECORD OF BOREHOLE: 04-203 PROJECT: 04-1120-021 SHEET 1 OF 1 DRILLING DATE: 2/13/2004 DATUM: Geodetic LOCATION: DRILL RIG: INCLINATION: -90° AZIMUTH: ---DRILLING CONTRACTOR: FR-FRACTURE F-FALET HTOOMS,M2 FL-FLEXURED BC-BROKEN CORE DRILLING RECORD CL-CLEAVAGE MB-MECH, BREAK UE-UNEVEN DEPTH SCALE METRES SYMBOLIC LOG 1-30IMT R-ROUGH SH-SHEAR P-POLISHED B-BEDDING TRAL LOAD (MPa) RUN No. NOTES ELEV. VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED WATER LEVELS DESCRIPTION POINT I HYDRAULIC CONDUCTIVITY k, cm/sec FRACT. INDEX PER 0,3 DEPTH RECOVERY DISCONTINUITY DATA INSTRUMENTATION (m) TOTAL SOLID TYPE AND SURFACE DESCRIPTION ... 0 5 0 હે હે હે હે GROUND SURFACE Possibly Silty Clay POWER AUGER Native Backfill Possibly Glacial Till Highly weathered LIMESTONE BEDROCK 2 Rotery NW cas 5 12 Fresh grey fine to medium crystaline LIMESTONE BEDROCK with occasional mud seam Bentonite Seal 10 Rolary Drill NQ Core 18 11 12 13 - 24 End of Borehole 28 DEPTH SCALE LOGGED: W.C.



CHECKED: J.F.B.

September 2004 04-1120-146

RECORD OF TEST PITS

Test Pit Number	Elevation	Description	
	0.00 0.05	TOROU	
TP 04-1	0.00 - 0.05 0.05 - 3.50	TOPSOIL Von stiff rod brown SH TV CL AV	
(Elev. 73.98)	0.05 – 5.50	Very stiff red brown SILTY CLAY (weathered crust)	
	3.50	End of test pit	
	3.50	No free water	
		Cu > 130 kPa throughout	
		Ü	
TP 04-2	0.00 - 0.05	TOPSOIL	
(Elev. 75.34)	0.05 - 3.80	Very stiff red brown SILTY CLAY	
		(weathered crust), trace gravel to 3.0 metres	
		End of test pit	
	3.80	No free water	
		Cu > 130 kPa throughout	
TP 04-3	0.00 - 0.08	TOPSOIL	
(Elev. 82.67)	0.08 - 2.40	Very stiff red brown SILTY CLAY, trace	
,		small cobbles, occasional grey silty sand	
		pockets (weathered crust)	
	2.40 - 3.45	Very stiff red brown silty clay (weathered	
		crust)	
	3.45	End of test pit	
		No free water	
		Cu > 130 kPa throughout	
TP 04-4	0.00 - 0.05	TOPSOIL	
(Elev. 84.58)	0.05 - 3.50		
,		occasional grey silty sand pockets, trace	Cu > 130 kPa throughout
		gravel (weathered crust)	
	3.50 - 3.90	Stiff red brown SILTY CLAY, occasional	Cu = 90 kPa @ 3.7 m
		grey silty sand seams (weathered crust)	Cu = 90 kPa @ 3.9 m
	3.90	End of test pit	•
		No free water	

RECORD OF TEST PITS (continued)

Test Pit			
Number	Elevation	<u>Description</u>	
TP. 04-5	0.00 - 0.30	TOPSOIL	
(Elev. 82.91)	0.30 - 3.50	Very stiff red brown SILTY CLAY,	
		occasional grey silty sand pockets below	
		3.3 metres (weathered crust)	•
	3.50	End of test pit	
		No free water	
		Cu = 120 kPa throughout	
TP 04-6	0.00 - 0.16	TOPSOIL	
(Elev. 85.80)	0.16 - 3.70	Very stiff to stiff red brown SILTY CLAY,	Cu > 130 kPa @ 2.1 m
(2010)		occasional grey silty sand pockets,	Cu = 110 kPA @ 2.4 m
		(weathered crust)	Cu = 100 kPa @ 2.8 m
			Cu = 86 kPa @ 3.1 m
			Cu = 110 kPa @3.4 m
	3.70 - 3.90	Stiff grey SILTY CLAY	Cu = 56 kPA @ 3.90 m
	3.90	End of test pit	
		No free water	