



# Terraprobe

Consulting Geotechnical & Environmental Engineering  
Construction Materials Inspection & Testing

**HYDROGEOLOGIC EVALUATION UPDATE  
PROPOSED RESIDENTIAL SUBDIVISION  
WEST HALF OF LOT 22, CONCESSION 1 (ALBION)  
PART 1, PLAN 43R-3575  
TOWN OF CALEDON, ONTARIO**

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## 1.0 INTRODUCTION

### 1.1 Study Scope and Purpose

Terraprobe Inc. was retained by 2031818 Ontario Limited c/o Lexis Bayview Developments, to conduct a hydrogeologic evaluation update for proposed Residential Subdivision. The proposed development is located on the east side of Airport Road approximately 600 m north of Old Church Road in the community of Caledon East, Ontario. The subject site is identified as Proposed Lexis-Bayview Caledon East Subdivision. The subject site is roughly rectangular parcel occupying a total area of about 188,453 m<sup>2</sup> (18.85ha). The site configuration is shown on the attached proposed site plan Figure 1.

The purpose of the hydrogeologic evaluation update was to provide an assessment of geology and hydrogeologic considerations for the proposed development of the property with a residential subdivision. Specifically, this report provides the following:

- An assessment of hydrogeologic constraints based on a review of applicable requirements and guidelines including local sub-watershed studies, the Oak Ridges Moraine Conservation Plan and the Oak Ridges Moraine Conservation Act. Based on this assessment, conceptual design of mitigation measure was developed to ensure compliance with the ORMCP.
- Identification of any sensitive hydrogeologic features such as zones of significant ground water recharge and discharge.
- An assessment of hydrogeologic features and functions of the site.
- Recommendations regarding potential impact on existing water wells in the area and requirements for a construction monitoring program.

### 1.2 Summary of Work Program

The work program for the study consisted of the following:

- Review of background information regarding site geology and hydrogeology. This included a review of Ministry of the Environment (MOE) well records, geologic and topographic mapping and results of previous studies and subsurface investigations which Terraprobe has conducted in the area. In addition, ground water studies conducted by Region of Peel were reviewed.
- Review of meteorological data. A review of meteorological data was conducted to assess local climate.
- Site inspection. A detailed visual inspection of the site and surrounding areas was conducted to determine local topography and drainage, and an assessment of potentially hydrogeologically significant features.

- Review of Previous Investigations. A review of previous hydrogeologic and geotechnical investigations conducted at the site by Terraprobe, to assess shallow and ground water conditions and pertinent site information.
- Assessment of Hydrogeologic Features. An assessment of the existing hydrogeologic features and functions such as zones of significant ground water recharge and discharge at the site was completed.
- Private Well Survey. Door-to-door survey to identify the location and nature of private water wells in the area. A door-to-door survey was conducted for residences and businesses located within 500 m of the proposed development. The purpose of the survey was to confirm the locations and depths of water wells in the area. Where permitted, water level measurements were obtained from each well.
- Assessment of hydrogeologic Features. An assessment of hydrogeologic constraints based on a review of applicable requirements and guidelines including local sub-watershed studies, the Oak Ridges Moraine Conservation Plan and the Oak Ridges Moraine Conservation Act.
- Assessment of potential impacts. An assessment of potential impacts to the shallow ground water system due to site development was completed. An assessment of appropriate mitigation measures to ensure that ground water function of the site is maintained following the development was completed.
- Engineering analysis. An analysis was completed to assess the potential impact of the development and underground servicing on local water quality and ground water levels.
- Water Balance. A water balance and assessment of infiltration rates for existing (pre-development) and post development conditions was conducted.

## **2.0 SITE AND PROJECT DESCRIPTION**

### **2.1 Site Location and Project Description**

The site is located on the east side of Airport Road approximately 600 m north of Old Church Road in the community of Caledon East, Ontario. The subject site is roughly rectangular parcel occupying a total area of about 188,453 m<sup>2</sup> (18.85ha). The proposed development consists of two areas identified as (The southwestern portion development area and the north east portion development area). The areas were located within the entire site.

The western portion of the site is comprised of open fields, generally covered with grasses and shrubs. A wooded area is located at the extreme west end, fronting Airport Road. The eastern portion of the property is covered by dense forest. Boyce's Creek transverses the width of the property, entering at the north middle portion of the property and exiting close to the southeast corner of the property. The valley lands associated with Boyce's Creek are densely wooded with variety of trees, grass and weeds etc. The Property is bounded by Airport Road to the southwest and by residential properties to the northeast, northwest, and southeast.

It is proposed to develop a section of the southwestern portion of the property as a residential subdivision, this development is identified as Southwest Development Area on Figure 2. In addition, the northeast section of the property is proposed for residential development and identified as Northeast Development Area on Figure 2. The development will be serviced with municipal water, sanitary and storm sewers. The extreme western portion, the woodlots and the areas around Boyce's Creek will not be developed and would be part of the undeveloped green space.

### **2.2 Regional Physiography**

From a regional perspective, the site is situated within the physiographic feature known as the Oak Ridges Moraine. The moraine forms a regional surface and ground water divide and is the highest point of land between Lake Ontario to the south and Lake Simcoe and Scugog to the north. The site is situated south of the height of land, on the southern slope of the moraine. The site is within the Humber River Watershed which extends to the southeast of the site all the way to Lake Ontario.

MOE well records for the area indicate sand and gravel aquifer beginning at a depth of approximately 8-30 m below the surface. The majority of water wells for this region are completed within this confined aquifer system. Municipal wells in the area are completed into a deeper aquifer system. The area is drained by several creeks which generally flow south toward Lake Ontario.

## **2.3 Site Topography and Drainage**

The site is characterized by moderately to gently rolling lands, which generally slope down to the south and west, towards the Boyce's Creek. An Ontario Base map from 1984, which was based on aerial photography from 1982, was reviewed. The map showed the elevation of the property range from approximately 323.5 m at the south central portion of the site to approximately 315 at the northeast corner, and about 310 m to the southwest corner of the site. The overall slope of the property is generally to the south and west, at a gradient of less than 15%.

There are localized areas of steep slopes, sloping down towards Boyce's Creek, along its banks, which enters at the north middle portion of the site and exits close to the southeast corner. Another localized area of steep slopes is located in the south central portion of the site.

The site is situated within the Upper Humber River watershed. Overall drainage at the site is towards the south, towards Centreville Creek, located approximately 950 m south of the property.

The principal drainage feature on the site is Boyce's Creek, which flows in a southerly direction, in a meandering, well defined channel. There are no other permanent water courses or significant drainage features on the site.

Boyce's Creek receives ground water discharge, or base flow. Based on discussions with Toronto and Region Conservation Authority (TRCA) and observation, this discharge originates from on-site and off-site sources. The on-site discharge consists of localized seepage from the shallow overburden materials at the site.

## **2.4 Surrounding Land Uses and Servicing**

The site is situated in a predominantly suburban/rural area. The surrounding lands to the northeast, northwest and southeast have been developed as residential properties. Airport Road borders the property to the west. The area west of Airport Road primarily consists of undeveloped wooded land.

## **2.5 Regional Geology**

The site is situated in the physiographic region known as the Oak Ridges Moraine. The Oak Ridges Moraine is an area of ground water recharge for intermediate and deep ground water systems. Based on published geological information for the general area, the near surface overburden soil in the Caledon East area consists of ice contact stratified drift, composed of sand and gravel with interlayered till, silt and clay. The total overburden soil thickness in the moraine is variable, the thickness of overburden ranges from 30 m to over 115 m. Ordovician-aged red Shale bedrock deposits of the Queenston Formation are found beneath the moraine.

Regional geologic conditions were assessed on the basis of geologic mapping of the Oak Ridges Moraine for the area, as shown on the appended Figures 6.

## 2.6 Regional Hydrogeology

The hydrogeology of the moraine is complex due to local variations in soil type, topography, and surface drainage throughout the moraine area. However, there are generally three distinct ground water flow systems associated with the moraine. The shallow flow systems are confined to the upper soil strata. These systems are typically confined or semi-confined, and the water table is generally encountered within several metres of the ground surface. These upper shallow flow systems are generally short, with localized ground water recharge and discharge occurring over a relatively short flow path. Therefore, these systems are relatively localized in nature; hence any impact to the systems is also localized.

The intermediate and deep ground water flow systems consist of fine sand or gravel aquifers that are found beneath the overlying layers of glacial till. These intermediate and deep ground water systems obtain ground water recharge over a much broader area than the shallow flow systems. The intermediate and deep flow systems extend over a great distance, and may form aquifer or water bearing zones that are extensive over several kilometres. The deep and intermediate systems typically discharge near the base of the moraine into the well developed creek valleys of the Humber, Don, and Rouge Rivers. The shallow upper flow systems typically extend for distances of several hundred metres or less and discharge into local topographic lows, including tributaries and swales.

The ground water flow systems in the moraine follow local and regional topography. The shallow flow systems are typically a subdued reflection of local topography, with recharge over higher areas of ground, and local discharge in water courses, valleys, swales or wetlands. The intermediate and deeper flow systems follow regional topography. Since there is a divide formed by the height of land, the deeper flow systems in the vicinity of the site are generally directed southeast following the regional slope of the land.

A major feature in the Caledon East area is a meltwater channel composed of sand and gravel, which traverses the area in an east to west direction. The channel is located beneath the present day valley of Centreville Creek which runs east-west in the vicinity of Old Church Road. Meltwater channels of this type were formed as a result of the runoff of vast quantities of water from retreating ice masses during glaciation. The channels were subsequently tilled with coarse glacial sediments, largely of sand and gravel. This channel is an important local aquifer from which one of the municipal wells for Caledon East (Well No. 2) obtains its ground water supply.

The locations of MOE wells located within one km of the site are shown on Figure 3 and the cross-section is shown on Figure 4. The MOE well records are appended.

From the cross-section, four major units were identified in the vicinity of the subject property. At the surface is a thin layer of sand and silt material, which is underlain by a thick confining layer of glacial till.

Thin and discontinuous pockets of sand and gravel are present throughout the till layer. The glacial till is underlain by a sand and gravel layer, which is in turn underlain by shale bedrock.

The surficial sand and silt layer pinches out south of the subject property as it approaches the valley feature. The glacial till layer also thins out in this area, and is underlain by thick sand and gravel layer, associated with the above mentioned meltwater channel. The sand gravel layer pinches out to the north in the vicinity of the subject property. This sandy layer is confined by the overlying glacial till.

The MOE water well records reveals that the majority of the wells in the Caledon East area are completed in overburden aquifers. Wells completed into the shale bedrock are also present, but less common. One artesian well was recorded. The artesian well was located approximately 200 m northwest of the subject property. The well is denoted as 35 on Figure 3.

The ground water within the surficial material at the subject property flows to the south to Centreville Creek, located in the valley feature. The artesian well located at the northwest of the subject property, is completed in a sandy pocket in the glacial till indicates an upward gradient through the glacial till layer.

## **2.7 Ground Water Resources**

The community of Caledon east is serviced with municipal ground water –based wells. The systems, which is owned and operated by Region of Peel consists of three wells and an in ground reservoir.

The three municipal wells are shown on Figure 3. Well No. 2 is located approximately 900 m south east of the site and is completed in fine sand at a depth of 31.4 m (103 ft). Well No. 3 is located approximately 800 m southeast of the site and is completed in overburden and extends to a depth of 48.2 m (158 ft). Well No. 4 is located approximately 1 km west of the site. It is complete in gravel at a depth of 56.7 m (186 ft).

Private individual wells are still used in the area. Piped municipal water is provided to the residences and business located within the limits of the Community of Caledon East.

The majority of wells are still used in the area are completed in sand and gravel layers within the overburden materials; however wells completed in the shale bedrock are also present. A meltwater channel composed of sand and gravel, acts as a major aquifer in the area. This channel is located in the vicinity of the Caledon East Well No.2 and traverses the area in an east to west direction.

Private well records on file with the Ministry of the Environment were reviewed for wells located in the study area. Records for wells situated within about 1,000 m of the site were reviewed to determine the nature of local ground water resources and water use. Information contained in these records provides data for determining the nature and use of local groundwater resources. Locations of those wells with available MOE records are shown on Figure 3. Cross sections were created using MOE well record data. Cross sections were plotted in Figure 4 to illustrate stratigraphy and water levels within the area. The

MOE well record data is presented in Appendix A. A summary of data obtained from these MOE records is presented in Table 2-1

**Table 2-1: Summary of Local Water Wells**

<b>Total Number of Wells</b>	<b>65</b>
Wells completed in Overburden	52 (80%)
Wells completed in Bedrock	13 (20%)
Unknown2	0 (0%)
<b>Depth Ranges</b>	
Less than 15 m	12 (18.5%)
15 m to 30 m	32 (49%)
30 m to 45 m	13 (20%)
Greater than 45 m	8 (12.5%)
<b>Water Use</b>	
Domestic	38 (58.5%)
Public Supply	7 (11%)
Commercial	2 (3%)
Stock	1 (1.5%)
Municipal	5 (8%)
Unknown or Dry	11 (18%)
<b>Water Quality</b>	
Fresh	41 (63%)
Saline	1 (1.5%)
Dry/ Unknown	23 (35.5%)
<b>Reported Pumping Rates</b>	
0 to 23 LPM (0 to 5 IGPM)	22 (34%)
23 to 45 LPM (5 to 10 IGPM)	5 (8%)
45 to 68 LPM (10 to 15 IGPM)	4 (6%)
68 to 91 LPM (15 to 20 IGPM)	1 (1.5%)
> 91 LPM (> 20 IGPM)	10 (15.5%)
Unknown or Dry	23 (35%)

The above summary indicates that most local wells registered in the area obtain their water supply from the overburden aquifer. The wells are generally small diameter drilled wells used for domestic purposes.

Well records indicate that almost all of the wells produce a fresh water supply. The depths of the wells ranged from about 15 to 45 m, and the static water levels in the wells ranged from approximately 1 to 50 m below ground levels.

One artesian well was recorded. The artesian well was located approximately 200 m northwest of the subject property. The well is denoted as 35 on Figure 3.

## **2.8 Results of Door to Door Survey**

A door-to-door survey was conducted to assess the locations of water wells in the vicinity of the proposed development. In addition to conducting this survey, Terraprobe staff contacted the Region of Peel and the Town of Caledon to confirm extends of municipal services (water supply). At the time of preparation of this report, the response from the region and Town of Caledon had not yet been received. The surrounding properties within a radius of 500 m were contacted by Terraprobe staff on May 29, 2013. During the survey, a questionnaire was completed with the well owner, where possible. At residences where no one was available to respond to the questionnaire, a letter was left informing the resident about the survey and encouraging the resident to contact our office. An example of the well questionnaire and letter provided to residents are provided in Appendix D.

The results of the door to door survey confirm that the surrounding properties were supplied with full municipal services for water and sewage.

There are about two hundred (200) private residences situated in the immediate vicinity of the property. A representative of Terraprobe visited each residence to obtain information regarding their well(s) and water supply. Only one of the 200 residents responded to the survey and confirmed full municipal services for water and sewage. The other residents did not respond to the survey.

In summary, the surrounding properties utilized municipal water supplied. There is no information available from the surrounding properties regarding the use of their private water wells.

## **2.9 Site Inspection to Assess Hydrogeologic Features**

A detailed site inspection was conducted to assess the presence of features which are significant from a hydrogeologic viewpoint. In particular, the site was inspected to assess the following:

- Areas of visible ground water discharge, springs or seepage at the site or in the vicinity of the on-site water courses.
- Areas of potential enhanced ground water recharge such as closed drainage features or depressions or large flat areas which may allow for significant ground water infiltration.
- Inspection of swales and drainage courses for evidence of ground water seepage or springs.



- Evidence of phreatophytic vegetation, which may indicate seasonally high ground water levels and/or ground water discharge and seepage.

The site is currently in its natural state. The majority of the site is occupied by woodlots and overgrown pasture land. There are several footpaths criss-crossing the property and barbed wire fence ran along the property boundary to the southwest. There is a permanent stream, Boyce's Creek, which is located in the eastern portion of the property and traverses the site in northeast to south east direction. There are no significant depressions or areas of enhanced infiltration visible. The site is generally drained by a series of broad drainage swales, which direct water to the south and toward the valley Boyce's Creek. Thick wooded areas are found along the western, north central, eastern, southeastern portions of the site and along the property limits. The valley lands associated with Boyce's Creek are densely wooded with variety of trees, grass and weeds etc. There was evidence of areas of phreatophytic vegetation this includes marsh and surface water pond area was noted in wetland located at the northeast portion of the site and east of Boyce's Creek.

## 2.10 Results of Previous Investigations

Terraprobe has previously completed hydrogeological in 2006 and geotechnical investigation in 2001 for the subject property. These reports included:

- Hydrogeologic Evaluation, Proposed Residential Subdivision, West Half of Lot 22, Concession 1 (Albion) Part 1, Plan 43R-3575, Town of Caledon, Ontario, dated June 2, 2006, prepared by Terraprobe Limited, File 1-05-0178.
- Geotechnical Investigation, Proposed Residential Subdivision, West Half of Lot 22, Concession 1 (Albion) Part 1, Plan 43R-3575, Town of Caledon, Ontario, dated March 23, 2001, prepared by Terraprobe Limited, File 01109.

The borehole logs are appended to this report. The borehole locations are presented on the accompanying Figure 5. Summary of previous investigations are presented below.

### 2.10.1 2001 Geotechnical Investigation (File No. 01109)

In 2001, Terraprobe completed a geotechnical investigation (File No. 01109, reported March 23, 2001) at the site. The investigation included ten boreholes advanced across the entire site and installation of six (6) nested monitoring well piezometers to assess the shallow subsurface conditions. The borehole findings and laboratory test results are provided in Appendix B.

The boreholes were completed to depths of approximately 5.0 to 8.1 m below grade. The piezometers were installed in selected boreholes to permit measurement of shallow ground water levels. Additional shallow boreholes (approximately 3.0m below existing grade) were advanced without soil sampling within metres of each of the boreholes 1 to 6 in order to facilitate piezometer installation. Borehole logs are appended to this report.

In summary, the subsurface soil conditions encountered in the boreholes across the site consisted of a surficial topsoil layer underlain by a stratum of disturb native soil, ranging from 0.8m to 1.5m in thickness. The disturbed native soil was in turn underlain by native soils which extended to the full depth of the investigation at every borehole location. The native soils consisted of alluvial deposits of silt to sandy silt or silty sand to sand with trace of clay. Glacial till, comprised of silty sand, was encountered underlain the alluvial soil deposits in Boreholes 7,9, and 10 at a depth of 2.3 m, 1.5 m and 4.6 m below existing grades respectively.

Water levels were measured in each of the boreholes immediately following the drilling operation and in each of the deep monitoring well piezometers approximately one week after drilling had been completed. No information about the water level measurement of the shallow peizometers. The water levels measured at the time of drilling and during visit are summarized below:.

**Table 2-2: Summary of Piezometers and Ground Water Levels (Terraprobe 2001)**

Borehole No.	Depth of borehole (mbgl)	Depth to cave (mbgl)	Unstabilized water level upon completion (mbgl)	Water Level in Well on January 29, 2001(mbgl)
				Depth
BH/Piezometer 1	8.1	7.0	2.1	1.2
BH 2	8.1	open	3.9	0.4
BH/Piezometer 3	8.1	open	1.2	0.1
BH/Piezometer4	7.9	4.2	3.6	5.0
BH/Piezometer5	8.1	3.0	2.1	2.3
BH/Piezometer6	8.1	open	3.0	2.8
BH 7	4.8	1.4	0.5	n/a
BH/Piezometer8	5.0	open	dry	dry
BH 9	4.7	open	dry	n/a
BH 10	4.7	2.4	dry	n/a

Note: mbgl = meter below ground level

n/a = piezometer not installed

## 2.10.2 2006 Hydrogeological Evaluation (File No. 1-05-0178)

Terraprobe completed a hydrogeological evaluation for the proposed subdivision (File No. 1-05-0178), reported June 2, 2006). The hydrogeological study was carried out based on the findings from the geotechnical investigation of 2001.

In summary, the hydrogeological evaluation concluded that:

- The site is situated within the Oak Ridges Moraine Conservation.

- Landform conservation techniques must be applied to the steeply sloping along the southwestern edge and in the north of the developments. These techniques will consist of maintaining existing site grades in these areas.
- The site is situated in an area of ground water recharge which contributes to the overall Hydrogeologic function of the Oak Ridges Moraine Area.
- Ground water recharge rates at the site can be maintained through simple mitigation measures including:
  - Direction of roof to overland flow or soakaway pits
  - Grading and filling at the site conducted with sandy material similar to those naturally occurring at the site.

## 2.11 Ground Water

Water levels were measured on March 27 and May 29, 2013 in all the existing monitoring wells piezometers installed as part of the previous investigation. Some of the monitoring wells piezometers from the previous investigations were not found during the site visit. The water levels measured in the remaining wells are summarized in the following table 2-3.

**Table 2-3: Summary of Piezometers and Ground Water Elevations (Terraprobe 2013)**

Borehole No.	Depth of borehole (mbgl)	March 27, 2013	May 29, 2013
		Water Level (mbgl)	
BH/Piezometer1S	2.94	1.24	0.45
BH/Piezometer1D	6.25	0.99	0.89
BH/Piezometer2S	Not Found		
BH/Piezometer2D			
BH/Piezometer3S			
BH/Piezometer3D			
BH/Piezometer4S	3.01	Blocked @ 0.1	dry
BH/Piezometer4D	6.82	4.62	4.35
BH/Piezometer5S	1.89	1.65	1.60
BH/Piezometer5D	5.94	1.76	1.57
BH/Piezometer6S	4.1	1.93	1.44
BH/Piezometer6D	5.97	Blocked @ 0.29	1.39
BH/Piezometer8S	Not Found		
BH/Piezometer8D			

It should be noted that field work consisting of borehole drilling and installation of monitoring wells peizometers was completed as part of 2001 geotechnical investigation. No additional boreholes or peizometers were completed as part of the current hydrogeological evaluation update. The boreholes from previous investigations were terminated at (5.0 to 8.1 m below grade). Historical data showing the ground water levels are provided in Table 2-2 above. The groundwater levels from the historical investigations are similar to the results from the recent investigation.

## **2.12 Review of Current Regulatory Requirements**

A review of current regulatory requirements in connection with the proposed development was conducted, including those of the Town of Caledon, the Oak Ridges Moraine Conservation Plan, the Toronto and Region Conservation Authority, relevant information is provided below:

### **2.12.1 The Town of Caledon**

The information contained in the Town of Caledon Official Plan indicates that the site is designated as “Policy Area 2”, as depicted in Figure 8. The Town specifies that the maximum permitted density in Policy Area 2 will be 31 units per 40.5 hectares (100 acres), plus any density bonuses awarded under Sections 7.1.9.12 and 7.1.11.3. The Official Plan (Land use Plan Schedule A and D) indicates that the western portion of the site is located within the special study area and the eastern portion is located within the Town of Caledon Environmental Policy Area. According to the Land Use Plan Schedule P the site is located within the Natural Core Area.

## **2.13 Review of Oak Ridges Moraine Conservation Plan**

The site falls within the Oak Ridges Moraine area. The Oak Ridges Moraine Conservation Plan was reviewed to assess considerations and requirements for site development, criteria such as

- Hydrologically- Sensitive Areas,
- Wellhead protection areas were reviewed
- Landform conservation,
- Aquifer vulnerability,
- Rapid Infiltration Basins and Columns
- Watershed Plans, Water budgets and conservation Plans.

A summary of the requirements of the Oak Ridges Moraine Conservation Plan is provided below.

### **2.13.1 Section 26 - Hydrologically Sensitive Features**

The Oak Ridges Moraine Conservation Plan indicates the following as hydrologically sensitive features:

- Permanent and intermittent streams
- Wetlands
- Kettle Lakes
- Seepage areas and springs

There are potentially hydrologically sensitive features found on or within 120 m of the site. There is a permanent stream, Boyce's Creek, situated on the property. Ground water seepage or springs is directly associated with Boyce's Creek. There are no kettle lakes on the site. The ORMCP requires that there will be no development or site alteration within a hydrologically- sensitive features or the vegetation protection zone. The minimum vegetation protection zone for these features is all land within 30 m of a meander belt for a permanent stream. Wetlands were also identified on the site by the Ministry of Natural Resources (MNR). Boyce's Creek and the associated wetland areas are part of regulated area and development within these areas is not permitted. It should be noted that proposed development is outside of the regulated areas and does not include Boyce's Creek and the associated wetland area. A further study, including a subsurface investigation and detailed feature based monitoring program will be required to determine the potential impact, if any, that the development may have on these features. Extent of proposed development is presented on the attached proposed development area Figure 2.

### **2.13.2 Section 28 - Well Head Protection Areas**

This section of the plan prohibits certain land uses and land management practices within well head protection areas. The prohibited uses are:

- Storage (except by an individual for personal or family use ) of:
  - Petroleum fuels
  - Petroleum solvents and chlorinated solvents,
  - Pesticides, herbicides, and fungicides,
  - Construction equipment,
  - Inorganic fertilizers,
  - Road salt
  - Contaminants listed in Schedule 3 of Regulation 347
- Generation and storage of hazardous waste or liquid industrial waste
- Waste disposal sites and facilities, organic soil conditioning sites, and snow storage and disposal facilities.

The proposed residential development will not involve any of the prohibited uses noted above.

Southern Portion of the site is located within the 25- year time of travel zone for Municipal Well 2 and 3 Caledon well fields as designated by the Town of Caledon (Figure 11). This is sufficient travel time to ensure that the proposed site (residential subdivision with full municipal services) will not affect these wells head protection areas.

### **2.13.3 Section 29 - Areas of High Aquifer Vulnerability**

The site is located in an area of high aquifer vulnerability. In areas of high aquifer vulnerability certain property uses are prohibited under the Oak Ridges Moraine Conservation Plan, such as the generation and

storage of hazardous waste or liquid industrial waste, waste disposal sites and facilities, organic soil conditioning sites, snow storage and disposal facilities, underground and above-ground storage tanks that are not equipped with an approved secondary containment device, and storage of a severely toxic contaminant (O.Reg.347) as noted in Section 2.13. 2 There will be no prohibited land uses or practices associated with the proposed residential subdivision. The areas of aquifer vulnerability are shown on Figure 10.

## **2.13.4 Section 30 - Land Form Conservation**

The assessment of the potential requirements for landform conservation requires a six step process. This process is outlined below.

### **Step 1- Applicability**

The subject site is located in a Category 2 Landform Conservation Area of the Oak Ridges Moraine Conservation Plan, as noted on Figure 8. On this basis, the guidelines suggest that it is necessary to proceed to Step 2.

### **Step 2- Determine Land Use Designation**

Step 2 requires the proponent to determine the land use designation on the subject property. As shown on the ORMCP Land Designation Map (Figure 9), the development lands are divided into two land use designations. The western portion of the site is designated as a settlement area and eastern portion of the site as designated as a natural linkage area. The proposed residential subdivision development will be on the western portion of the site, a private dwelling is proposed for the northeastern portion of the site.

### **Step 3- Determine Type of Application**

Step 3 of the development involves assessment of the scale or type of development. Based on the guidelines, the site is defined as a major development since it involves the creation of more than four lots for the proposed residential subdivision on the western portion of the site. On this basis, it is necessary to proceed to Step 4.

### **Step 4- Background Information**

Step 4 requires the collection of more detailed background information to provide further assessment of site and ANSI characteristics.

Elevation contours for the site were prepared at a scale of 1: 2000 at a contour interval of 1m, per the requirement of the guidelines. The contour plan is shown on Figure 14. The slopes were classified in the following categories;

- Less than 2 percent
- 2 to 5 percent
- 5 to 10 percent
- 10 to 15 percent

- 15 to 25 percent
- Greater than 25 percent

Detailed analysis indicated that areas of steeply sloping land are found in the south central portion of the property, and along the banks of Boyce's Creek; however, for the development portion of the site, steeply sloping land is found only along the southeastern edge and a portion in the northern section of this area, as shown in Figure 15.

Sloping ground is defined as slopes of greater than 15 percent gradient over a vertical height of 5 m and a continuous distance of 50 m.

Category 2 Landform Conservation Areas are areas with a slope of greater than 10 percent constituting between 20 and 50 percent of the land area. For the development portion, only a small portion (i.e. less than 20 percent) of the land has a slope of greater than 10 percent. Therefore, this area of the site does not fall in a Category 2 Landform Conservation Area.

It was determined that there were no significant landforms such as kames, kettles, or ridges found directly on the development site. One permanent stream, Boyce's Creek, is located on the subject property, but is not within the development lands. There are no other water bodies located on the property.

Based on the above analysis, the following conclusions are reached:

- The topographic characteristics of the site indicate that the development area does not fall in a Category 2 Landform Conservation Area.
- Only a small portion of the development area contains steeply sloping lands.
- There are no significant landform features such as kames, kettles, or ridges situated on the site.
- There is one permanent stream located on the subject property, but not within the development area.
- The development area is not situated within the boundary of an Earth Science ANSI.

The results of this analysis were then applied to assess appropriate site design characteristics subsequently in Step 5.

#### **Step 5- Identify Planning, Design, and Construction Standards and Targets**

Step 5 of the guideline requires the proponent to identify the basic limitations and opportunities with respect to design of the site. The specific design considerations required by the guideline are noted below:

- (i) *Identify policies of Section 30 of the ORMCP that apply to the application*

The landform analysis indicates that the development area of the site does not exhibit the characteristics of a Category 1 or Category 2 Landform Conservation Area, nor does it possess significant landforms. Based on this, the only applicable policy is Section 30(9), which requires a development strategy that identifies appropriate planning, design and construction practices to minimize disruption to landform character.

- (ii) *Identify the areas of the subject lands that are subject to the design standards specified in Sections 30(5) and (6) of the ORMCP.*

There are no portions of the development area that are subject to the design standard specified in Section 30(5) or (6) of the ORMCR, since the land is not classified as either Category 1 or Category 2 with respect to landform conservation.

- (iii) *Identify the area of the subject lands that will not be developed or altered due to:*

- *presence of key natural heritage features and hydrogeologically-sensitive features including vegetative protective zones*
- *presence of significant landform features including kames, kettles, ravines, and sloping lands,*
- *limitations passed by the connectivity requirements of Section 20 of the plan*

Development will only take place on the southwestern and north east portions of the property as shown on Figure 15. There will be no development east of the western banks of Boyce's Creek; hence there will be no alteration to the slopping banks of the creek or the creek itself. The sloping area in the south central portion of the property will not be developed or altered. No development or alteration will occur in the extreme western portion of the site, in the wooded area.

- (iv) *identify the areas of the subject land that may be developed subject to landform conservation techniques.*

The area designated as the development area, as shown on Figure 15, may be developed subject to landform conservation techniques. Landform conservation techniques may be required along the southeastern edge of the development area, and a small portion in the north of this area due to the steeply sloping land present.

There are no open corridors on the site that are required to be set aside.

- (vii) *Identify areas of the subject within an Earth Science ANSI where an earth science*



*evaluation must be prepared.*

None of the subject land falls within an Earth Science ANSI, therefore there is no requirement to prepare an earth science evaluation.

### **Step 6- Prepare Development Strategy/ Detailed Design**

Step 6 of the guideline requires a more detailed description of the planning design and construction practices that will be required to minimize disruption to landform character.

The development plans for the property have not yet been finalized. Once the plan is finalized, the proponent should provide a site plan which identifies:

- Final contours of the site at a map scale of 1:2000 or larger and final contours of at least 2 metre intervals;
- The final location of all roads, building and structures;
- Identification of the areas on the site where grading changes are proposed;
- Representative cross sections across the site showing before and after contours;
- A detailed description of all landform conservation techniques that will be employed during the planning, design and construction techniques will be applied only along the development areas. These techniques will consist of maintaining existing site grades in this area;
- Lands where disturbance to landform character is proposed including a breakdown by
  - Total area of disturbance; and
  - % of total developable area.

### **2.13.5 Section 47 – Rapid Infiltration Basins and Columns**

The plan prohibits the construction of rapid infiltration basins and columns in the Oak Ridges Moraine area.

Infiltration basins and columns are not proposed as part of the storm water management works. Therefore, this section of the plan is not applicable.

### **2.13.6 Watershed and Conservation Plans**

The above plans will be discussed in section 2.13.7 under the Toronto and Region Conservation Authority.

### **2.13.7 Toronto and Region Conservation Authority**

The site is located within the Main Humber River Sub watershed of the Humber River. The TRCA, Humber River State of the Watershed Report; Surface Water Quality (2008) indicated that the site is within the boundary of Centreville Creek secondary sub-watershed units. Centreville Creek is one of the main Humber River drainage areas. The headwater of this Creek originates from Niagara Escarpment from which it flows across the Oak Ridges Moraine down to the south slope into the Peel Plain. A permit from the TRCA will be required prior to site development.

A review of the *interim watershed Characterization Report of TRCA Watersheds of (2009)* indicates that the subject site is located within a Highly Vulnerable Aquifer (HVA) area as well as a Significant Groundwater Recharge Area (SGRA). The HVA and SGRA designation is based on the potential for high infiltration rates. The site is not located within any currently existing Wellhead Protection Areas or Intake Protection Zones, and is therefore not considered to be a vulnerable area for municipal drinking water supplies under the Clean Water Act.

### **2.13.8 Ontario Ministry of Natural Resources**

The Ontario Ministry of Natural Resources mapping of Natural Areas is shown on Figure 12. The Ontario Ministry of Natural Resources National Heritage Information Centre database for listings of Areas of Natural or Scientific Interest (ANSIs) was reviewed. According to the database, no ANSIs were listed within 500 m of the Property. However, wetlands were also identified on the site by the Ministry of Natural Resources (MNR). Under the Oak Ridges Moraine Conservation Act the minimum area of influence for an Earth Science ANSI is 50 m; therefore, planning, design and construction practices must ensure protection of ecological or geomorphological attributes for which the ANSI was identified as well as the determination of whether a minimum vegetation protection zone is required for the site.

### **2.13.9 Other Regulatory Authorities**

The property is not located within the Niagara Escarpment Plan Area or the Greenbelt Protection Area, but within Natural Heritage Area. This Natural Heritage Area includes a cold water stream (Boyce's Creek) that discharges into Centreville Creek.

## **2.14 Summary of Potential Hydrogeological Constraints to Site Development**

Based on a review of current regulatory requirements the (Oak Ridges Moraine Conservation Plan and other regulatories) there are few significant hydrogeologic constraints to the proposed site development that have been identified.

The results of the study indicate that the most significant hydrogeologic and hydrologic function at the site is ground water recharge. Therefore the main goal during design of any residential subdivision planned for the property should be to maintain the ground water recharge rates at the site.

The results of the investigation indicate that the water table is situated at depths of approximately 1 to 4 m below grade. A feature based water balance and monitoring program would be required in order to assess the potential impacts to the local natural feature in the vicinity of the site.

## 2.15 Regional Climate

The site is located in the climatic region of Southern Ontario known as the South Slopes Region. The following general climate data were obtained from Environment Canada publications and from the Environment Canada on-line database. This information presents Average climate data was taken for the period of 1960 to 1999.

Annual total precipitation	863mm
Mean annual water surplus (based on 100 mm soil storage)	313mm
Mean annual evapotranspiration	550mm

The climate is typical for Southern Ontario with rainfall exceeding evapotranspiration. It is noted that the above are average values which are representative in a regional context. There will be seasonal and annual variations in these values. However, the average values will govern long term ground water recharge rates. Therefore, average values are appropriate for the assessment of hydrogeologic conditions at the site.

## 2.16 Site Inspection to Assess Hydrogeologic Features

A detailed site inspection was conducted to assess the presence of features which are significant from a hydrogeologic viewpoint. In particular, the site was inspected to assess the following:

- Areas of visible ground water discharge, springs or seepage at the site or in the vicinity of the on-site water courses.
- Areas of potential enhanced ground water recharge such as closed drainage features or depressions or large flat areas which may allow for significant ground water infiltration.
- Inspection of swales and drainage courses for evidence of ground water seepage or springs.

- Evidence of phreatophytic vegetation, which may indicate seasonally high ground water levels and/or ground water discharge and seepage.

The inspection indicates the site is generally characterized by gently rolling topography. No significant areas of ground water recharge (such as depression or kettles) were identified on the subject property. A cold water stream (Boyce's Creek) transverses the north middle and southeast corner of the property. The principal drainage feature on the site is Boyce's Creek, which flows in a southward direction, in a meandering, well defined channel. Runoff and base flow at the property generally drains across the property by diffuse overland flow from the northern property boundary toward the south; into the Boyle's Creek. There are no other permanent water courses or significant drainage features on the site. There was evidence of areas of phreatophytic vegetation this includes marsh and surface water pond area was noted in wetland located at the northeast portion of the site and east of Boyce's Creek.

## **3.0 DISCUSSION AND ANALYSIS**

### **3.1 Proposed Development Plan**

The proposed development plan is presented on Figure 2. The proposed development will consist of residential subdivision at the western portion of the site and the private dwelling at the north east corner of the site. . The development will be serviced by internal roadways and full municipal services for water and sewage.

As noted Figure 2, the proposed development concept includes the following:

- The extreme western portion, the eastern portion of the site and the areas around Boyce's Creek will not be developed.
- The proposed development will incorporate low impact development (LID) measures with respect to storm water management.

### **3.2 Principal Hydrogeologic Features and Hydrogeologic Function**

Based on the data review, the site exhibits the following principal hydrogeologic features:

- The shallow soil conditions at the site are characterized by alluvial deposits consisting of sand and silt materials, underlain by sandy silt glacial till. These materials are of moderate to low hydraulic conductivity.
- The site is situated within the Oak Ridge Moraine area, both from a geologic perspective, and as defined by Provincial Policy Plan.
- There is a permanent stream, Boyce's Creek, which is located in the eastern portion of the property and transverses, the site in a northwest to southeast direction. The creek receives ground water discharge.
- There are several confined aquifer systems found at depth, on or in the vicinity of the site. These systems provide water supply to both individual and municipal wells.

On the basis of the above features, it is considered that the most important Hydrogeologic function of the site is to provide ground water recharge. This recharge primarily provides local base flow to Boyce's Creek.

### **3.3 Water Balance for Pre- and Post- Development**

As noted in the hydrogeological evaluation report prepared by Terraprobe, the near surface soils at the site generally consist of a silt and sand matrix. The surface soils at the site provide medium to low volume of ground water recharge into the shallow ground water system.

While the area of the site is considered a ground water recharge zone; the soils at the site are generally of Moderate to low permeability and will not provide significantly large recharge rates. Notwithstanding this, the primary hydrogeologic function of the site is as a ground water recharge area.

A water balance model was prepared for the site to assess the distribution of rainfall, run-off and infiltration for existing (pre- and post- development) conditions. The model is based on the climate data presented in Section 2.15 of this report. The Thornthwaite method was used to evaluate the relative balance between rainfall, evaporation and evapotranspiration in the shallow soil zone as shown in Appendix C. Based on this calculation, water balance was developed.

The site statistics were based upon the details as provided by VA3 Design for 2031818 Ontario Inc. A copy of the site plan is attached as Figure 2. The following summarizes the site statistics for the property:

**Proposed Development (Southwest Portion -Town Homes)**

- Residential roof area – 4,792 m<sup>2</sup>
- Pavement areas (roads, driveways) – 1,890 m<sup>2</sup>
- Proposed Pervious Driveway area (assuming 70% permeability) – 1,432 m<sup>2</sup>

**Proposed Development (Northeast Portion –Single Residential Models)**

- Residential roof area (house coverage and deck) – 477.64 m<sup>2</sup>
- Proposed Pervious Driveway area (assuming 70% permeability) – 458.79 m<sup>2</sup>

**Other Areas within the Site**

- Access roadways area outside the development area is 2,080 m<sup>2</sup>
- Total open space/ landscape areas – 177,322 m<sup>2</sup>

Total site coverage is approximately **188,453 m<sup>2</sup>**

In summary, the total annual ground water recharge component for the area is about 188 mm/a. This recharge was determined using the MOE Table 2 and Table 3 approach in the *MOE Hydrogeological Technical Information Requirements for Land Development Applications (1995)*. The remaining water surplus, which is approximately 125 mm, will be directed to runoff. Using this water balance, the infiltration volumes over the site were calculated. These calculations are based on a total site area of 188,453 m<sup>2</sup>, and total impervious lot coverage of approximately 5.2% (2.8% roof coverage and 2.4% hard/ impervious coverage) as per the information provided by VA3 Design. A copy of the site plan is attached as Figure 2.

The detailed water balance calculations are presented in the accompanying Appendix C. The water balance (pre- and post-development) is summarized below:

### 3.4 Pre-Development Condition

**Table 3-1 Pre- Development Water Balance**

Condition	Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-Off (m <sup>3</sup> )
Vacant Land	188,453	162,635	103,649	35,429	23,557

### 3.5 Post-Development Condition

A water balance was conducted for the post-development conditions, using the site development plan provided on Figure 2. The post-development water balance accounts for hard-surfaced areas created by buildings, sidewalks, and pavements.

The following assumptions were applied for the post-development water balance

- There will be no infiltration beneath hard- surface areas including, buildings, pavements, and sidewalks.
- It is assumed that the entire road allowance consists of hard-surface areas (e.g., infiltration within grassed boulevards is not included).
- Infiltration rates in open areas of the site (lawns, landscaped areas and parks) will occur at rates similar to those for pre-development conditions.
- There will be no evapotranspiration beneath hard- surfaced areas.
- Runoff from residential housing units will be available for infiltration over lawn areas.

The water balance (pre- and post-development) is summarized below:

The water balance calculations for the post-development case are provided in the appendix C. The results of the analysis are summarized in Table 3-2 below:

**Table 3-2 Post- Development Water Balance**

Condition	Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-Off (m <sup>3</sup> )
Open Area	177,322	153,029	97,527	33,337	22,165
Hard Surfaces	4,537	3,916	nil	nil	3,916
Pervious Surface	1,324	1,142	728	249	165
Building Roofs	5,270	4,548	nil	nil	4,548

In the post-development case, there is a significant decrease in evapotranspiration and increase in available surface water run-off.

The volume of surface water run-off available from residential roof tops was calculated as noted in Appendix C. This volume of water will be available as a resource, to maintain ground water recharge and function at the site. The volume of roof run-off available is compared to the difference in infiltration between pre-development and post-development, as noted in Table 3-3 below:

**Table 3-3 Roof runoff Infiltration Deficit and Volume of Available Roof Run-off**

	Potential Post-Development Infiltration Deficit (m <sup>3</sup> )	Volume of Roof Run-off Available (m <sup>3</sup> )
Proposed Development Site	1,844	4,548

As noted, the volume of roof runoff exceeds the infiltration deficit. This confirms that, with proper storm water management and mitigation measures, the overall infiltration rates at the site can be maintained.

The proposed development of the site would have the following effect:

- A net increase in runoff at the site from 23,557 m<sup>3</sup> to 30,794 m<sup>3</sup>.
- A net decrease in evapotranspiration from 103,649 to 98,255 m<sup>3</sup>/a.
- A net decrease in the infiltration at the site from 35,429 m<sup>3</sup> to 33,585 m<sup>3</sup> /a.
- The deficit of 1,844 m<sup>3</sup>/a. in post development infiltration volume can be matched by using 41% of roof runoff available in the post development conditions. In addition, post development infiltration volume could be enhanced by implementation of any of the mitigation measures which are discussed below.

Given the medium to low permeability soils found at the surface, and the resulting recharge rates at the site, the most practical method for maintaining a water balance at the site would be through the implementation of various passive, low-impact development (LID) techniques. It is recommended that these systems be implemented at the site on a best management practice approach, where feasible. Further information regarding potential LIDs at the site is provided below.

### 3.6 Low Impact Development Techniques

As noted above, the site is considered to be significant in terms of ground water recharge. This is due to the medium to low permeability soils encountered at the surface of the site. As such, low impact development techniques are recommended to be considered and implemented using a best management practice approach. The TRCA normally requires retaining storage on site for the first 5 mm of rainfall.

In order to enhance ground water recharge at the site, any of the following LID measures may be implemented:

- Use of extra topsoil in open space areas and backyards.



- Infiltration measures within the green space and buffer located at the rear of the property.
- Directing roof leaders to overland flow.
- The use of permeable surface cover such as permeable pavers.
- Reducing lot grades to maximize contact time of run-off and maximize infiltration.
- Rain water harvesting and cisterns.

Generally, lot level controls, such as those noted above, will be suitable for all areas of the site to maintain ground water infiltration. Lot level controls generally provide for infiltration over broad areas, which more closely duplicate the infiltration conditions at the site, prior to development.

The storm water management measures must specifically address the maintenance of ground water recharge of the proposed development in order to preserve the Boyce's Creek function at and beyond the proposed development.

Further details regarding these measures can be found within the Low Impact Development Storm Water Management Planning and Design Guide prepared by the Toronto and Region Conservation Authority.

### **3.7 Site Design Measures to Preserve Ground Water Conditions**

Notwithstanding the moderate to low permeability soils encountered across the majority of the site, the primary hydrogeologic goal at the site is the maintenance of recharge rates. Therefore, the primary design considerations will be:

- Maintenance of ground water recharges rates. The recharge should occur over a broad or diffuse area, where practical, to match existing conditions
- Maintenance of the overall continuity of the surface drainage and ground water flow at the site.

Each of these issues is addressed separately below.

#### **3.7.1 Maintenance of Ground Water Recharge Rates**

On-site features, specifically Boyce's Creek and the associated wetlands relies on ground water input. The existing ground water recharge rates at the site are approximately 188 mm/a. These recharge rates are based on the site-specific conditions. This recharge occurs in a broad or diffuse manner over the entire site. Within the proposed development area, there are no significant local depressions or zones of enhanced recharge. Provided the overall recharge volume at the site is maintained, the hydrogeologic function on the site will be preserved. There are no specific on-site features (such as spring or wetlands) that are supported by ground water discharge.

Stormwater and Flood Plain Management Report indicating the implementation of Low Impact Development (LID) practices should be prepare to for the subject site.

As noted in the water balance calculation, the implementation of LID measures of the property will result in a surplus of infiltration in the post development case.

### **3.7.2 Maintenance of the Overall Continuity of the Ground Water and Base Flow at the Site**

It will be necessary to ensure that shallow ground water flow is maintained to prevent reduction of base flow to water courses. Generally, shallow ground water is directed through the sand and silty sand deposits. Property servicing activity should be conducted in a fashion to ensure that the ground water flow is not disrupted over the long-term. This will include application of the following mitigating measures:

- Use of native backfill materials at the property. In particular, excavations should be backfilled with native sand and silt materials to ensure continuity of ground water flow across excavations.
- Use of trench plugs to prevent drainage of shallow ground water. Trench plugs should be installed to prevent drainage of shallow ground water along granular bedding for services and long-term lowering of ground water levels.
- Use of appropriate materials for property grading purposes. Property grading should be conducted using materials of like or higher hydraulic conductivity than the materials found at the property. Property material should not be capped with lower permeability materials which would serve to reduce ground water recharge rates.

### **3.8 Site Design Measures to Preserve Ground Water Conditions**

It will be necessary to ensure that the ground water levels at the site are not lowered as a result of drainage which may occur along bedding for underground services. Similarly, it will be necessary to ensure that the lateral ground water flow through the sandy deposits is not truncated, in the event that excavations or site grading occurs in these deposits.

The site grading measures and installation of underground services should consider the following:

- The excavation of underground services across sand layers may interrupt ground water flow. Trench backfilling operations should be carried out with materials that are similar to the materials that have been excavated. In particular, sand zones must not be truncated by backfilling of the trench using lower permeability materials.
- All underground services should be provided with cutoff plugs at manhole locations. Care should be taken to seal all pipe joints and manhole structures. This is required to prevent ground water flow and drainage along granular bedding for the services, and infiltration into underground services.
- The overall volume and duration of surface water flow to sensitive features, such as the valley lands west of the proposed development should be considered. Site grading measures should ensure that surface water flows to these features are maintained.

## 4.0 REQUIREMENT FOR FURTHER STUDY

There is sufficient information available to assess the potential hydrogeologic impacts of the proposed development. Appropriate mitigating measures are available to ensure that the impacts are maintained at acceptable levels.

Additional study will be required prior to detailed design. The additional study will include the following:

- Drilling of boreholes to assess the shallow and deep soil conditions including the vertical and horizontal extent of potential ground water bearing zones throughout the site.
- Detailed feature based water balance to assess the impact of the development on the wetland and Boyce's Creek located within the subject property.
- Installation of monitoring wells to assess groundwater levels and groundwater flow directions and gradients.
- Design of engineered measures to maintain ground water infiltration

## 5.0 SUMMARY AND CONCLUSIONS

In summary, the results of the site investigations indicate that it is feasible to develop the subject residential community without creating ground water related impacts. The following specific summary and conclusions are made summary and conclusions are provided.

1. The results of a previous subsurface investigation conducted at the property indicate that the property is underlain by highly variable soils, comprising of sand silt soils matrix. The soils are typically of moderate to low permeability. The groundwater table was identified at approximately 0.1 to 4.35 m below grade
2. A review of the MOE water well records indicates that the majority of existing wells are completed within the bedrock. The majority of the wells are drilled for domestic purposes.
3. The property is situated in a hydrogeological- sensitive area, based on the review of various regulatory guidelines and published information. These designations are based on the potential for high infiltration rates (i.e. presence of permeable surface soils). However, the property is not located within any currently existing Wellhead Protection Areas or Intake Protection Zones, and is therefore not considered to be a vulnerable area for municipal drinking water supplies under the Clean Water Act.
4. The primary hydrogeologic functions which must be maintained at the site include:
  - Maintenance of ground water recharge across the site including the base flow input to Boyce's creek.
  - Maintaining surface drainage to on-site natural features including woodlots and wetland.
  - Preservation of the pathways or zones of ground water transmission
5. Infiltration rates at the site can be maintained through the use of a variety of low impact development techniques. These include:
  - Lot grading.
  - Increased topsoil thickness.
  - Direction of roof leaders to overland flow
  - Bio-retention swales.
  - Permeable pavers.

## 6.0 RECOMMENDATIONS

The results of the current study confirm that the hydrogeologic function of the site can be maintained, provided proper mitigation measures and Low Impact Development techniques are applied. There are well established techniques which have been demonstrated on similar projects in Ontario which can be applied to the site.

As part of final design of the development, it will be necessary to confirm the water balance based on the final design. The infiltration measures must be designed to maintain ground water levels and ground water flow volumes to the natural features located to the west of the development area.

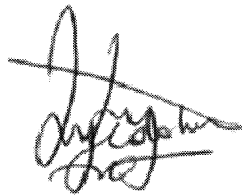
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We trust that the above-noted information is suitable for your review. If you have any questions regarding this information, please do not hesitate to contact the undersigned.

Yours truly,

**Terraprobe Inc.**



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Associate

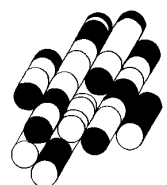


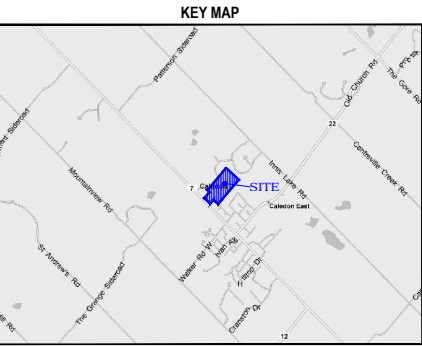
## 7.0 REFERENCES

1. Russel, H.A.J., Moore, A., Logan, C., Kenny, F., Brennand, T.A., Sharpe, D.R., and Barnett, P.J. 1998: Sediment Thickness of the Greater Toronto and Oak Ridges Moraine Areas, Southern Ontario; Geological Survey of Canada, Open File 2892, Scale 1:200,000.
2. Surficial Geology of the Greater Toronto and Oak Ridges Moraine Area, Southern Ontario. Ministry of Northern Development and Mines, Ontario, 1997.
3. Barnett, P.J., Cowan, W.R. and Henry, A.P. 1991: Quaternary Geology of Ontario, Southern Sheet; Ontario Geological Survey Map 2544, scale 1:1,000,000.
4. Ontario Geological Survey 1991: Bedrock Geology of Southern Ontario, Southern Sheet; Ontario Geological Survey Map 2556, scale 1:1,000,000.
5. Terraprobe Inc. “*Hydrogeologic Evaluation, Proposed Residential Subdivision, West Half of Lot 22, Concession 1 (Albion) Part 1, Plan 43R – 3575, Town of Caledon, Ontario,*”(Terraprobe Project No. 1-05-0178; dated June 2, 2006).
6. Terraprobe Inc. “*Geotechnical Investigation*” *Proposed Residential Subdivision, West Half of Lot 22, Concession 1 (Albion) Part 1, Plan 43R – 3575, Town of Caledon, Ontario.*” (Terraprobe Project No. 1-05-0178; dated March 23, 2001)

# FIGURES

**TERRAPROBE INC.**






REFERENCE:  
Microsoft Streets & Trips 2011

NOTES:

LEGEND:

 Site Location

PROJECT TITLE:  
Hydrogeological Investigation

SITE LOCATION:  
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

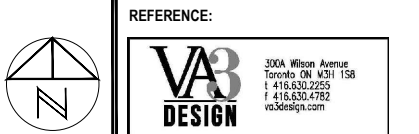
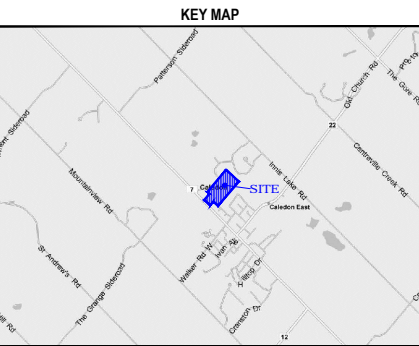
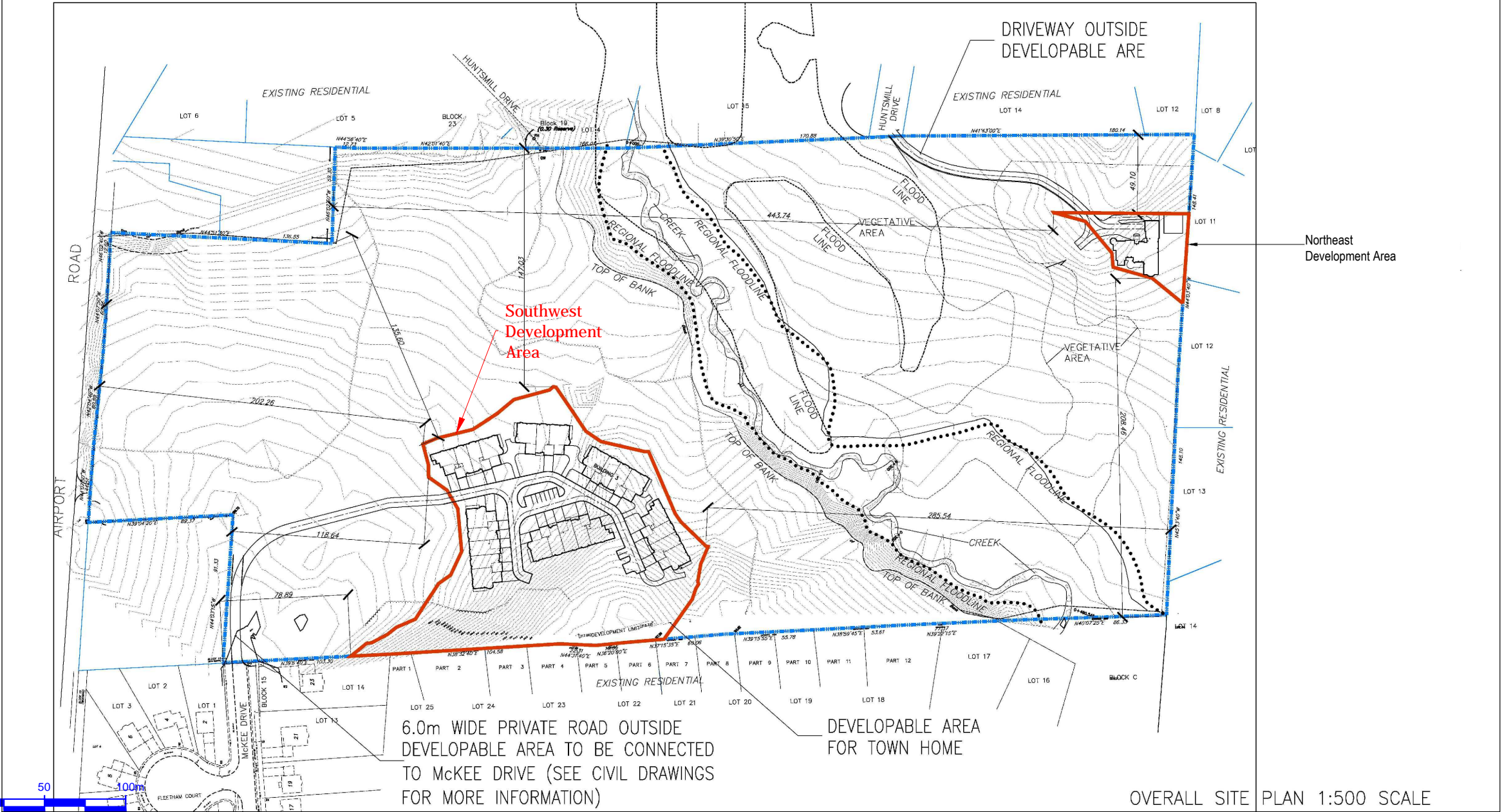
FIGURE TITLE:  
SITE LOCATION PLAN

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 1
DATE: October 2013	

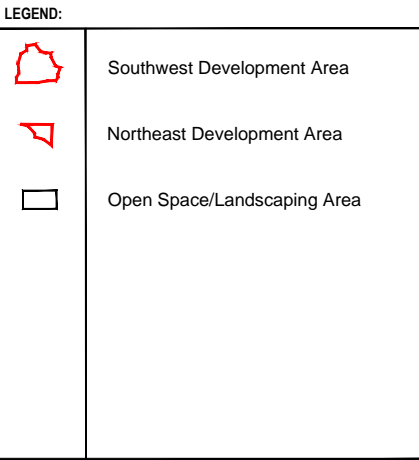


BUILDING 1					BUILDING 2					BUILDING 3				
LOT No.	Model Type	Coverage (sq.m.)	GFA (sq.m.)		LOT No.	Model Type	Coverage (sq.m.)	GFA (sq.m.)		LOT No.	Model Type	Coverage (sq.m.)	GFA (sq.m.)	
1	R1	177.98	274.21		5	R4MOD	214.83	272.55		8	R4	211.38	269.72	
2	R2	180.96	277.62		6	R2	180.96	277.62		9	R2	180.96	277.62	
3	R2	180.96	277.62		7	R4	211.38	269.72		10	R2	180.96	277.62	
4	R4	211.38	269.72							11	R4	211.38	269.72	
TOTAL		751.28	1,099.17		TOTAL		607.17	819.89		TOTAL		784.68	1,094.69	
BUILDING 4					BUILDING 5					BUILDING 6				
LOT No.	Model Type	Coverage (sq.m.)	GFA (sq.m.)		LOT No.	Model Type	Coverage (sq.m.)	GFA (sq.m.)		LOT No.	Model Type	Coverage (sq.m.)	GFA (sq.m.)	
12	R1	177.98	274.21		16	R1	177.98	274.21		21	R4	211.38	269.72	
13	R2	180.96	277.62		17	R2	180.96	277.62		22	R2	180.96	277.62	
14	R2	180.96	277.62		18	R3	180.56	273.53		23	R3	180.56	273.53	
15	R4	211.38	269.72		19	R2	180.96	277.62		24	R2	180.96	277.62	
TOTAL		751.28	1,099.17		TOTAL		931.84	1,372.70		TOTAL		965.24	1,368.21	

Caledon East EIS Pt W1/2 Lot 22, Con. 1 Town of Caledon	Caledon East EIS Pt W1/2 Lot 22, Con. 1 Town of Caledon	Caledon East EIS Pt W1/2 Lot 22, Con. 1 Town of Caledon
ZONING: RE ESTATE RESIDENTIAL	ZONING: RE ESTATE RESIDENTIAL	ZONING: RE ESTATE RESIDENTIAL
SITE STATS FOR TOWN HOMES ONLY	SITE STATS FOR SINGLE RESIDENTIAL ONLY	SITE STATS FOR SINGLE RESIDENTIAL AND TOWN HOMES
TOTAL LOT AREA= 188,453.14m2 PRIVATE ROAD AREA OUTSIDE DEVELOPABLE AREA= 1,196.43m2 (0.64%)	TOTAL LOT AREA= 188,453.14m2 PRIVATE ROAD AREA OUTSIDE DEVELOPABLE AREA= 883.64m2 (0.47%)	TOTAL LOT AREA= 188,453.14m2 PRIVATE ROAD AREA OUTSIDE DEVELOPABLE AREA= 2,080.07m2 (1.10%)
DEVELOPABLE AREA= 20,606.08m2 ALLOWABLE IMPERVIOUS AREA= 10,303.04m2 (50% OF DEVELOPABLE AREA)	DEVELOPABLE AREA= 2,196.65m2 ALLOWABLE IMPERVIOUS AREA= 1,098.33m2 (50% OF DEVELOPABLE AREA)	DEVELOPABLE AREA= 22,802.73m2 ALLOWABLE IMPERVIOUS AREA= 11,401.37m2 (50% OF DEVELOPABLE AREA)
PROPOSED IMPERVIOUS AREA= 8,113.18m2 (IMPERVIOUS AREA INCLUDES TOWN HOUSE COVERAGE, PRIVATE ROAD/PARKING AND DRIVEWAY)	PROPOSED IMPERVIOUS AREA= 477.64m2 (IMPERVIOUS AREA INCLUDES HOUSE COVERAGE AND DECK AREA)	PROPOSED IMPERVIOUS AREA= 8,590.82m2
TOTAL TOWN HOUSE COVERAGE= 4,791.48m2 PRIVATE ROAD/PARKING AREA= 1,890.15m2 PROPOSED PERVIOUS DRIVEWAY AREA= 1,431.55m2	HOUSE COVERAGE= 434.84m2 DECK AREA= 42.80m2 PROPOSED PERVIOUS DRIVEWAY AREA= 458.79m2	TOTAL COVERAGE= 5,269.12m2 PRIVATE ROAD AREA= 1,890.15m2 TOTAL DRIVEWAY AREA= 1,890.34m2
COVERAGE OF TOTAL LOT AREA= 4,791.48m2 (2.54%) (INCLUDES PORCH)	COVERAGE OF TOTAL LOT AREA= 477.64m2 (0.25%) (INCLUDES TOTAL HOUSE/DECK/PORCH COVERAGE)	COVERAGE OF TOTAL LOT AREA= 5,269.12m2 (2.80%)
GROSS FLOOR AREA= 6,853.83m2	GROSS FLOOR AREA= 1,109.35m2	GROSS FLOOR AREA= 7,963.18m2
MAXIMUM HEIGHT= 10.43m	MAXIMUM HEIGHT= 10.43m	MAXIMUM HEIGHT= 10.43m



NOTES:



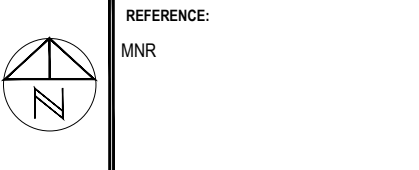
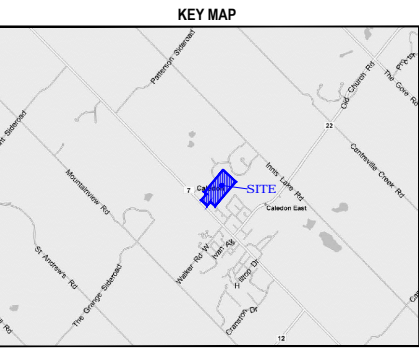
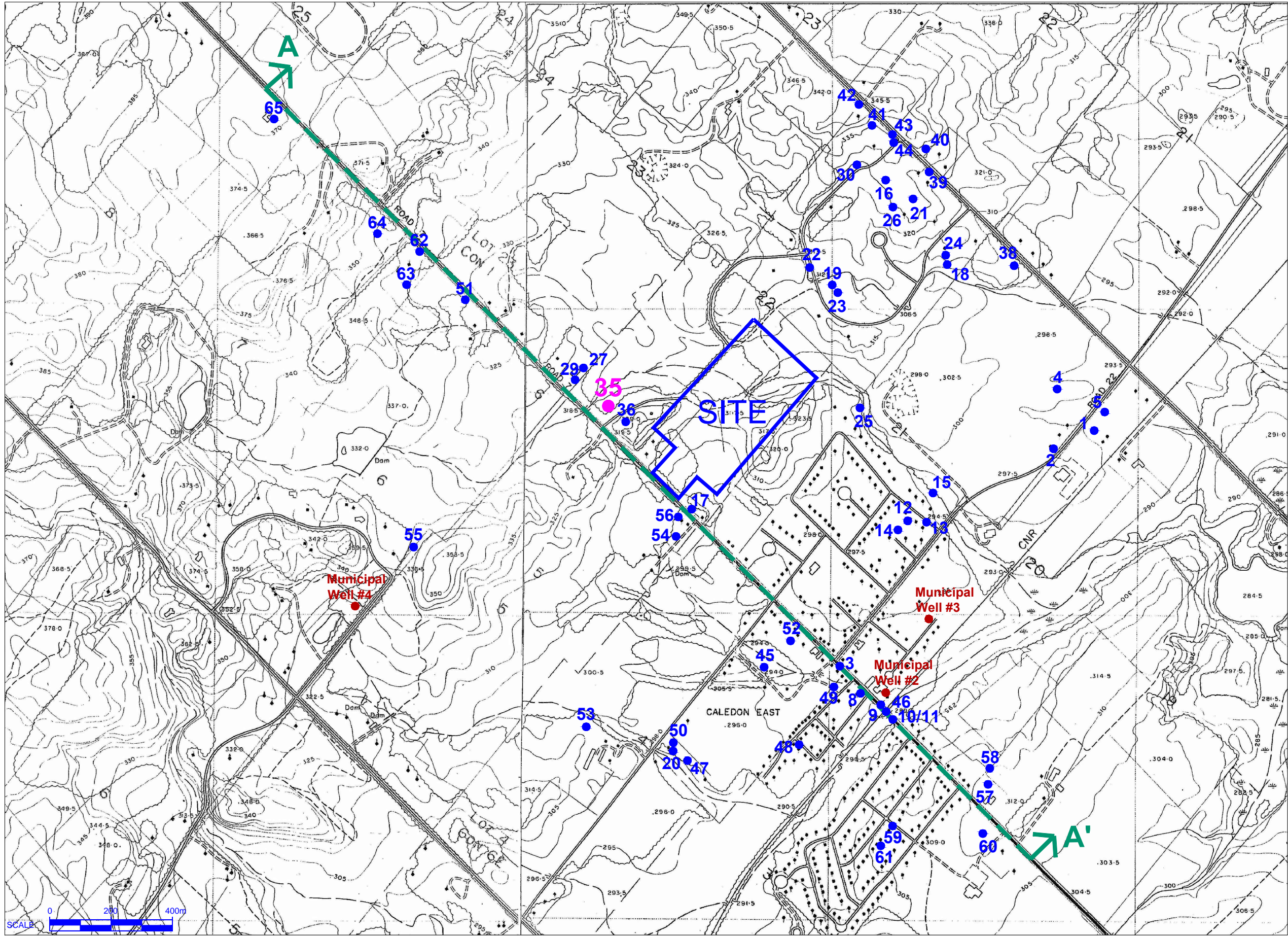
PROJECT TITLE:  
Hydrogeological Investigation

SITE LOCATION:  
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

FIGURE TITLE:  
PROPOSED SITE PLAN

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 2
DATE: October 2013	





NOTES:

- LEGEND:
- Water Well Location
  - Municipal Well Location
  - Artesian Well Location
  - Section Location

PROJECT TITLE:

Hydrogeological Investigation

SITE LOCATION:

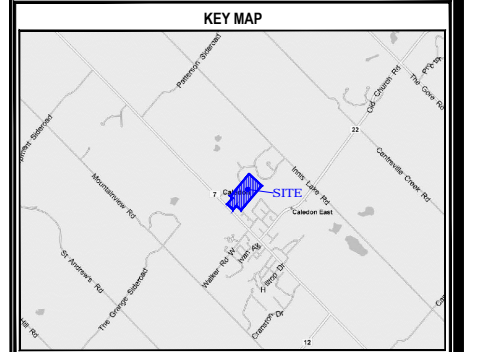
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

FIGURE TITLE:

MOE WELL LOCATION PLAN

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 3
DATE: October 2013	





REFERENCE:  
 Well Records  
 Ministry of Environment

NOTES:

LEGEND:	
	SAND AND GRAVEL DEPOSITS
	GLACIAL TILL
	SHALE BEDROCK
	STATIC WATER LEVEL
	WATER FOUND

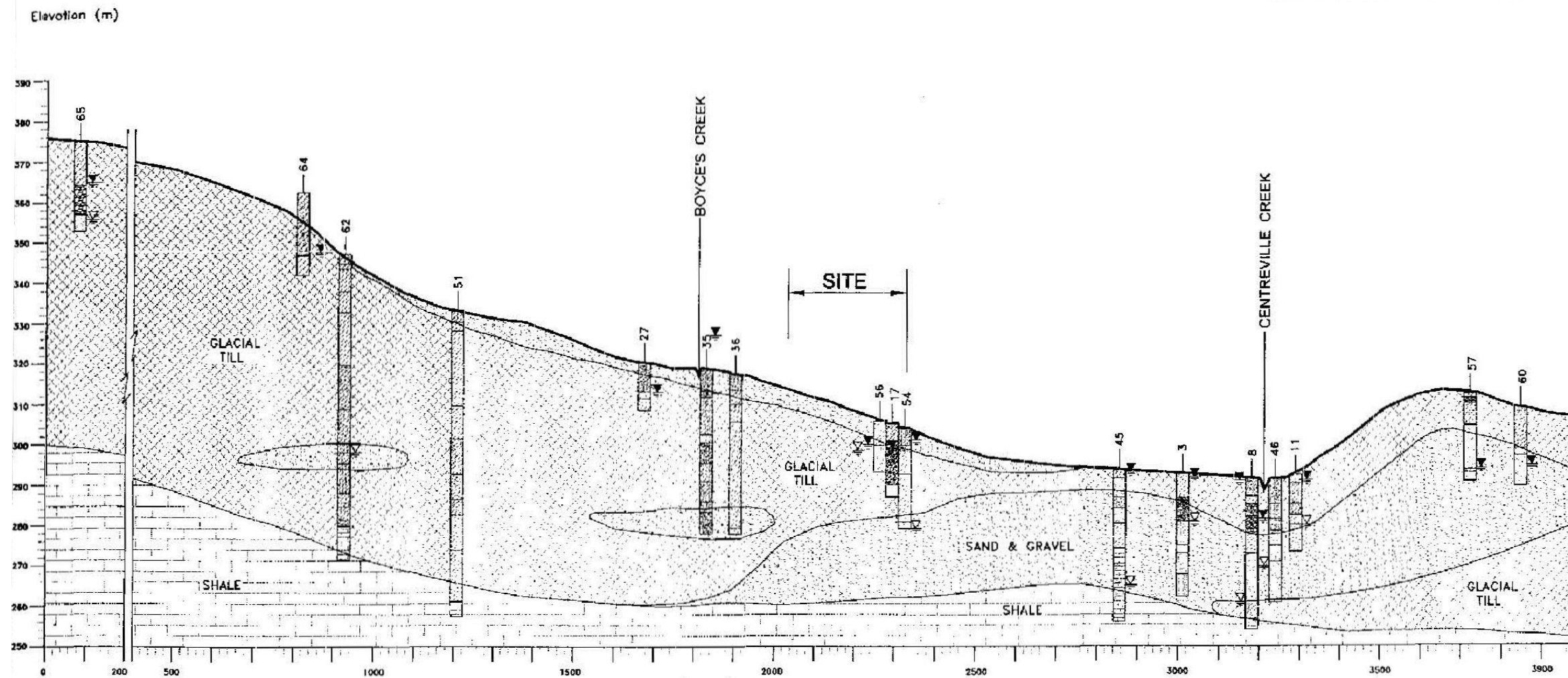
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 Hydrogeological Investigation

SITE LOCATION:  
 Lexis-Bayview Caledon East Subdivision,  
 Caledon, Ontario

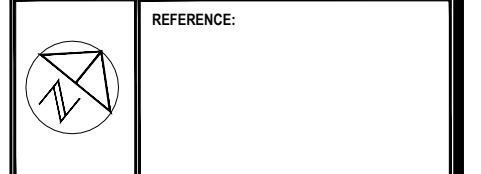
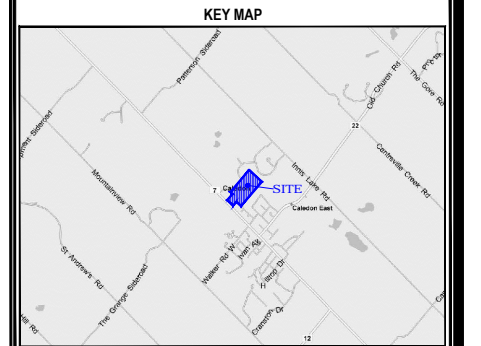
FIGURE TITLE:  
 CROSS SECTION A-A'

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 4
DATE: October 2013	

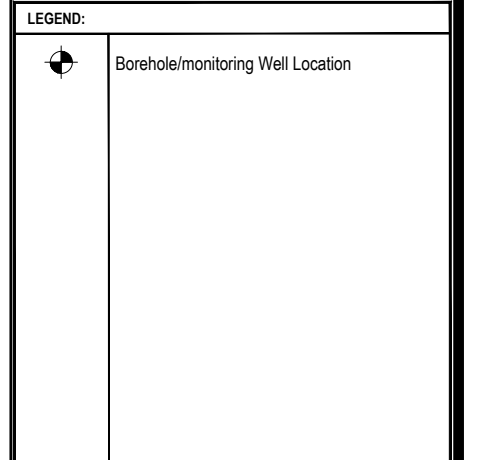
## SECTION A - A'







NOTES:



PROJECT TITLE:

Hydrogeological Investigation

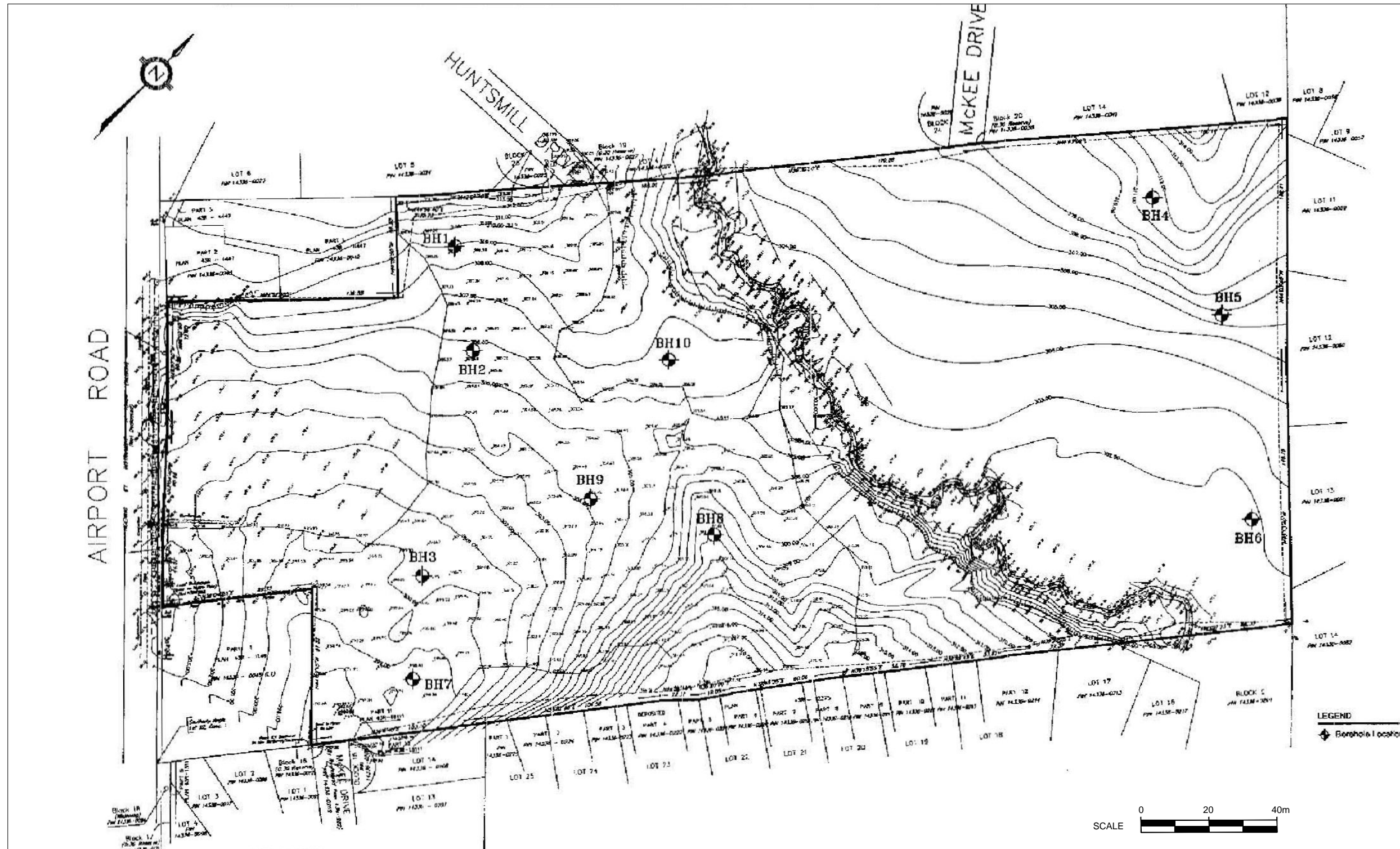
SITE LOCATION:

Lexis-Bayview Caledon East Subdivision,  
 Caledon, Ontario

FIGURE TITLE:

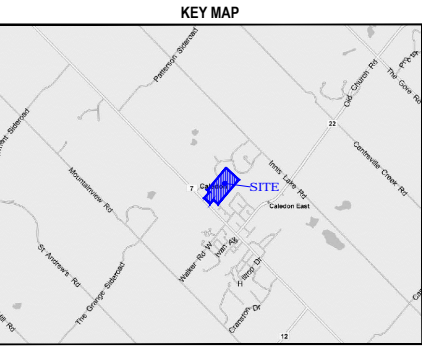
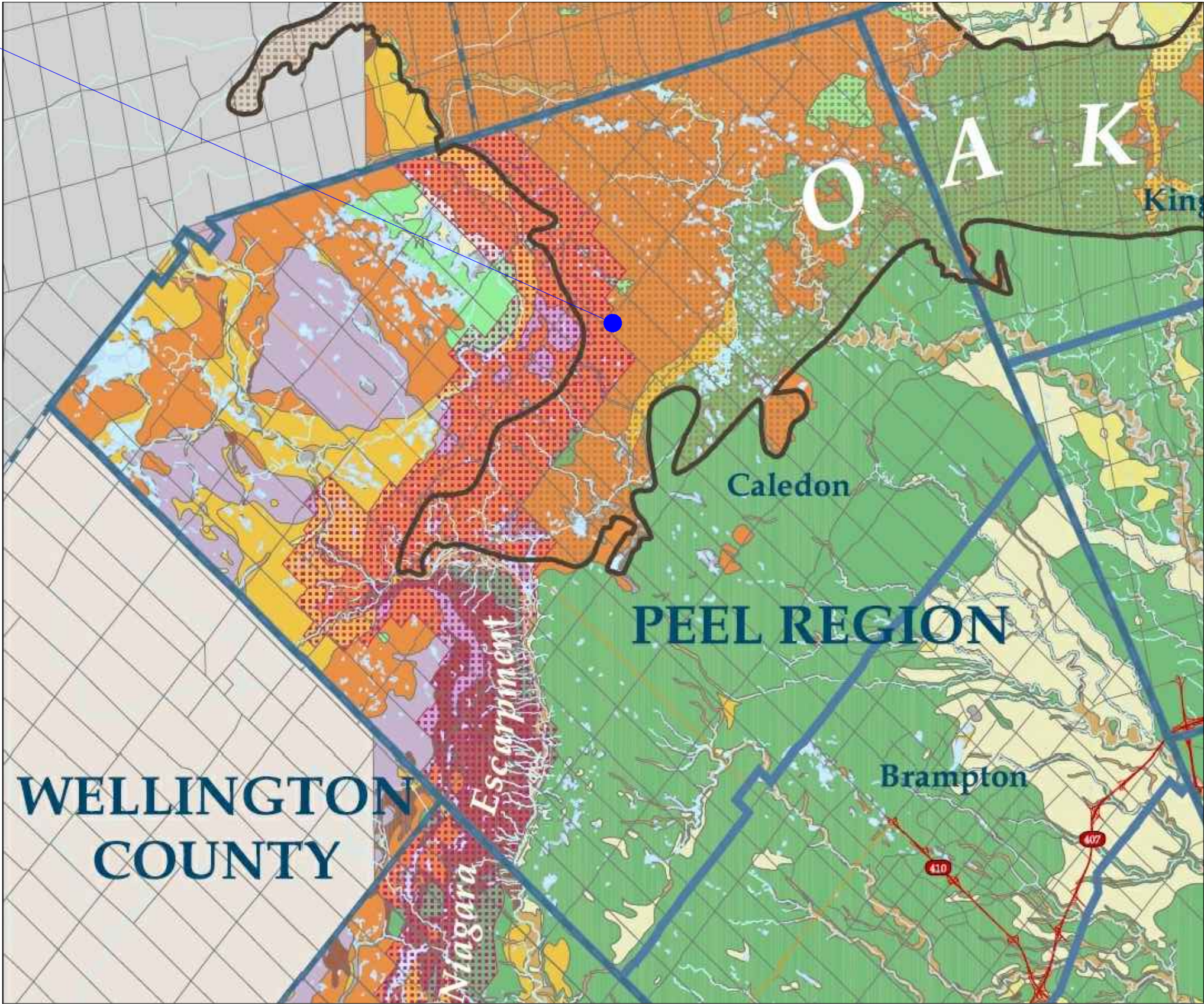
BOREHOLE LOCATION PLAN

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 5
DATE: October 2013	





SITE



REFERENCE:

York Region Geomatics Division

Produced by:  
Geomatics Division  
Planning and Development Services Department  
© Copyrights: The Regional Municipality of York, City of Toronto,  
The Regional Municipality of Peel, The Regional Municipality of Durham,  
The Regional Municipality of Halton, June, 2013.

NOTES:

LEGEND:

	Glacial Till Deposits: 4. Hutton, Kettleby and Wildcat, 1-15 m thick 3. Newmarket, Northern, Bowmanville Till, 1-50 m thick
	Granular Moraine Deposits: 6. sand and gravel, 1-15 m thick 5. fine to coarse sand, some gravel, 1-50 m thick
	Glacial Lake Deposits: 8. sand, silt and gravel, 1 to >50 m thick 7. silt and clay, 1-10 m thick
	Organic Deposits: 1-7 m thick
	River Deposits: sand and gravel, 1-8 m thick
	Recent Lake Deposits and Landfill: 1-3 m thick
	Undifferentiated Till: 1-50 m thick
	Bedrock
	Major Roads Provincial Highway Provincial Freeway Regional Boundary Municipal Boundaries Oak Ridges Moraine Niagara Escarpment Waterbodies Watercourses

PROJECT TITLE:

Hydrogeological Investigation

SITE LOCATION:

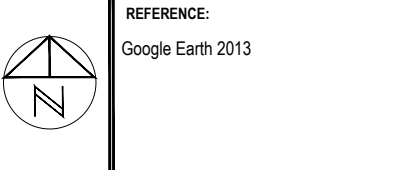
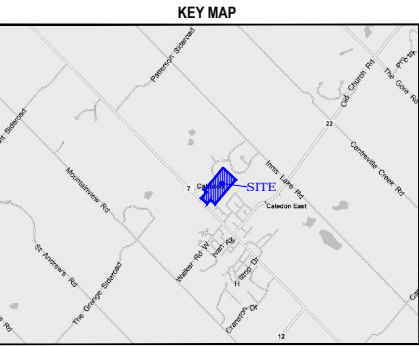
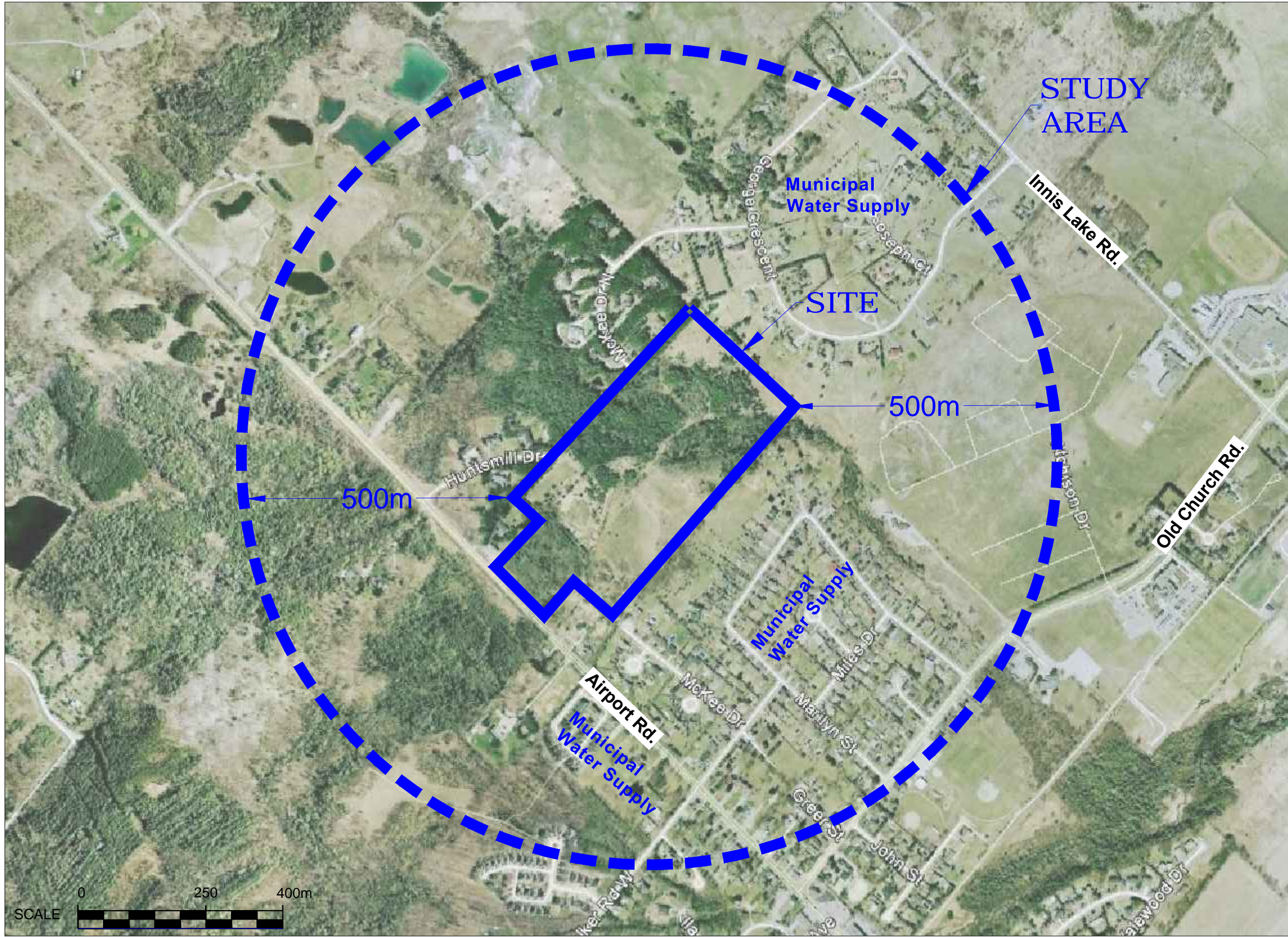
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Caledon, Ontario

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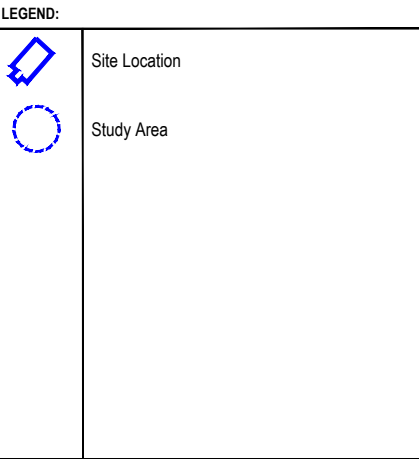
SURFICIAL GEOLOGY OF  
THE OAK RIDGES MORAINÉ

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: NTS	FIGURE NO.: 6
DATE: October 2013	





NOTES:



PROJECT TITLE:

Hydrogeological Investigation

SITE LOCATION:

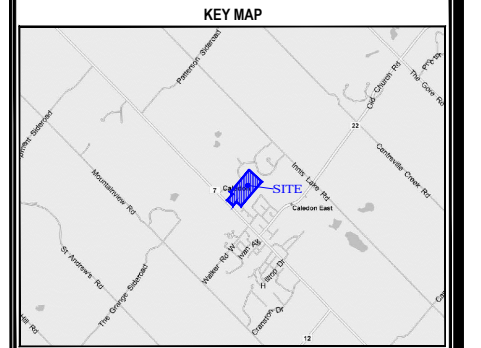
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

FIGURE TITLE:

PROPOSED SITE & SURROUNDING PROPERTY

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 7
DATE: October 2013	














REFERENCE:  
Town of Caledon  
Official Plan Schedule P-2  
Date: December 31, 2008  
Oak Moraine Conservation Plan  
Landform Conservation Areas

NOTES:

LEGEND:

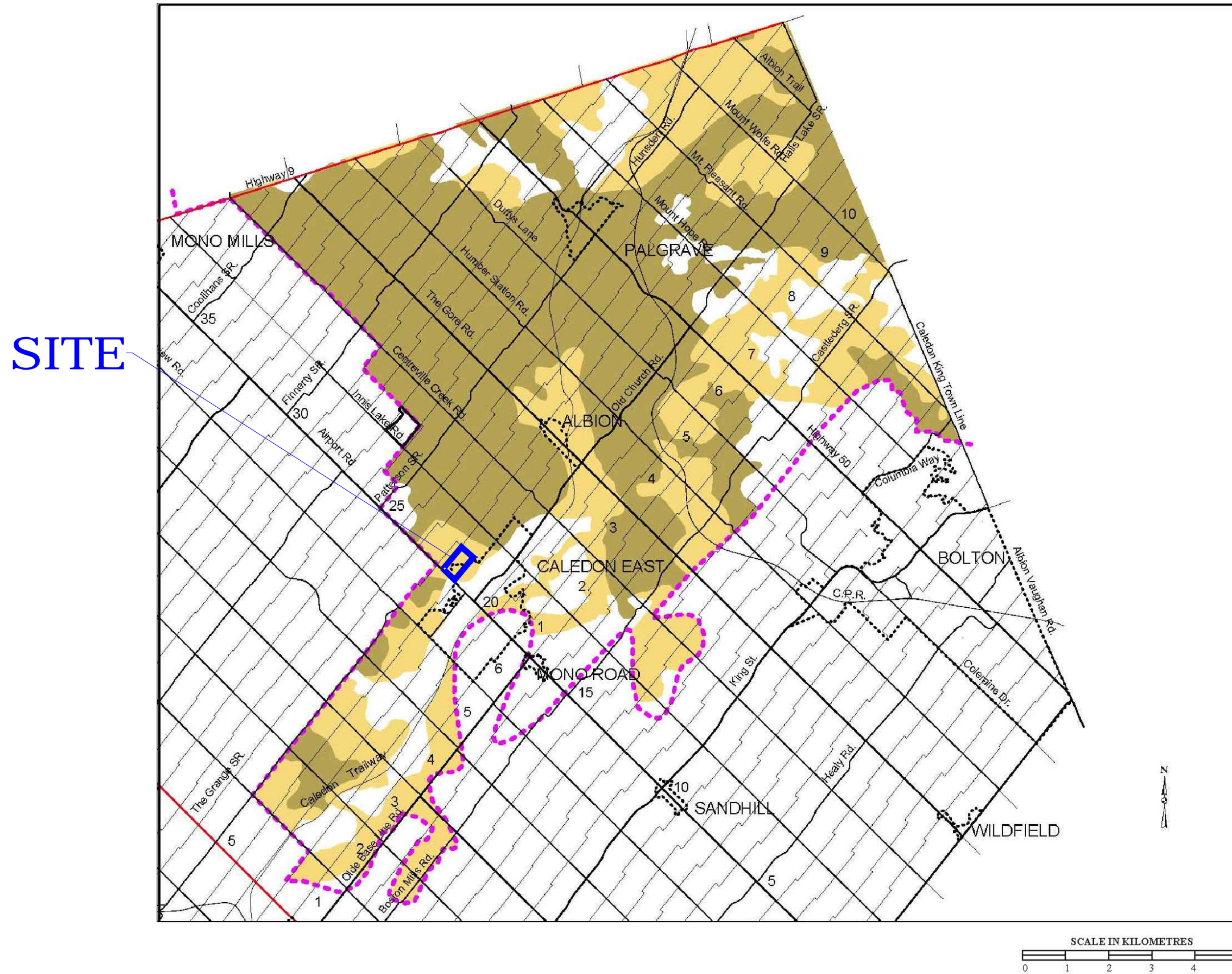
	Site Location
	LANDFORM CONSERVATION AREA CATEGORY 1
	LANDFORM CONSERVATION AREA CATEGORY 2
	OAK RIDGES MORaine CONSERVATION PLAN AREA
	LOT & PARCELS BOUNDARIES
	PROVINCIAL ROADS
	PROVINCIAL ROADS
	LOCAL ROADS
	RAILWAY LINES

PROJECT TITLE:  
Hydrogeological Investigation

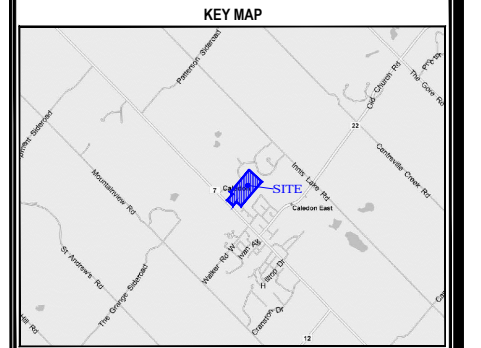
SITE LOCATION:  
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

FIGURE TITLE:  
Oak Ridges Moraine Conservation Plan  
Landform Conservation Areas

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 8
DATE: October 2013	







REFERENCE:  
Town of Caledon  
Official Plan Schedule P  
Date: December 31, 2008  
Oak Moraine Conservation Plan  
Landform Conservation Areas

NOTES:

LEGEND:

	Site Location
	NATURAL CORE AREA
	NATURAL LINKAGE AREA
	COUNTRYSIDE AREA
	RURAL SETTLEMENT (*)
	PALGRAVE ESTATE RESIDENTIAL COMMUNITY (*)
	SETTLEMENT AREA
	PALGRAVE ESTATE RESIDENTIAL COMMUNITY
	OAK RIDGES MORaine CONSERVATION PLAN AREA
	LOCAL ROAD - MINOR
	LOCAL ROAD - MAJOR
	REGIONAL ROAD
	PROVINCIAL HIGHWAY

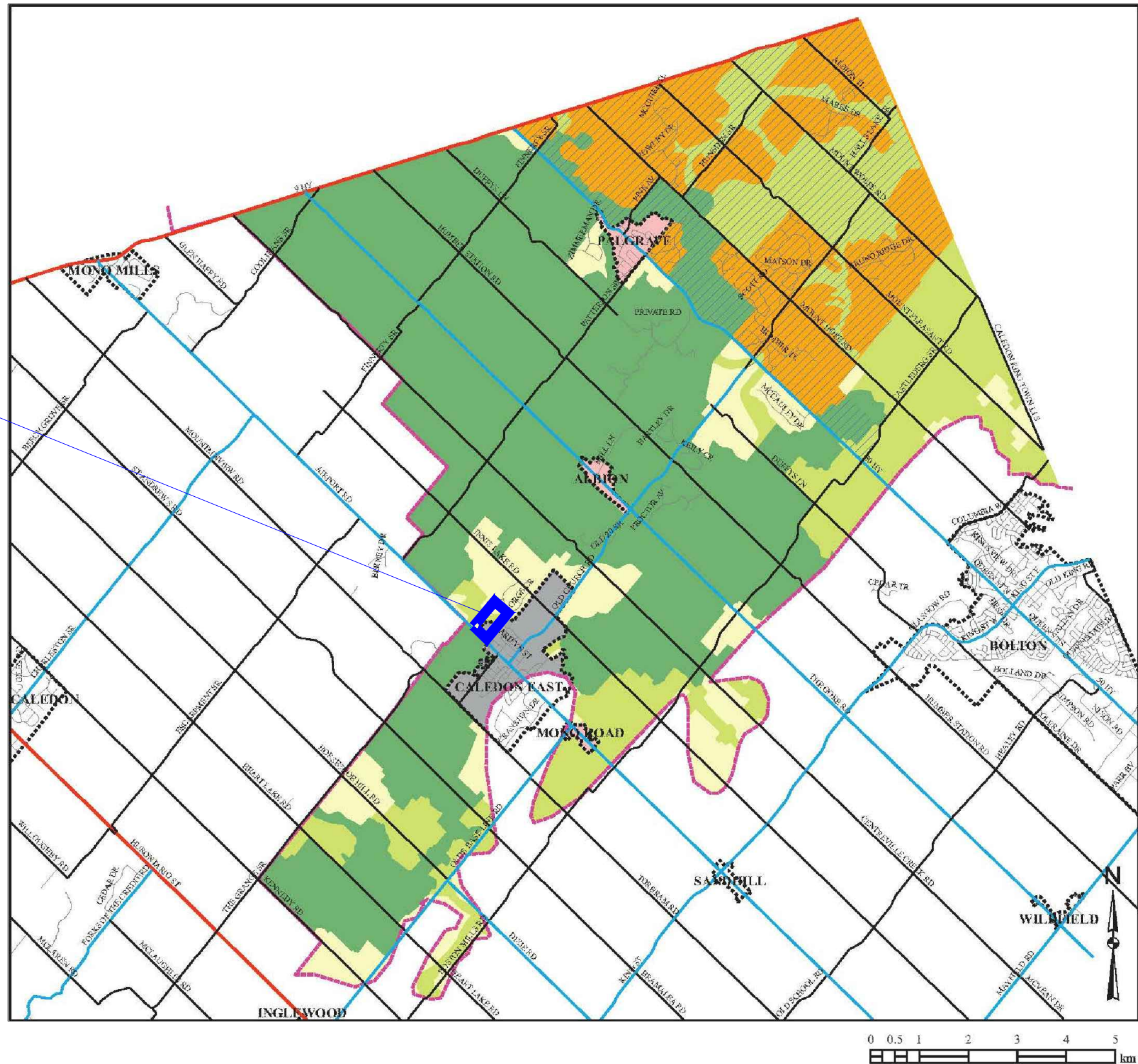
PROJECT TITLE:  
Hydrogeological Investigation

SITE LOCATION:  
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

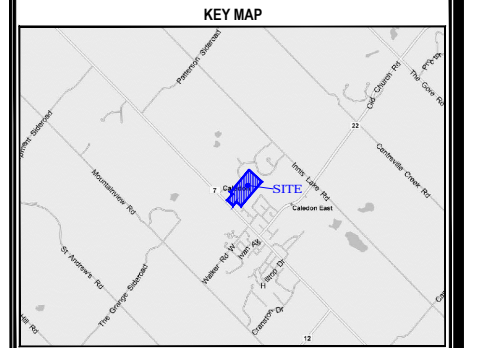
FIGURE TITLE:  
LAND USE DESIGNATIONS

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 9
DATE: October 2013	

SITE







REFERENCE:  
Town of Caledon  
Official Plan Schedule P-1  
Date: December 31, 2008  
Oak Moraine Conservation Plan  
Landform Conservation Areas

NOTES:

LEGEND:

	Site Location
	HIGH AQUIFER VULNERABILITY
	LOW AQUIFER VULNERABILITY
	OAK RIDGES MORAINIC CONSERVATION PLAN AREA
	LOT & CONVEYANCE LINES
	PROVINCIAL ROADS
	REGIONAL ROADS
	LOCAL ROADS
	RAILWAY LINES

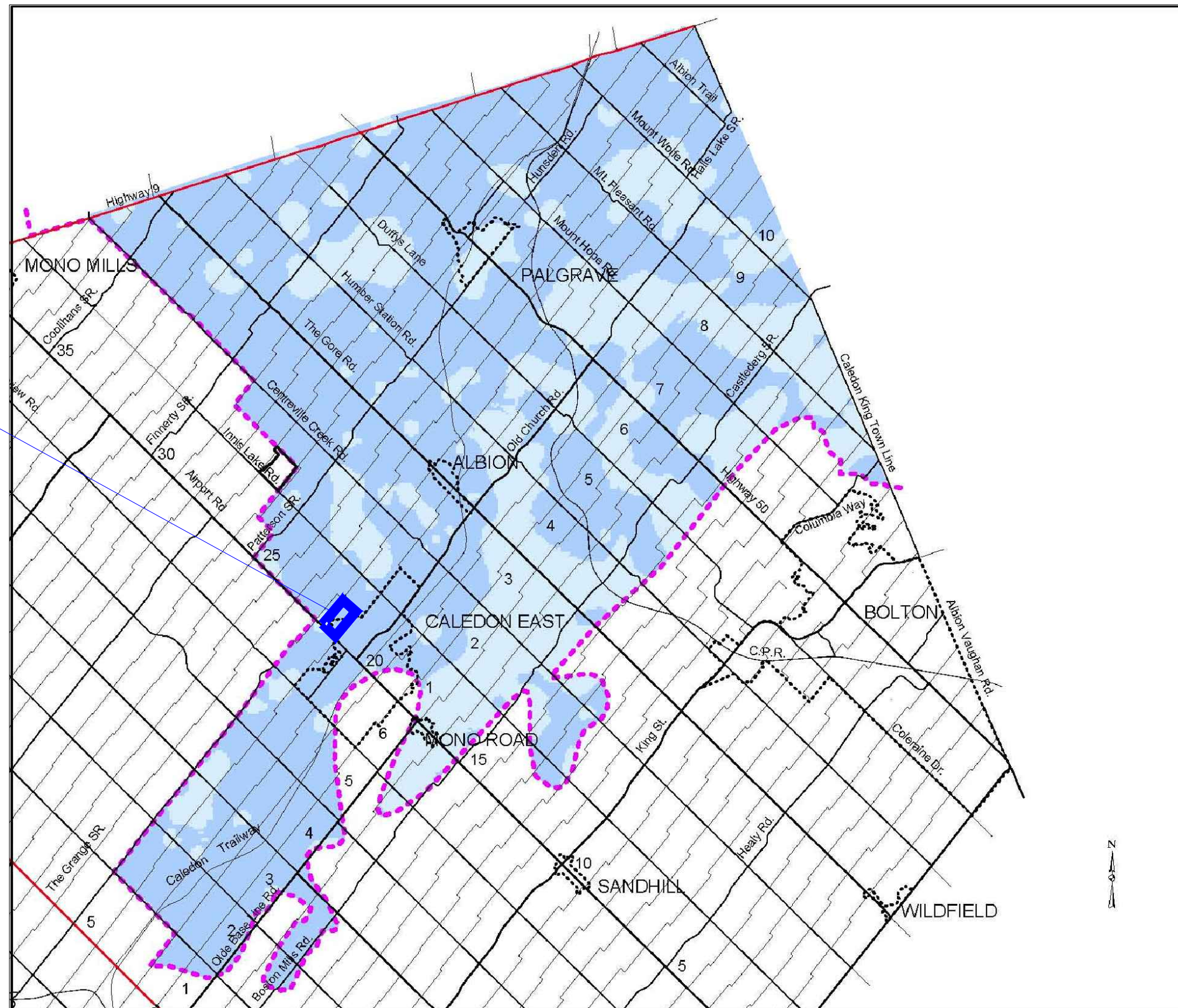
PROJECT TITLE:  
Hydrogeological Investigation

SITE LOCATION:  
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

FIGURE TITLE:  
Oak Ridges Moraine Conservation Plan  
Aquifer Vulnerability Areas

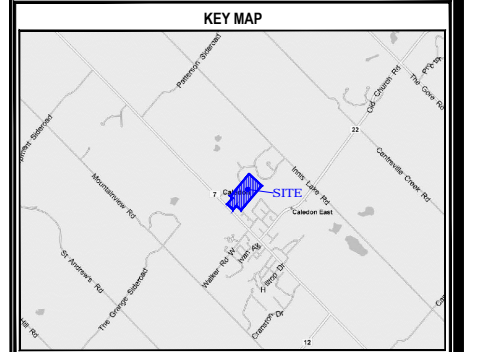
REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 10
DATE: October 2013	

SITE



SCALE IN KILOMETRES  
0 1 2 3 4 5





REFERENCE:  
 Town of Caledon  
 Official Plan Schedule P-2  
 Date: December 31, 2008  
 Oak Moraine Conservation Plan  
 Landform Conservation Areas

NOTES:

LEGEND:	
	Site Location
	2 YEAR PROTECTION AREA
	10 YEAR PROTECTION AREA
	25 YEAR PROTECTION AREA
	5 YEAR PROTECTION AREA
	10 YEAR PROTECTION AREA
	OAK RIDGES MORaine CONSERVATION PLAN AREA
	PROVINCIAL HIGHWAY
	REGIONAL ROAD
	LOCAL ROAD - MAJOR
	LOCAL ROAD - MINOR
	RAILWAY LINES

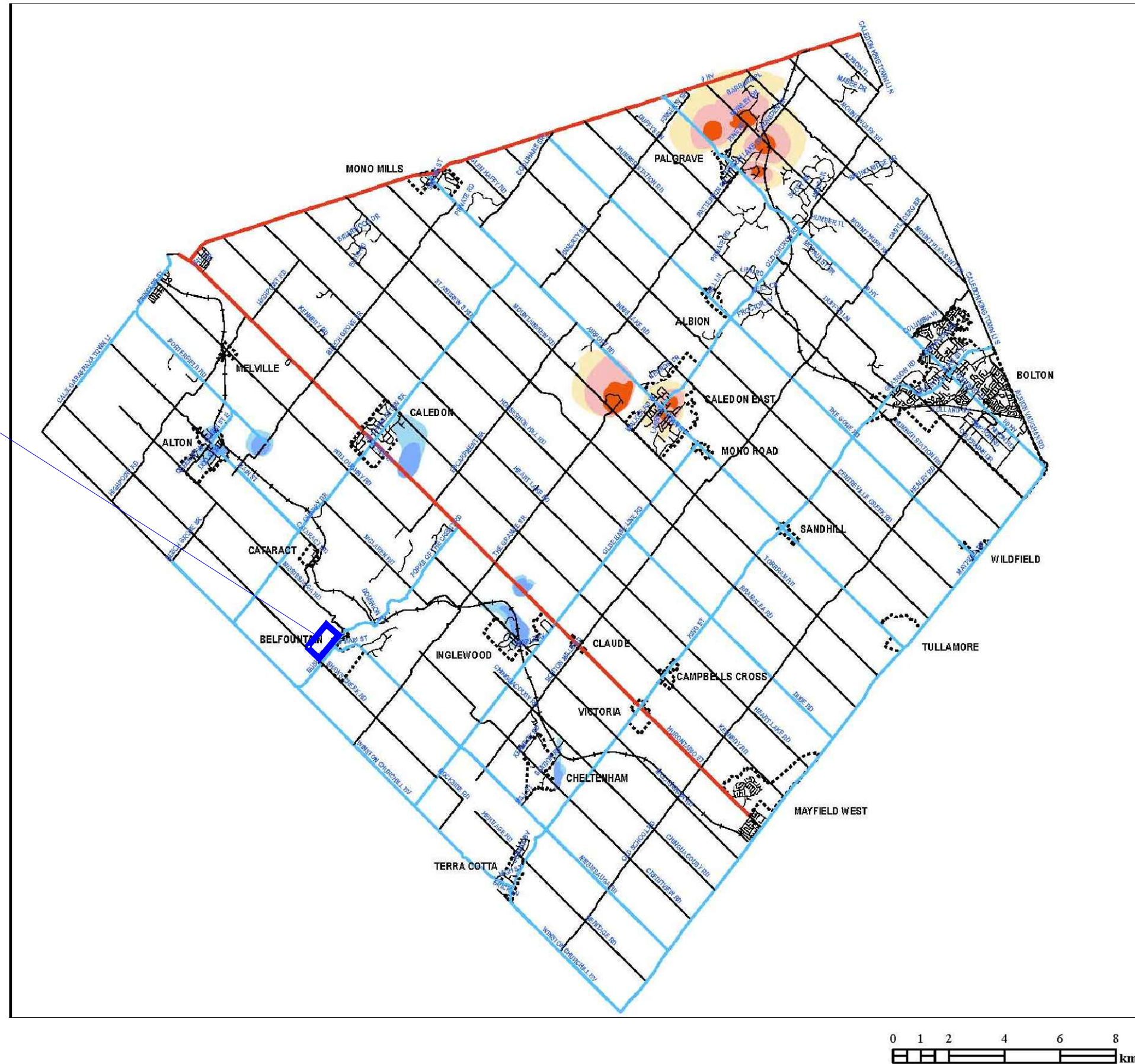
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 Hydrogeological Investigation

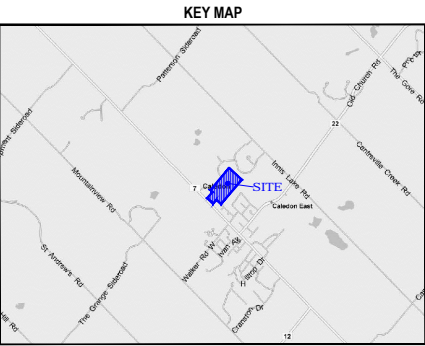
SITE LOCATION:  
 Lexis-Bayview Caledon East Subdivision,  
 Caledon, Ontario

FIGURE TITLE:  
 WATER HEAD PROTECTION AREA

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 11
DATE: October 2013	

SITE





REFERENCE:  
Ministry of Natural Resources  
Biodiversity Explorer V.2.0.3  
Date: July 25, 2012

NOTES:

LEGEND:

	Site Location
	Ontario
	ANSIs
	Water Area (1:20k)
	Water Line (1:20k)
	Lots
	Railways (1:20k)

PROJECT TITLE:  
Hydrogeological Investigation

SITE LOCATION:  
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

FIGURE TITLE:  
AREA OF NATURAL SIGNIFICANT

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: NTS	FIGURE NO.: 12
DATE: October 2013	



**Humber River  
 Watershed  
 Subwatersheds**

**SITE**

**LEGEND**

- Watershed Boundary\*
- Municipal Boundary
- Road
- Pond & Lake
- Watercourse

**SECONDARY SUBWATERSHED UNITS\***

#	NAME	#	NAME
1	MAIN - UPPER	13	KING CREEK
2	MAIN - PALGRAVE TO BOLTON	14	EAST - NOBLETON TO KLEINBURG
3	CENTREVILLE CREEK	15	PURPLEVILLE CREEK
4	COLD CREEK	16	EAST - KLEINBURG TO WOODBRIDGE
5	MAIN - BOLTON TO WOODBRIDGE	17	BLACK CREEK
6	RAINBOW CREEK	18	LOWER - WOODBRIDGE TO REXDALE
7	WEST - WEST BRANCH	19	EMERY CREEK
8	WEST - MAIN BRANCH	20	LOWER - REXDALE TO WESTON
9	WEST - EAST BRANCH	21	BERRY CREEK
10	WEST - LOWER BRANCH	22	HUMBER CREEK
11	ALBION CREEK	23	SILVER CREEK
12	EAST - UPPER BRANCH	24	LOWER - LAMBTON TO MOUTH

0 2 4 8 12 Kilometers

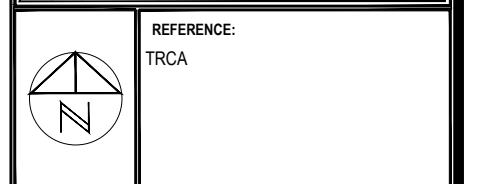
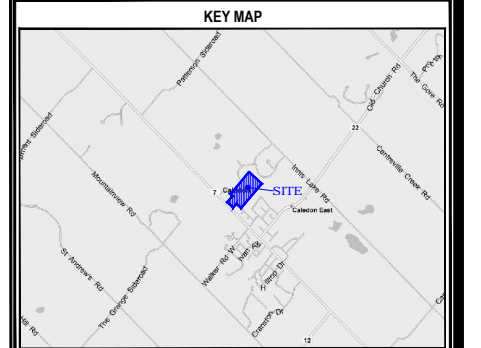
\*Watershed boundary has been derived from the Humber River Hydrology Model drainage boundaries.  
 Date: February, 2007

**TORONTO AND REGION  
 Conservation  
 for The Living City**

Canadian  
 Heritage  
 Rivers  
 System

Le Réseau  
 des rivières  
 du patrimoine  
 canadien

**Humber  
 River**



**NOTES:**

**LEGEND:**

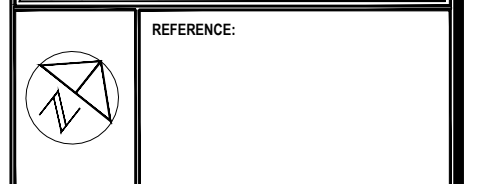
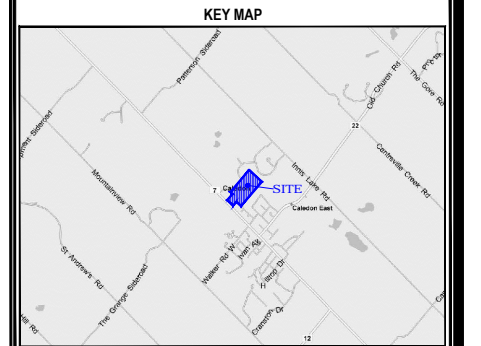
**PROJECT TITLE:**  
 Hydrogeological Investigation

**SITE LOCATION:**  
 Lexis-Bayview Caledon East Subdivision,  
 Caledon, Ontario

**FIGURE TITLE:**  
 HUMBER RIVER WATERSHED

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: <b>13</b>
DATE: October 2013	





NOTES:

LEGEND:

	<2%
	2-5%
	5-10%
	10-15%
	15-20%
	>25%

PROJECT TITLE:

Hydrogeological Investigation

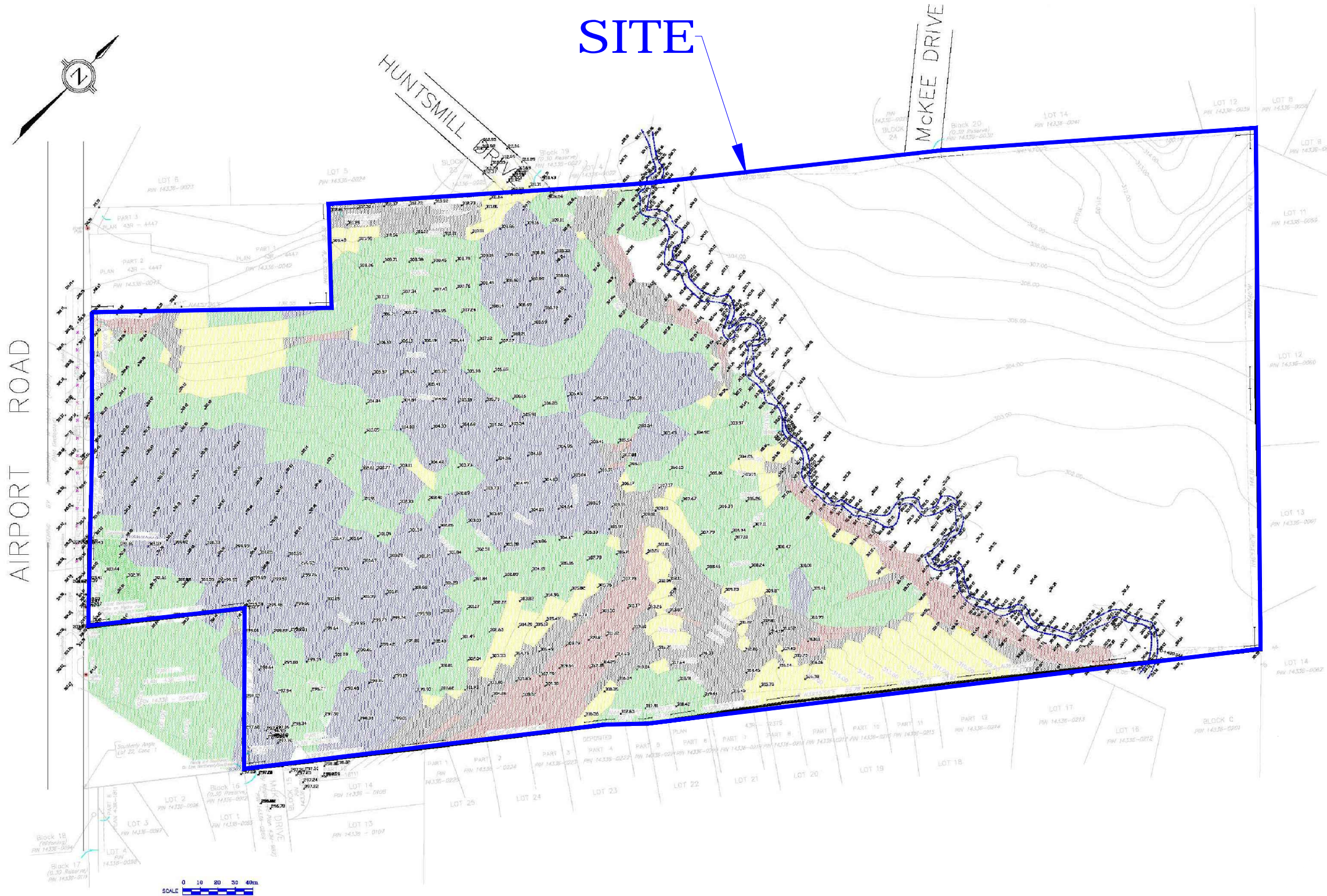
SITE LOCATION:

Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

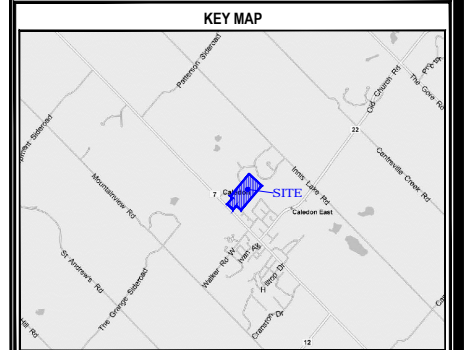
FIGURE TITLE:

SLOPE CLASSIFICATION

REV NO.: 0	FILE NO.: 13-13-3081
SCALE: As Shown	FIGURE NO.: 14
DATE: October 2013	







NOTES:

LEGEND:

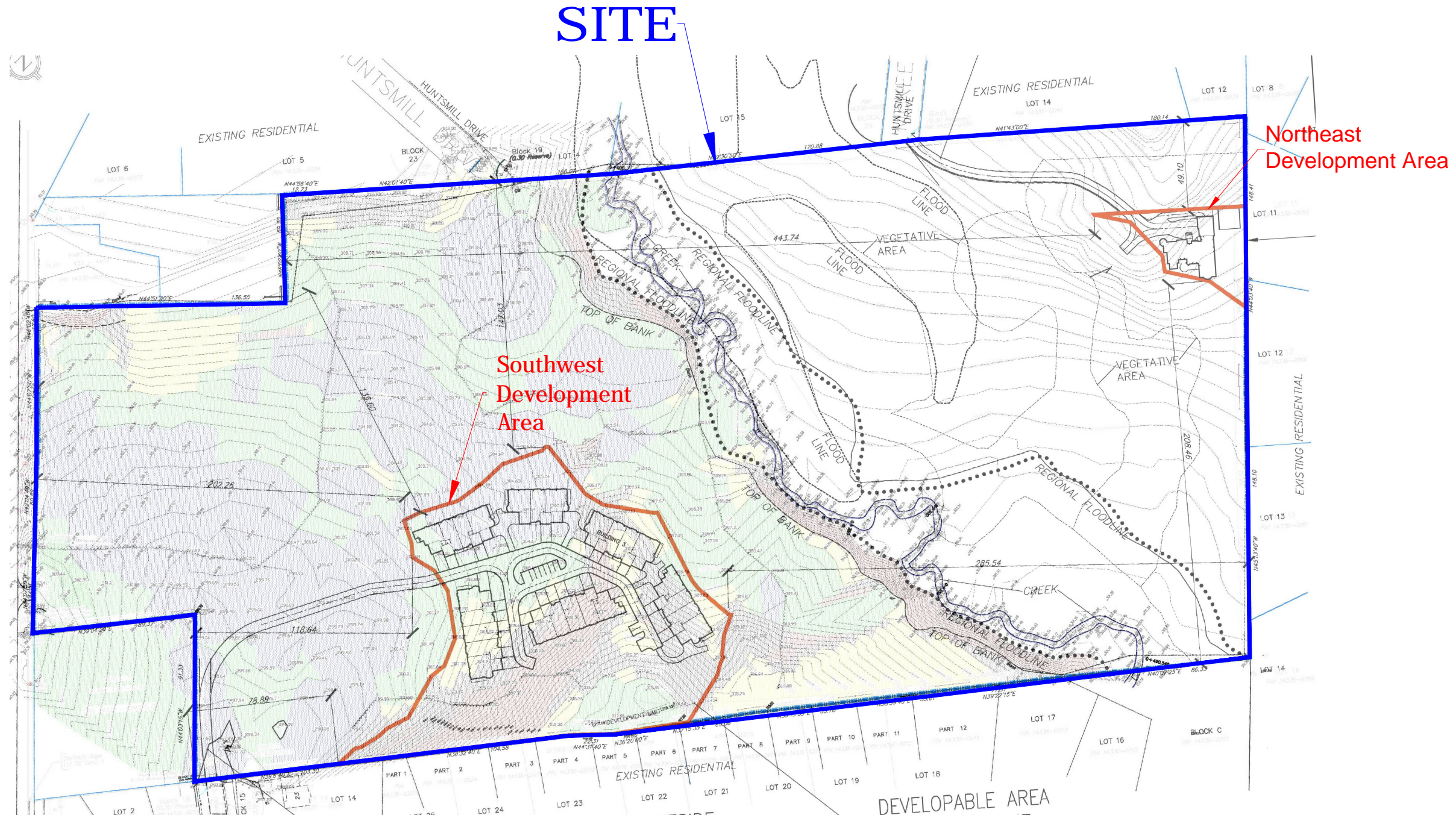
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	15-20%
	>25%

PROJECT TITLE:  
Hydrogeological Investigation

SITE LOCATION:  
Lexis-Bayview Caledon East Subdivision,  
Caledon, Ontario

FIGURE TITLE:  
STEEPLY SLOPING LAND WITHIN  
THE DEVELOPMENT AREA

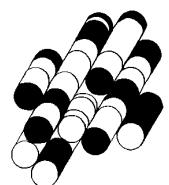
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SCALE: As Shown	FIGURE NO.: 15
DATE: October 2013	





# APPENDIX A

**TERRAPROBE INC.**



## WATER WELL DATA SYSTEM

25 OCT 86

## GROUND WATER BULLETIN REPORT

WELL NUMBER	CONCESSION ETC	LOT	UTM		WELL NO	EASTING FEET	ELEV DATE	DRILLER	CSG	KIND	DIA INS	WATER FEET	STAT FEET	PUMP FEET	TEST GPM	TEST HR/MN	WATER USE	OWNER/LOG/SCREEN DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
			NORTHING	FEET														
1	CON	01 020	49- 05749	591950 4858700	950	1980/05	3612	30	UK	0022	22	30	4	1 :30	DO			---
2	CON	01 020	49- 00039	591823 4858548	965	1965/10	3612	36	FR	0023	23		3	:	DO			BRWN LOAM 0002 BRWN SAND CLAY 0021 BRWN SAND 0026 BRWN SAND GRVL 0032
3	CON	01 020	49- 00038	591076- 4857798	955	1960/08	2801	10	FR	0039	3	29	155	24:0	MN	0065 10		LOAM 0001 MSND STNS 0027 QSND 0030
4	CON	01 020	49- 00035	591827- 4858769	965	1960/03	2801	10	FR	0090				:	NU			LOAM 0002 MSND SILT 0020 BLUE CLAY 0039 GRVL MSND CLAY 0046 MSND SILT 0049 FSND 0059 MSND 0067 FSND SILT 0117
5	CON	01 020	49- 04342	591995 4858675	955	1974/04	3612	30	UK	0021	21	35	3	1 :0	DO			LOAM 0001 FSND 0002 MSND GRVL BLDR 0012 FSND GRVL 0021 MSND SILT GRVL 0026 MSND SILT 0032 GRVL 0033 MSND SILT 0038 FSND SILT 0045 MSND SILT 0067 CLAY 0090 MSND SILT 0112 GRVL 0114 FSND GRVL 0115 BLUE CLAY 0116 SHLE 0135
6	CON	01 020	49- 07902	591223 4857640	968	1994/08	6490	02	FR	0040				:	NU	0040 05		BRWN LOAM 0002 BRWN SAND 0020 GREY SAND 0022 GREY GRVL 0035 GREY FSND 0037
7	CON	01 020	49- 08579	591715- 4858110		2000/03	7110	06	FR	0208	20	175	12	2 :0	DO	0209 07		BLCK LOAM 0001 GREY SILT CLAY SAND 0014 GREY SILT CLAY 0040 BRWN SAND GRVL LYRD 0050
8	CON	01 020	49- 00032	591157 4857698	950	1959/01	2904		FR	0101	4			:	NU			BRWN SAND CLAY 0044 BLUE CLAY 0072 GREY SILT 0208 BRWN SAND 0217 BLUE CLAY 0220
9	CON	01 020	49- 07959	591224 4857641	968	1994/09	3406	08	UK	0041	6	40	200	6 :	NU	0049 21		BRWN MSND 0002 BLCK MUCK MSND 0016 GREY CLAY 0018 QSND 0046 QSND GRVL 0048 CLAY FSND 0062 QSND 0101 QSND GRVL 0102 CLAY MSND 0119 HPAN SHLE 0123
10	CON	01 020	49- 07901	591223 4857640	968	1994/08	6490	04	FR	0042				:	NU	0042 05		GRVL FILL STNS 0001 BLCK SILT 0002 GREY CLAY SLTY SAND 0009 GREY SILT CLAY 0024 GREY CLAY 0029 GREY CLAY STNS 0031 GREY CLAY SOFT 0039 GREY CLAY STNS 0040 BRWN CLAY SAND 0041 BRWN FSND MSND 0064 BRWN MSND 0071
11	CON	01 020	49- 07960	591223 4857640	968	1994/08	3406	08	UK	0041	7	40	150	6 :30	NU	0041 20		GREY GRVL FILL 0002 BLCK LOAM 0003 GREY SILT CLAY SAND 0016 GREY SILT CLAY 0042 BRWN SAND GRVL LYRD 0062
12	CON	01 021	49- 00040	591308 4858300	950	1959/11	2801	02	SA	0055	8	12	16	3 :0	NU	0051 10		GRVL FILL 0001 BLCK LOAM 0002 GREY CLAY SLTY SAND 0008 GREY SILT CLAY 0029 GREY CLAY SLTY SOFT 0038 GREY CLAY STNS HARD 0040 BRWN CLAY SAND 0041 BRWN SAND CLAY LYRD 0063
13	CON	01 021	49- 00042	591379 4858305	950	1959/12	2801	02	FR	0051	8	14	30	4 :0	NU	0050 11		LOAM 0001 FSND CLAY 0004 MSND GRVL 0015 MSND GRVL BLDR 0031 CSND GRVL 0037 MSND GRVL BLDR 0042 CSND GRVL 0055 MSND CLAY GRVL 0061
																		LOAM 0001 FSND BLDR 0008 MSND GRVL BLDR 0030 MSND GRVL 0041 MSND CLAY 0051 FSND CLAY 0061



## WATER WELL DATA SYSTEM

25 OCT 86

## GROUND WATER BULLETIN REPORT

WELL NUMBER	CONCESSION ETC	LOT	UTM WELL NO	EASTING FEET	ELEV FEET	DATE	DRILLER	CSG INS	KIND WATER	STAT FEET	PUMP FEET	TEST LVL	TEST LVL	RATE GPM	TIME HR/MN	WATER USE	OWNER/LOG/SCREEN DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
14	CON	01 021	49- 00041	591279 4858275	950	1959/11 2801	02 FR	0061	8	15	30	6 :0	NU	0061	11		---
15	CON	01 021	49- 00034	591400 4858400	960	1959/03 2904	06 FR	0044	9	38	80	72 :0			0028 10 0038 06		LOAM 0001 MSND GRVL BLDR 0044 FSND 0061 FSND SILT CLAY 0083 ---
16	CON	01 022	49- 05561	591200 4859500	1075	1979/09 4919	30 UK	0060	60	76		0 :30	DO				LOAM 0002 SAND GRVL CLAY 0016 SAND GRVL 0018 BLDR SAND 0019 SAND GRVL 0024 SAND STNS BLDR 0027 SAND GRVL 0035 CSND GRVL 0040 FSND 0041 GRVL SAND 0044 FSND 0055 ---
17	CON	01 022	49- 05698	590550 4858350	1010	1978/08 3561	07 FR	0060	20	20	5	24 :0	DO				BRWN LOAM HARD 0001 BRWN CLAY SAND PCKD 0058 BRWN SAND LOOS 0079 ---
18	CON	01 022	49- 03425	591420 4859200	990	1970/05 3637	30 FR	0055	55	70		2 :0	DO				LOAM 0002 SAND CLAY 0020 CLAY GRVL SAND 0050 HPAN 0060 ---
19	CON	01 022	49- 04263	591020 4859136	977	1973/08 2801							PS				BRWN LOAM 0001 BRWN MSND CLAY 0065 BRWN CLAY 0070 ---
20	CON	01 022	49- 05847	590500 4857500	1000	1981/08 3317	05 FR	0083	0	70	2	3 :0	DO	0083	04		LOAM 0001 BRWN FSND 0017 GREY SAND CLAY 0040 GREY CLAY SAND 0047 FSND GRVL CLAY 0058 GREY CLAY 0072 GREY FSND CLAY 0078 GREY CLAY GRVL 0087 GREY FSND CLAY 0103 GREY CLAY GRVL 0110 GREY SHLE LMSN 0122 ---
21	CON	01 022	49- 05330	591300 4859425	1070	1977/05 4320	FR	0054	54	54	1	1 :0	DO				FSND CLAY 0020 SAND SLTY 0042 GREY CLAY SOFT 0057 SAND CLAY LYRD 0082 MSND FGVL LYRD 0087 ---
22	CON	01 022	49- 04261	590952 4859190	987	1973/08 2801							PS				BRWN FSND 0013 BRWN CSND 0053 BRWN FSND 0069 ---
23	CON	01 022	49- 04265	591030 4859103	977	1973/09 2801							PS				LOAM 0001 GRVL CSND 0008 BRWN FSND 0017 BRWN FSND CLAY 0030 BRWN CLAY SAND 0043 GREY CLAY 0048 GREY SILT CLAY 0052 GREY CLAY 0062 GREY SHLE LMSN 0065 GREY CLAY 0066 RED SAND CLAY SHLE 0108 GREY CLAY 0114 GREY SHLE CLAY 0116 GREY SHLE LMSN 0117 ---
24	CON	01 022	49- 04260	591412 4859237	1000	1973/08 2801							PS				LOAM 0003 GREY SILT CLAY 0073 BRWN SAND CLAY GRVL 0105 GREY CLAY GRVL 0110 RED CLAY 0117 GREY CLAY SHLE 0125 ---
25	CON	01 022	49- 04266	591134 4858701	973	1973/08 2801							PS				BRWN MSND FSND 0015 BRWN CLAY 0041 GREY CLAY 0051 GREY SAND CLAY 0059 GREY SAND CLAY 0068 GREY CLAY 0075 GREY CLAY SAND 0093 GREY FSND CLAY 0097 SAND GRVL SHLE 0099 GREY CLAY GRVL SHLE 0108 RED SHLE 0112 ---
																	BRWN SAND GRVL BLDR 0005 BRWN CLAY SAND 0051 BRWN CLAY SILT 0062 GREY CLAY 0076 GREY SHLE CLAY 0083 GREY LMSN 0086

## WATER WELL DATA SYSTEM

25 OCT 86

## GROUND WATER BULLETIN REPORT

WELL NUMBER	CONCESSION ETC	LOT	UTM		WELL NO	EASTING	ELEV FEET	DATE	DRILLER	CSG INS	KIND WATER	STAT FEET	PUMP FEET	TEST GPM	TEST HR/MN	WATER USE	OWNER/LOG/SCREEN DEPTHS IN FEET TO WHICH FORMATIONS EXTEND
			NORTHING	FEET													
26	CON	01 022	49- 04264	591226 4859404	1063	1973/08	2801									PS	--- BRWN SAND GRVL CLAY 0038 BRWN CLAY 0044 BRWN SAND CLAY 0049 GREY CLAY GRVL 0063 GREY CLAY 0070 SAND GRVL 0071 GREY SAND CLAY GRVL 0083 GREY CLAY 0137 GREY FSND GRVL CLAY 0143 GREY SHLE 0150 GREY SHLE LMSN 0151 --- BLCK LOAM 0001 BRWN CLAY BLDR 0025 GREY MSND CLAY STNS 0030 GREY CLAY 0039 --- BRWN LOAM 0001 BRWN CLAY 0020 BRWN SAND 0025 BRWN CLAY 0035 BRWN SAND CLAY 0054 BRWN CLAY 0057 BRWN SAND 0075 --- BRWN LOAM 0001 BRWN MSND 0015 GREY CLAY GRVL 0020 --- BRWN CLAY SAND STNS 0015 BRWN FSND 0060 BRWN MSND 0063 BRWN FSND 0075 --- LOAM 0002 BRWN CLAY BLDR 0027 CSND STNS 0030 --- BRWN LOAM 0001 BRWN SAND CLAY 0053 --- BRWN LOAM 0001 BRWN CLAY SAND 0046 BRWN SAND CLAY 0060 BRWN SAND 0064 --- PRDG 0045 GREY SILT 0057 GREY CLAY SOFT 0069 GREY CLAY FGVL PCKD 0086 GREY CLAY 0090 BRWN CLAY FGVL 0094 BRWN MSND 0098 ---
27	CON	01 023	49- 03303	590140 4858830	1050	1969/09	3612	36	FR	0025	25	38	1	1 : 0	DO		
28	CON	01 023	49- 05142	590700 4859950	1105	1977/04	3612	36	UK	0054	54	73	3	1 : 30	DO		
29	CON	01 023	49- 03493	590120 4858800	1040	1970/06	4919	36	FR	0015	2	18		1 : 0	DO		
30	CON	01 023	49- 03817	591090 4859550	1090	1972/05	1830	30	FR	0060	60	61	1	1 : 0	DO		
31	CON	01 023	49- 00044	590554 4859628	1075	1967/10	3612	36	FR	0027	18	29	6	3 : 0	ST DO		
32	CON	01 023	49- 04228	590747 4859963	1105	1973/12	4919	30	UK	0040	40	50	0	1 : 0	DO		
33	CON	01 023	49- 04227	590698 4859993	1108	1973/12	4919	30	UK	0046	46	60	0	1 : 0	DO		
34	CON	01 023	49- 07995	590697 4859992	1132	1995/03	6782	30	FR	0090	42	57	4	1 : 30	DO	0088 07	
35	CON	01 023	49- 05970	590250 4858700	1025	1982/11	2801	12			FLW	60	400	8 : 0	PS	0110 10	--- FILL SAND GRVL 0004 BLCK LOAM 0005 CLAY SILT SAND 0022 SILT GRVL BLDR 0029 CLAY SILT SOFT 0054 SAND GRVL CLAY 0059 CLAY GRVL 0071 CLAY 0080 BLDR CLAY PCKD 0091 SILT CLAY 0105 SILT CLAY SAND 0110 GRVL SAND BLDR 0119 CLAY GRVL 0130 GRVL SAND CLAY 0131 LMSN 0133 --- GRVL 0002 WDFR LOAM LOOS 0010 BRWN CLAY LOOS 0017 BRWN CLAY SAND 0020 BLUE CLAY QSND 0032 BLUE CLAY SAND SOFT 0103 BLUE CLAY HARD 0105 GRVL 0105 --- BRWN LOAM 0002 BRWN CLAY SAND 0024 BRWN CLAY SAND GRVL 0065 GREY SAND CLAY 0088 RED MSND 0092 --- LOAM 0001 BRWN MSND CLAY 0044
36	CON	01 023	49- 05954	590300 4858650	1025	1982/08	3561								NU		
37	CON	01 023	49- 08018	590768 4859961	1132	1995/07	6782	08	FR	0088	52	73	5	2 : 20	DO	0089 03	
38	CON	02 021	49- 03204	591650 4859200	975	1969/05	3637	30	FR	0028	26				DO		

25 OCT 86

WELL NUMBER	CONCESSION ETC	LOT	UTM		WELL NO	ELEV FEET	DATE	DRILLER	CSG INS	KIND WATER	STAT FEET	PUMP LV L	TEST LV L	TEST RATE GPM	TEST TIME HR/MN	TEST WATER USE
			EASTING NORTHING	ELEV												

OWNER/LOG/SCREEN  
DEPTHS IN FEET TO WHICH  
FORMATIONS EXTEND

39	CON	02	022	49-03050	5913504859520	1050	1968/10	3612	36	FR	0062	68	77	2	1	:	DO
40	CON	02	022	49-03063	5913404859600	1050	1968/08	4813	06	FR	0158	50	155	3	6	:	DO
41	CON	02	023	49-05508	5911504859700	1109	1979/08	3612	30	UK	0042	40	55	4	3	:	DO
42	CON	02	023	49-05492	5911004859750	1004	1979/05	4320	30	FR	0064	64	64	3		:	DO
43	CON	02	023	49-04435	5912114859660	1100	1974/08	4321	07	FR	0068	21	71	2	4	:	DO 0069 03
44	CON	02	023	49-04597	5912184859653	1100	1974/05	2341	07	FR	0068	40	64	4	8	:	DO 0068 03
45				49-00676	5908054857806	965	1958/12	2904	06	FR	0095	2	120	13	4	:	NU
46				49-04257	5912254857700	950	1972/08	3002	20	FR	0071	33	44	225	20:0	MN	0079 20
47				49-00677	5905574857454	970	1967/05	3612	36	FR	0012	12	17	3		:	DO
48				49-00674	590952~4857516	960	1949/08	4620		FR	0050	39				:	CO
49				49-00675	591066~4857707	960	1954/09	3512	04	FR	0152	72	121	2	1	:	DO
50				49-00678	5905014857519	970	1967/05	3612	36	FR	0009	9	17	2		:	DO
51		06	006	49-06952	5897194859062	1089	1988/04	3903	06							:	MN
52	HS E	06		49-08767	5909114857874		2001/04	4011								:	
53	HS E	06	004	49-00679	5901904857572	975	1961/09	1307	30	FR	0028			25		:	ST DO
54	HS E	06	005	49-05724	5905004858250	1000	1980/05	3317	05	FR	0083	12	60	6	3	:	ST DO0083 03

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LOAM 0002 BRWN CLAY MSND 0047 MSND STNS 0061
CSND 0065 MSND CLAY 0076 MSND STNS 0079
---
BRWN CLAY MSND 0050 BLUE CLAY 0114 MSND SILT
0124 SHLE 0160
---
BLCK LOAM 0002 BRWN CLAY 0018 BRWN CLAY SAND
STNS 0029 BRWN SAND 0031 BRWN CLAY 0035 BRWN
CLAY SAND STNS 0050 BRWN CLAY 0058
---
BRWN MSND 0010 BRWN SILT CLAY 0054 BRWN MSND
0075
---
BRWN SAND 0009 BLDR 0014 BRWN SAND 0068 BRWN
SAND 0075
---
BRWN SAND 0068 BRWN SAND 0073
---
BLCK LOAM 0001 BRWN CLAY FSND STNS 0018 GREY
FSND 0035 GREY FSND CLAY 0041 QSND 0066 GREY
CLAY 0078 HPAN SHLE 0081 SHLE MSND 0126
---
BRWN CLAY SILT SAND 0021 GREY CLAY SILT 0035
CLAY SILT 0042 HPAN 0044 SAND CLAY 0068 HPAN
0071 FSND 0075 FSND 0103
---
LOAM 0001 CSND 0012 GRVL MSND 0020
---
LOAM MSND 0003 CLAY 0006 CLAY MSND 0030 BLUE
CLAY 0043 GRVL CLAY MSND 0046 FSND 0055 FSND
CLAY 0062 CLAY FSND 0069 HPAN CLAY 0096 MSND
CLAY 0103 CLAY HPAN 0107 SHLE 0109
---
YLLW CLAY 0006 YLLW MSND 0023 BLUE CLAY 0080
QSND 0121 BLUE CLAY 0152 FSND 0160
---
LOAM 0001 CSND 0009 MSND 0018 QSND 0020
---
BRWN CLAY SAND LYRD 0016 BRWN CLAY STNS HARD
0024 GREY CLAY STNS HARD 0068 BRWN CLAY DNSE
0086 GREY CLAY DNSE 0145 BRWN CLAY SAND CMTD
0160 GREY CLAY SAND STNS 0170 RED CLAY SAND
STNS 0175 RED CLAY LYRD 0195 RED CLAY ROCK
LYRD 0240 GREY SHLE FCRD DNSE 0252
---
---
BRWN LOAM 0015 GRVL 0035
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SAND CLAY SLTY 0028 CLAY BLDR 0032 RED CLAY
0040 GREY CLAY STNS 0083 SAND STNS 0086

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## WATER WELL DATA SYSTEM

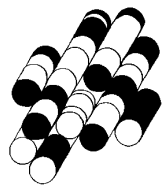
25 OCT 86

## WATER BULLETIN REPORT

WELL NUMBER	CONCESSION ETC	LOT	UTM		WELL NO	EASTING	ELEV	DATE	DRILLER	INS	CSG KIND	WATER DIA OF	STAT FOUND	PUMP LVL	TEST LVL	TEST RATE	TEST TIME	WATER USE	3/SCREEN DEPTH TO WHICH FOR TEND
			NORTHING	FEET															
55	HS E	06 006	49- 06953	589571 4858194	1096	1988/07 3903	06	FR	0186	24	150	50	0 : 8	MN	0183	10			BRWN SAND CR1 BRWN CLAY DNSE 0065 GREY CLAY SP0 GREY CLAY DNSE 0105 GREY CLAY SP2 GREY CLAY DNSE 0156 BRWN SAND GR6 RED CLAY SAND HARD 0205 RED CRD 0215 BRWN LOAM HAN CLAY HARD 0020 BRWN SAND LOOS 00
56	HS E	06 008	49- 07104	590504 4858319		1989/03 4919	30	UK	0022	18	34	10	1 : 0	DO					BRWN CLAY 011 BRWN CLAY MSND 0029 BRWN MSND 0AY MSND 0073 BRWN MSND 0075 CLAY 0010 M40 GREY CLAY 0178 MSND 0196 BRWN LOAM 0AM MSND 0054 BRWN FSND 0063 BRWN LOAM 0AY SAND 0041 GREY SAND 0049 BRWN S BRWN LOAM 0WD 0055 BRWN CLAY SA6 BRWN CLAY STNS HARD 0024 GREY CLD 0068 BRWN CLAY DNSE 0086 BRWN CLD 0145 BRWN CLAY SAND STNS 0160 GRD LYRD 0170 RED CLAY SAND STNS 0LY STNS SILT 0195 GREY SHLE CLAY LTY SHLE DNSE 0252 BLCK LOAM 0QY 0018 BRWN SAND 0036 GREY SAND 00 BRWN LOAM HAN SAND CLAY HARD 0048 BRWN SAND PQN CLAY HARD 0067 SANSONE C BRWN CLAY IGRVL 0064 MSND 0075
57	CON	01 019	49- 00031	591615 4857380	1005	1961/05 1308	30	FR	0062	62		7	:	ST					
58	CON	01 019	49- 03339	591620 4857420	1000	1969/11 3316	05	FR	0178	75	86	12	2 : 0	ST	DO0179	15			
59	HS E	06 002	49- 00671	591275~ 4857228	1005	1956/12 1307	36	FR	0054	54		1	:	DO					
60	HS E	06 002	49- 05179	591600 4857190	995	1977/06 3612	30	UK	0049	49	63	2	1 : 30	DO					
61	HS E	06 002	49- 00672	591235~ 4857142	1003	1957/11 1307	36	FR	0037	37		3	:	DO					
62	HS E	06 007	49- 06861	589559 4859248	1129	1988/04 3903	06	FR	0160				:	MN NU					
63	HS E	06 007	49- 04754	589517 4859134	1140	1975/09 3612	30	UK	0020	18	38	3	1 : 0	DO					
64	HS E	06 007	49- 05738	589400 4859300	1200	1980/11 4919	30	UK	0048	48	64		0 : 30	DO					
65	HS E	6 8	49- 681	588909 4859849	1230	08/64	4813	7	FR	64	35	40	10	3/00	CO				

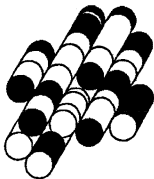
# APPENDIX B

**TERRAPROBE INC.**



**BOREHOLE LOGS**

SAMPLING METHOD		PENETRATION RESISTANCE		
SS	split spoon	<b>Standard Penetration Test (SPT)</b> resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).		
ST	Shelby tube			
AS	auger sample			
WS	wash sample			
RC	rock core			
WH	weight of hammer	<b>Dynamic Cone Test (DCT)</b> resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.).		
PH	pressure, hydraulic			
SOIL DESCRIPTION - COHESIONLESS SOILS		SOIL DESCRIPTION - COHESIVE SOILS		
Relative Density	'N' value	Consistency	Undrained Shear Strength, kPa	'N' value
very loose	< 4	very soft	< 12	< 2
loose	4 - 10	soft	12 - 25	2 - 4
compact	10 - 30	firm	25 - 50	4 - 8
dense	30 - 50	stiff	50 - 100	8 - 16
very dense	> 50	very stiff	100 - 200	16 - 32
		hard	> 200	> 32
SOIL COMPOSITION		TESTS, SYMBOLS		
	% by weight	MH	mechanical sieve and hydrometer analysis	
'trace' (e.g. trace silt)	< 10	w, w <sub>c</sub>	water content	
'some' (e.g. some gravel)	10 - 20	w <sub>l</sub>	liquid limit	
adjective (e.g. sandy)	20 - 35	w <sub>p</sub>	plastic limit	
'and' (e.g. sand and gravel)	35 - 50	I <sub>p</sub>	plasticity index	
		k	coefficient of permeability	
		Y	soil unit weight, bulk	
		φ'	angle of internal friction	
		c'	cohesion shear strength	
		C <sub>c</sub>	compression index	
GENERAL INFORMATION, LIMITATIONS				
The conclusions and recommendations provided in this report are based on the factual information obtained from the boreholes and/or test pits. Subsurface conditions between the test holes may vary.				
The engineering interpretation and report recommendations are given only for the specific project detailed within, and only for the original client. Any third party decision, reliance, or use of this report is the sole and exclusive responsibility of such third party. The number and siting of boreholes and/or test pits may not be sufficient to determine all factors required for different purposes.				
It is recommended Terraprobe be retained to review the project final design and to provide construction inspection and testing.				



# Terraprobe

## LOG OF BOREHOLE 1

PROJECT: Proposed Residential Subdivision

DATE: 19 January 2001

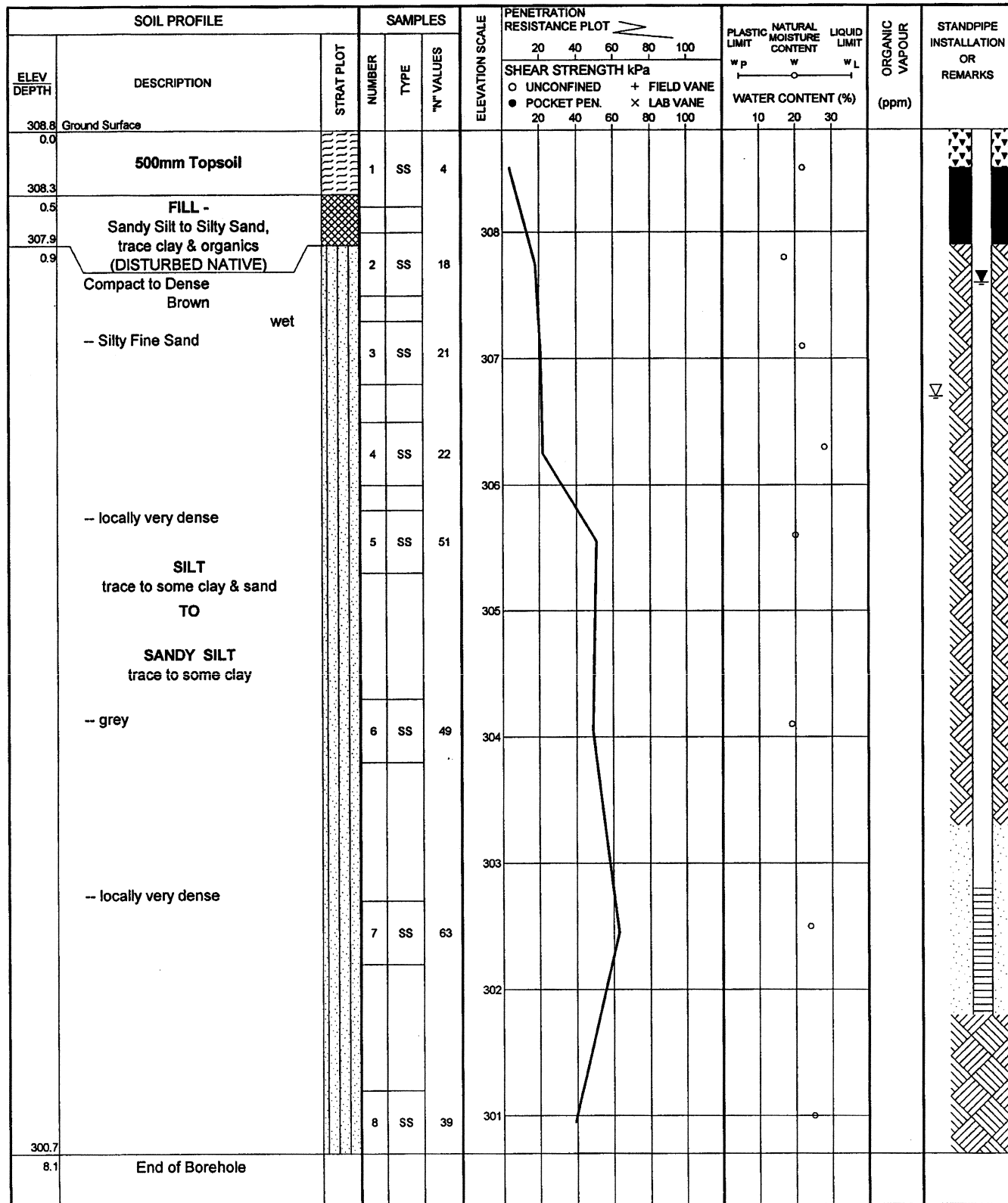
LOCATION: Caledon East, Ontario

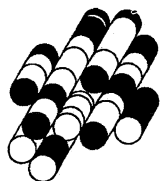
EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

FILE: 01109





# Terraprobe

## LOG OF BOREHOLE 2

PROJECT: Proposed Residential Subdivision

DATE: 19 January 2001

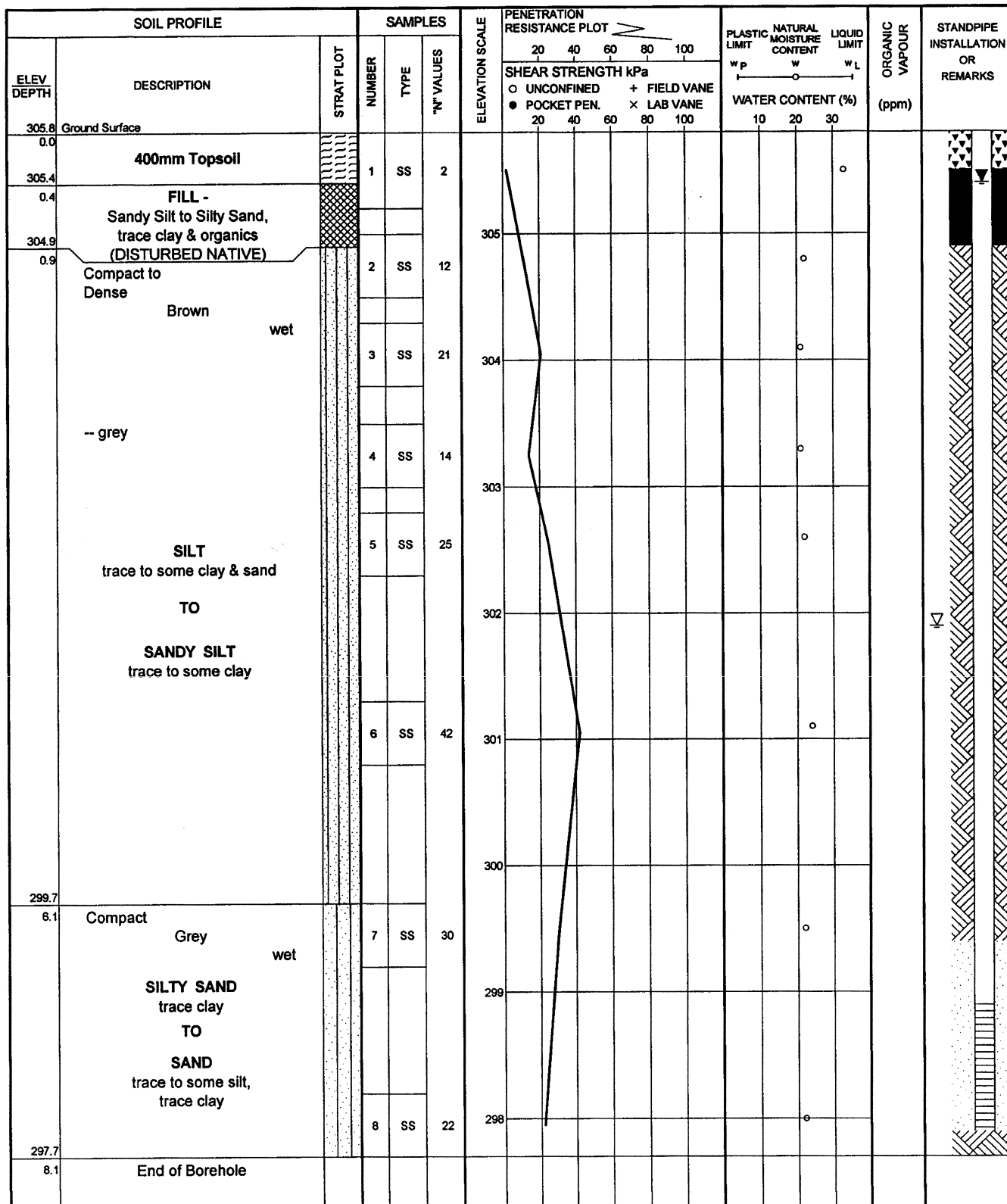
LOCATION: Caledon East, Ontario

EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

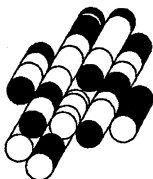
FILE: 01109



### NOTES:

Borehole was open and water level at 3.9m depth on completion of drilling. Water level in standpipe at 0.4m depth on January 29, 2001.





# Terraprobe

## LOG OF BOREHOLE 3

PROJECT: Proposed Residential Subdivision

DATE: 19 January 2001

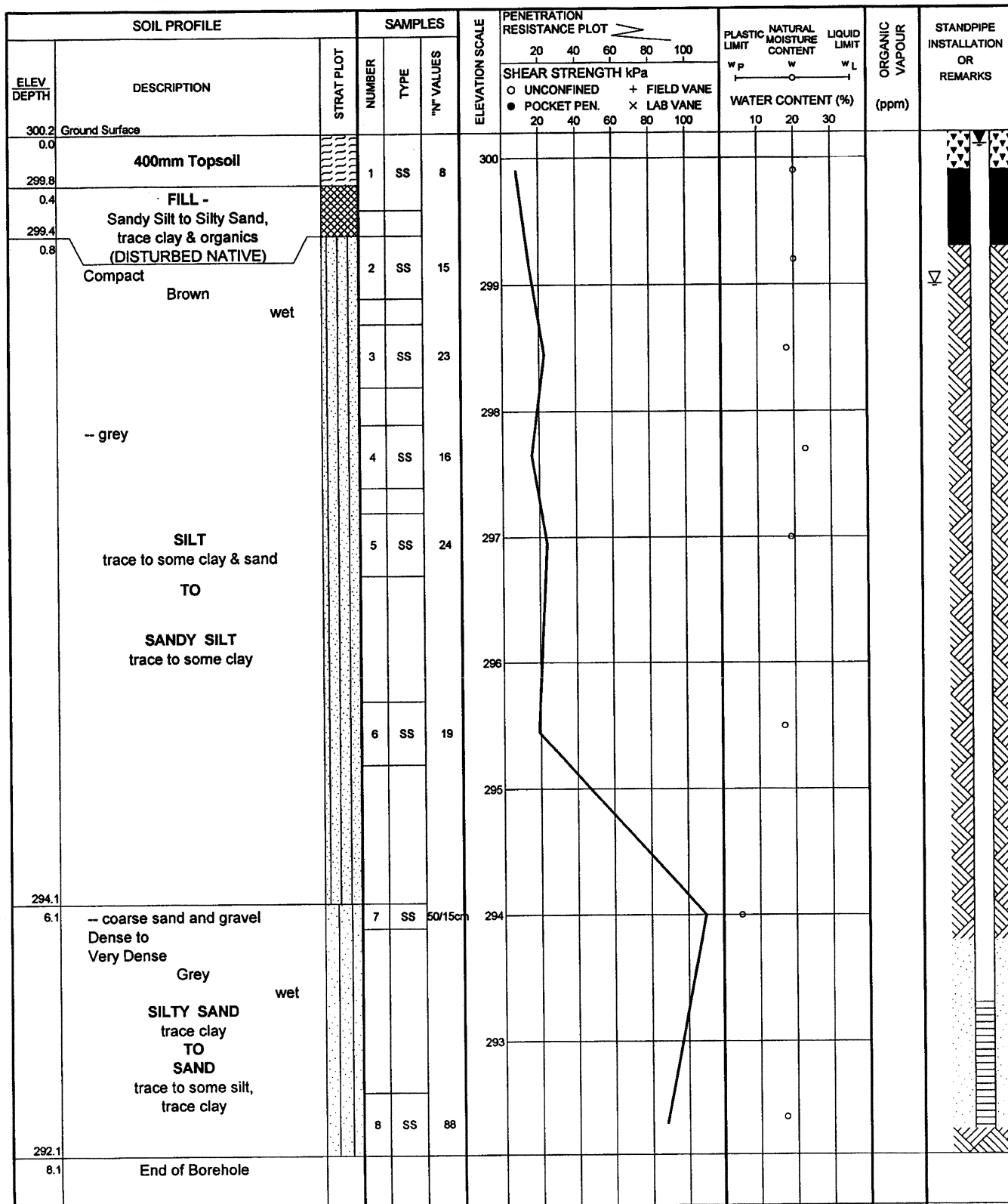
LOCATION: Caledon East, Ontario

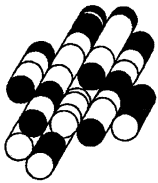
EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

FILE: 01109





# Terraprobe

## LOG OF BOREHOLE 4

PROJECT: Proposed Residential Subdivision

DATE: 18 January 2001

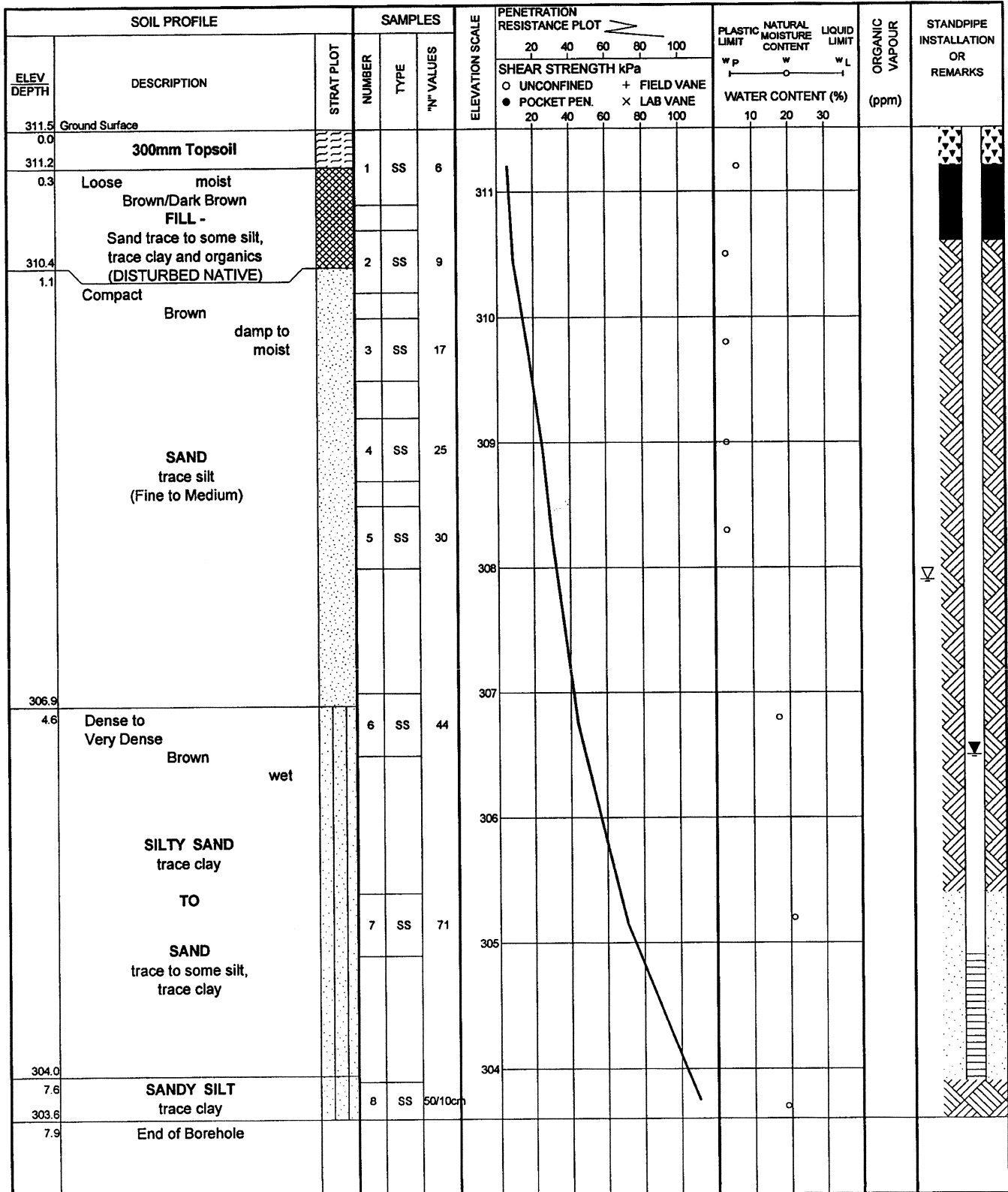
LOCATION: Caledon East, Ontario

EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

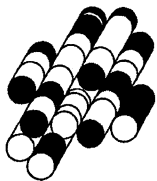
ELEVATION DATUM: Geodetic

FILE: 01109



### NOTES:

Borehole was caving at 4.2m and water level at 3.6m depth on completion of drilling. Water level in standpipe at 5.0m depth on January 29, 2001.



# Terraprobe

## LOG OF BOREHOLE 5

PROJECT: Proposed Residential Subdivision

DATE: 18 January 2001

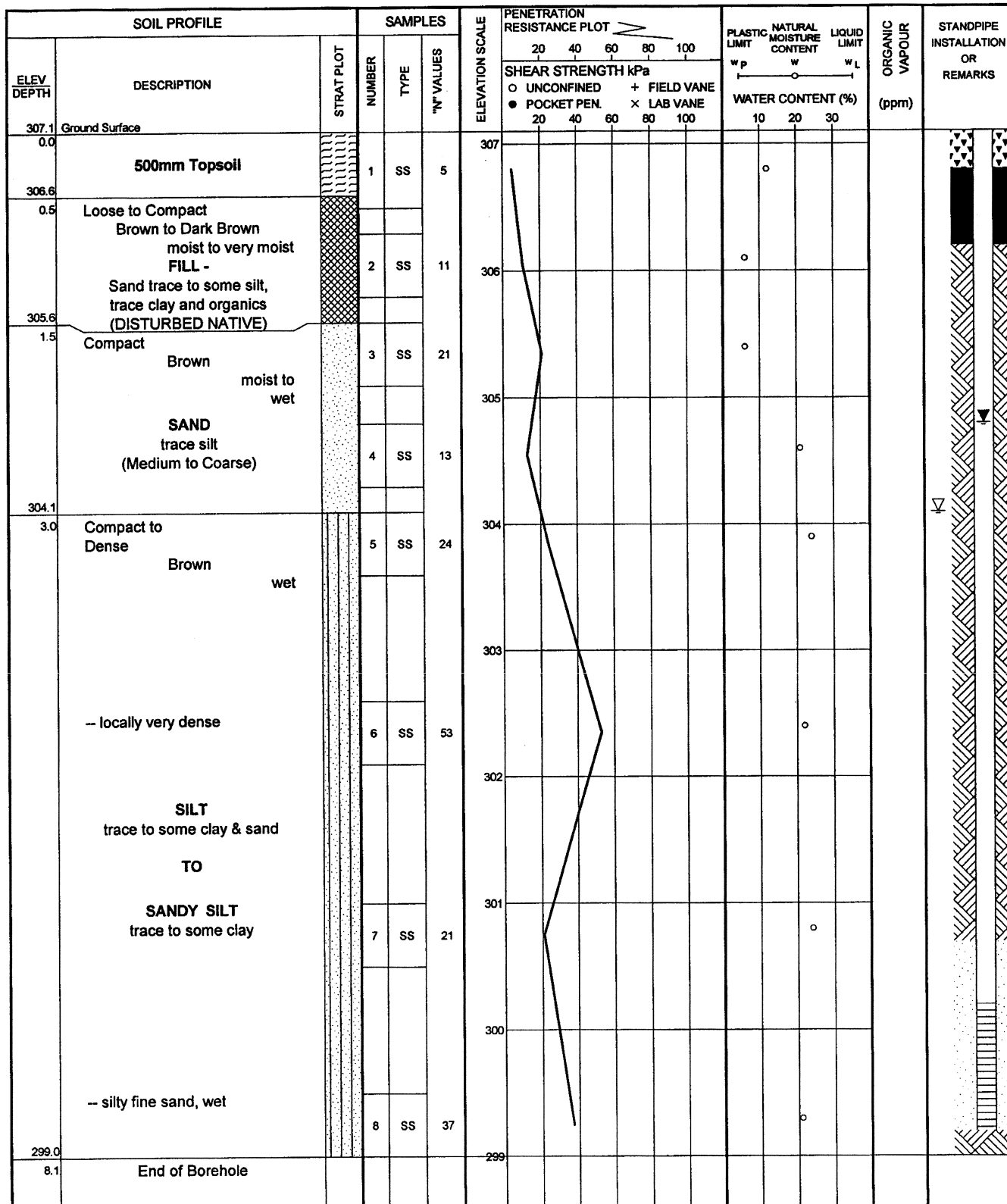
LOCATION: Caledon East, Ontario

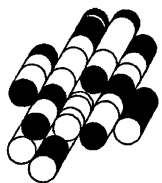
EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

FILE: 01109





# Terraprobe

## LOG OF BOREHOLE 6

PROJECT: Proposed Residential Subdivision

DATE: 18 January 2001

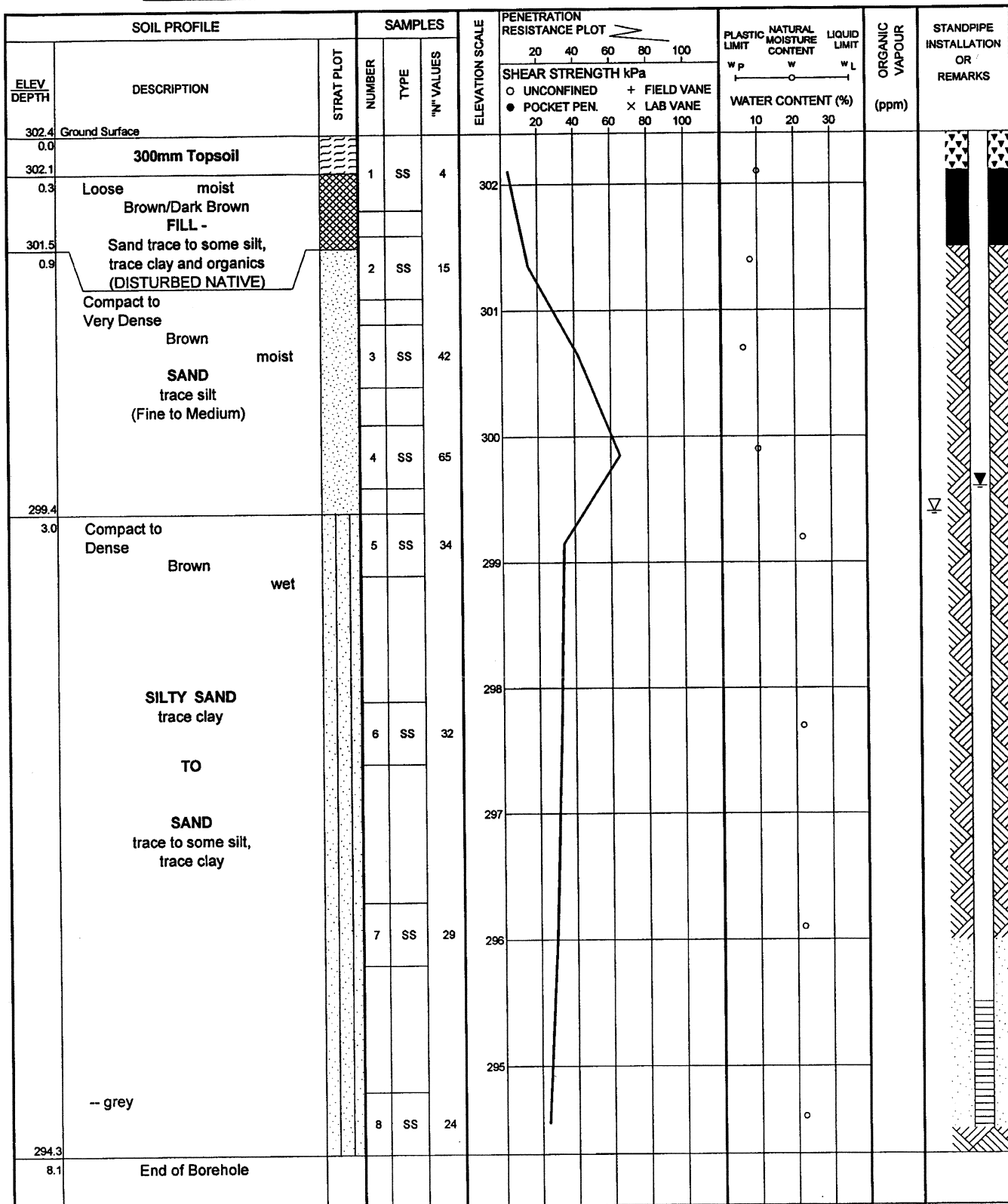
LOCATION: Caledon East, Ontario

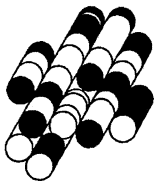
EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

FILE: 01109





# Terraprobe

## LOG OF BOREHOLE 7

PROJECT: Proposed Residential Subdivision

DATE: 22 January 2001


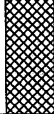


LOCATION: Caledon East, Ontario

EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

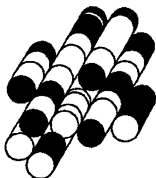
ELEVATION DATUM: Geodetic

FILE: 01109

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● POCKET PEN. x LAB VANE	PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES					
298.2	Ground Surface									
0.0 298.0	150mm Topsoil									
0.2	Loose wet Brown/Dark Brown FILL - Sand trace to some silt, trace clay and organics (DISTURBED NATIVE)		1	SS	6	298				▽
297.3	Compact wet Brown		2	SS	23	297				
0.9	SAND trace silt (Fine to Medium)		3	SS	17	296				
295.9	Dense to Very Dense Brown/Grey moist		4	SS	50/8cm	295				
2.3	SILTY SAND some gravel and clay (TILL)		5	SS	43	294				
293.4	End of Borehole		6	SS	50/10cm					
4.8										

### NOTES:

Borehole was caving at 1.4m and water level at 0.5m depth on completion of drilling.



# Terraprobe

## LOG OF BOREHOLE 8

PROJECT: Proposed Residential Subdivision

DATE: 22 January 2001

LOCATION: Caledon East, Ontario

EQUIPMENT: Trackmount 6M2

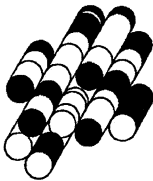
CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

FILE: 01109

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
309.0	Ground Surface					309						
0.0	350mm Topsoil		1	SS	4							
308.6												
0.4	Loose moist Brown/Dark Brown FILL - Sand trace to some silt, trace clay and organics (DISTURBED NATIVE)		2	SS	4							
307.5												
1.5	Compact to Dense Brown moist SILT trace to some clay & sand TO SANDY SILT trace to some clay - grey, locally very dense		3	SS	15							
			4	SS	26							
			5	SS	40							
			6	SS	89							
304.0	End of Borehole					304						
5.0												

NOTES:  
Borehole was open and dry on completion of drilling. Standpipe dry on January 29, 2001.



# Terraprobe

## LOG OF BOREHOLE 9

PROJECT: Proposed Residential Subdivision

DATE: 22 January 2001

LOCATION: Caledon East, Ontario

EQUIPMENT: Trackmount 6M2

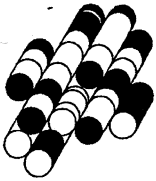
CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

FILE: 01109

SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
304.8	Ground Surface											
0.0	350mm Topsoil		1	SS	5							
304.4	FILL -											
0.4	Sandy Silt to Silty Sand,											
304.0	trace clay & organics											
0.8	(DISTURBED NATIVE)											
	Dense Brown very moist		2	SS	40							
303.3	SAND											
	trace silt											
1.5	(Medium to Coarse)											
	Dense to		3	SS	43							
	Very Dense											
	Brown/Grey											
	moist											
			4	SS	73							
	SILTY SAND											
	some gravel and clay		5	SS	78							
	(TILL)											
300.1			6	SS	50/13cm							
4.7	End of Borehole											

NOTES:  
Borehole was open and dry on completion of drilling.



# Terraprobe

## LOG OF BOREHOLE 10

PROJECT: Proposed Residential Subdivision

DATE: 22 January 2001

LOCATION: Caledon East, Ontario

EQUIPMENT: Trackmount 6M2

CLIENT: Valley Grove Investments

ELEVATION DATUM: Geodetic

FILE: 01109

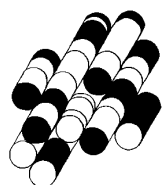
SOIL PROFILE			SAMPLES			ELEVATION SCALE	PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
306.3	Ground Surface											
0.0												
306.0	300mm Topsoil		1	SS	10							
0.3	Compact wet Brown/Dark Brown FILL -											
305.4	Sandy Silt to Silty Sand, trace clay & organics (DISTURBED NATIVE)		2	SS	16							
0.9	Compact Brown wet		3	SS	24							
	SILTY SAND trace clay		4	SS	28							
	TO											
	SAND trace to some silt, trace clay		5	SS	17							
301.8												
4.6	SILTY SAND TILL		6	SS	50/15cm							
301.6	End of Borehole											
4.7												

NOTES:  
Borehole was caving at 2.4m depth and dry on completion of drilling.



# APPENDIX C

**TERRAPROBE INC.**



**TABLE 1: DETAILED WATER BALANCE -  
PROPOSED LEXIS-BAYVIEW CALEDON EAST SUBDIVISION, CALEDON, ONTARIO**

**1. Climate Information**

Precipitation	863 mm/a	0.863 m/a
Evapotranspiration	550 mm/a	0.55 m/a
Water Surplus	313 mm/a	0.313 m/a

**2. Infiltration Rates**

*Table 2 Approach - Infiltration Factors*

Hilly Land	0.1
Open sandy loam	0.4
Cover-Cultivated	0.1
TOTAL	0.6

Infiltration (0.6 x 313)	188 mm/a	0.188 m/a
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Run-off (313-188)	125 mm/a	0.125 m/a
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*Table 3 Approach - Typical Recharge Rates*

silty sand to sandy silt	150 - 200 mm/a
silt	125 - 150 mm/a
clayey silt	100 - 125 mm/a

Site development area is underlain by silty sand to sandy silt

Based on the above, the recharge rate is approximately	188 mm/a	0.188 m/a
with runoff of	125 mm/a	0.125 m/a

**3. Property Statistics**

**Pre- development lot coverage**

Lot Area	18.85 ha	188,453 m <sup>2</sup>
<b>Existing Lot Area</b>	18.85 ha	188,453 m <sup>2</sup>

**4. Post- development lot coverage**

**A) Southwest Portion (Town Homes)**

<b>Developable Area</b>	2.061 ha	20,606 m <sup>2</sup>
<b>Allowable Impervious Area (50% of Developable area)</b>	1.303 ha	13,030 m <sup>2</sup>
<b>a) Proposed Building Area/Rooftops</b>		
Building Area/ Rooftops Coverage	0.479 ha	4,792 m <sup>2</sup>
<b>b) Hard surfaces</b>		
Private Road/ Parkind Area Paved or Asphalt Surfaced	0.189 ha	1,890 m <sup>2</sup>
<b>c) Proposed Pervious Driveway area</b>		
Total Pervious Driveway area	0.143 ha	1,432 m <sup>2</sup>
Assume gravel covered with 70% permeability	0.100 ha	1,002 m <sup>2</sup>
Impervious driveway area with 30% impermeability	0.043 ha	430 m <sup>2</sup>
<b>Impervious layers (outside the developable areas)</b>		
<b>d) Paved / Asphalt (Driveways)</b>	0.120 ha	1,196 m <sup>2</sup>
<b>Proposed Total Development Area (a+b+c+d)</b>	0.831 ha	8,308 m <sup>2</sup>

**B) Northeast Portion (Single Residential)**

<b>Developable Area</b>	0.220 ha	2,197 m <sup>2</sup>
<b>Allowable Impervious Area (50% of Developable area)</b>	0.110 ha	1,098 m <sup>2</sup>
<b>a) Proposed Building Area/Rooftops</b>		
Building Area/ Rooftops Coverage/Deck	0.048 ha	478 m <sup>2</sup>
<b>b) Proposed Pervious Driveway area</b>		
Total Pervious Driveway area	0.046 ha	459 m <sup>2</sup>
Assume gravel covered with 70% permeability	0.032 ha	321 m <sup>2</sup>
Impervious driveway area with 30% impermeability	0.014 ha	138 m <sup>2</sup>
<b>Impervious layers (outside the developmental areas)</b>		
<b>c) Paved / Asphalt (Driveways)</b>	0.088 ha	884 m <sup>2</sup>
<b>Proposed total Development Area (a+b+c)</b>	0.150 ha	1,500 m <sup>2</sup>
<b>C) Total Impervious layers (outside the developmental areas)</b>		
Southwest Portion- Paved / Asphalt (Driveways)	0.120 ha	1,196 m <sup>2</sup>
Northeast- Paved / Asphalt (Driveways)	0.088 ha	884 m <sup>2</sup>
<b>Total Impervious layers outside the developmental areas for site</b>	0.208 ha	2,080 m <sup>2</sup>

<b>D) Proposed Building Area/Rooftops for the entire site</b>	0.53 ha	5,270 m <sup>2</sup>
<b>E) Hard/ Impervious surfaces for the entire site</b>	0.45 ha	4,537 m <sup>2</sup>
<b>F) Proposed Pervious Driveway area for the entire site</b>	0.13 ha	1,324 m <sup>2</sup>
<b>G) Open Space/ Landscape</b>		

**TABLE 1: DETAILED WATER BALANCE -  
PROPOSED LEXIS-BAYVIEW CALEDON EAST SUBDIVISION, CALEDON, ONTARIO**

Total Open Space/ Landscape within the development areas and the remainder of the site	17.73	177,322	m <sup>2</sup>
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**TABLE 1: DETAILED WATER BALANCE -  
PROPOSED LEXIS-BAYVIEW CALEDON EAST SUBDIVISION, CALEDON, ONTARIO**

**5. Annual Pre-Development Water Balance**

Land Use	Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-Off (m <sup>3</sup> )
Existing Buildings & Hard surfaces	nil	nil	nil	nil	nil
Open Space/Landscape	188,453	162,635	103,649	35,429	23,557
<b>Total</b>	<b>188,453</b>	<b>162,635</b>	<b>103,649</b>	<b>35,429</b>	<b>23,557</b>

**6. Annual Post-Development Water Balance**

Land Use	Area (m <sup>2</sup> )	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-Off (m <sup>3</sup> )
Building/Roof tops Coverage (entire site)	5,270	4,548	nil	nil	4,548
Hard surfaces (entire site)	4,537	3,916	nil	nil	3,916
Landscape (entire site)	177,322	153,029	97,527	33,337	22,165
Proposed Pervious Driveway (70% Peameability)	1,324	1,142	728	249	165
<b>TOTAL</b>	<b>188,453</b>	<b>162,635</b>	<b>98,255</b>	<b>33,585</b>	<b>30,794</b>

**7. Comparison of Pre-Development and Post-Development**

	Precipitation (m <sup>3</sup> )	Evapotranspiration (m <sup>3</sup> )	Infiltration (m <sup>3</sup> )	Run-Off (m <sup>3</sup> )
Pre-Development	162,635	103,649	35,429	23,557
Post-Development	162,635	98,255	33,585	30,794

**8. Requirement for Infiltration of Roof Runoff**

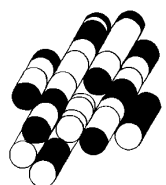
Volume of post-development infiltration	33,585	m <sup>3</sup>
Volume of pre-development Infiltration	35,429	m <sup>3</sup>
Deficit from pre to post-development infiltration	1,844	m <sup>3</sup>
Percentage of total roof runoff required to match pre-development infiltration	41	%

Note: Totals may vary slightly due to rounding of values during calculation.

**TABLE 1: DETAILED WATER BALANCE -  
PROPOSED LEXIS-BAYVIEW CALEDON EAST SUBDIVISION, CALEDON, ONTARIO**

# APPENDIX D

**TERRAPROBE INC.**





May 29, 2013

File No. 13-13-3081-6  
Brampton Office

Dear Resident/ Property Owner:

---

**RE: PRIVATE WELL INVENTORY  
PROPOSED LEXIS- BAYVIEW, CALEDON EAST  
SUBDIVISION, CALEDON, ONTARIO**

---

Terraprobe Inc. was retained by 2031818 Ontario Limited c/o Lexis Bayview Developments, to undertake a private well inventory for properties within the vicinity of their property identified as Proposed Lexis-Bayview, Caledon East Subdivision. The proposed development is located on the east side of Airport Road approximately 600 m north of Old Church Road in the community of Caledon East, Ontario. The well inventory is being conducted to identify private wells within the vicinity of the proposed development.

The purpose of our visit is to conduct interviews with local residents and land owners in regards to water supply wells in operation surrounding the development project. The information we hope to obtain will include:

1. The Location of the well(s) and septic bed (if known)
2. The depth, diameter and construction details of the well(s);
3. The pump type and depth, and any water treatment systems in use;
4. Information regarding the past performance of the well(s);

A copy of the completed questionnaire will be provided upon request. We anticipate that these questions can be answered in a few minutes. If there is access to your well, and with your permission, our representatives will measure the depth and level of water in your well.

Although you were not at home today when we visited, our staff will be working in the area for the next several weeks. If you would like to participate in the survey, and there is a particular time that suits your schedules, please contact Samuel Oyedokun of Terraprobe at (905) 796-2650, any question you may have regarding the survey can also be answered at that time. When calling please reverse the long distance charges and indicate to the receptionist that you are calling in regards to the "Proposed Lexis-Bayview

---

**Terraprobe Inc.**

**Greater Toronto**

11 Indell Lane  
Brampton, Ontario L6T 3Y3  
(905) 796-2650 Fax: 796-2250

**Hamilton – Niagara**

903 Barton Street, Unit 22  
Stoney Creek, Ontario L8E  
(905) 643-7560 Fax: 643-7559

**Central Ontario**

220 Bayview Drive, Unit 25  
Barrie, Ontario L4N 4Y8  
(705) 739-8355 Fax: 739-8369

**Northern Ontario**

1012 Kelly Lake Rd., Unit 1  
Sudbury, Ontario P3E 5P4  
(705) 670-0460 Fax: 670-0558

[www.terraprobe.ca](http://www.terraprobe.ca)

Caledon East, Subdivision, Well Survey”. Our receptionist is available during regular working hours of 8:30 am to 5 pm. The questionnaire may also be completed over the telephone, or the attached questions can be answered and forwarded via email to [soyedokun@terraprobe.ca](mailto:soyedokun@terraprobe.ca).

We understand that your participation in this survey is voluntary; however your co-operation is greatly appreciated. Thank you for your consideration of our private well inventory.

Yours truly,  
**Terraprobe Inc.**

Samuel Oyedokun, B.Eng., PMP®

*Brampton Office*





# Terraprobe

Consulting Geotechnical & Environmental Engineering  
Construction Materials Engineering, Inspection & Testing

May 29, 2013

File No. 13-13-3081-6  
Brampton Office

Dear Resident/Property Owner:

---

**RE: PRIVATE WELL INVENTORY  
PROPOSED LEXIS-BAYVIEW CALEDON EAST  
SUBDIVISION, CALEDON, ONTARIO**

---

If you have received the attached letter regarding the above mentioned water well inventory, it's because you were unavailable at the time of door-to-door canvassing and if you would like to participate in the well survey we ask that you please contact Samuel Oyedokun of Terraprobe at (905) 796-2650 or by email at [soyedokun@terraprobe.ca](mailto:soyedokun@terraprobe.ca).

If replying to the well survey by telephone or email, the following information pertaining to the well is requested, if known:

- Type of well (i.e. drilled, dug, bored)
- Casing material (i.e. Metal, concrete, stone, etc.)
- Pump type & depth (i.e. Submersible [Pump in well]/Jet Pump [Pump in house])
- Water treatment systems in use (i.e. Water Softener, Reverse Osmosis, UV light)
- Date well was constructed
- Depth of well
- Use of the well (i.e. Residential/Agriculture/Livestock/Commercial etc.)
- Number of residents/people well supplies water
- Past water quality problems with well (i.e. High bacteria levels, high iron, etc.)
- Past water quantity problems with well (i.e. Does/has well run dry in past, why?)
- Is well water consumed, or is water purchased for consumption (i.e. bottled water)
- Any past operating problems with well detailing the nature of the problem and when it occurred.

Your response and participation in our water well monitoring program is appreciated. Thank you for your consideration in this matter.

---

**Terraprobe Inc.**

**Greater Toronto:**  
11 Indell Lane  
Brampton, ON L6T 3Y3  
Tel: (905) 796-2650  
Fax: (905) 796-2250  
[brampton@terraprobe.ca](mailto:brampton@terraprobe.ca)

**Hamilton-Niagara:**  
903 Barton Street, #22  
Stoney Creek, ON L8E 5P5  
Tel: (905) 643-7560  
Fax: (905) 643-7559  
[stoneycreek@terraprobe.ca](mailto:stoneycreek@terraprobe.ca)

**Central Ontario:**  
220 Bayview Drive, #25  
Barrie, ON L4N 4Y8  
Tel: (705) 739-8355  
Fax: (705) 739-8369  
[barrie@terraprobe.ca](mailto:barrie@terraprobe.ca)

**Northern Ontario:**  
1012 Kelly Lake Rd., #1  
Sudbury, ON P3E 5P4  
Tel: (705) 670-0460  
Fax: (705) 670-0558  
[sudbury@terraprobe.ca](mailto:sudbury@terraprobe.ca)

[www.terraprobe.ca](http://www.terraprobe.ca)