HYDROGEOLOGIC INVESTIGATION
PROPOSED BRYNE DRIVE EXTENSION FROM VETERAN’S DRIVE TO COMMERCE PARK DRIVE AND NORTH ALONG BRYNE DRIVE TO ESSA ROAD
BARRIE, ONTARIO

Prepared For: City of Barrie
70 Collier Street
P.O. Box 400
Barrie, ON, L4M 4T5
Attention: Mr. Ralph Scheunemann, P.Eng.

Distribution of Report:
1 copy - City of Barrie
1 copy - LGL Limited
1 copy - Terraprobe Limited, Brampton

File No. 1-05-0337
November 30, 2005
© Terraprobe Limited
# TABLE OF CONTENTS

1.0 INTRODUCTION ........................................................................................................... 1

2.0 SCOPE OF WORK .......................................................................................................... 2

3.0 RESULTS OF INVESTIGATION .................................................................................... 3
   3.1 Site Location and Current Land Use ...................................................................... 3
   3.2 Project Description ................................................................................................. 3
   3.3 Site Topography and Drainage ............................................................................. 3
   3.4 Local Geology ......................................................................................................... 4
   3.5 Hydrogeologic Studies ........................................................................................... 5
   3.6 Results of Site Inspection ...................................................................................... 7

4.0 DISCUSSION AND RECOMMENDATIONS ................................................................. 9
   4.1 Identification of Principle Hydrogeologic Features .............................................. 9
   4.2 Summary of Hydrogeologic Features .................................................................. 9
   4.3 Potential Impact of Proposed Undertaking ......................................................... 10
   4.4 Mitigation Measures ............................................................................................. 10
   4.5 Requirements for Further Study or Monitoring ................................................ 11

5.0 SUMMARY AND CONCLUSIONS ............................................................................. 12

Figure 1 - Site Location Plan
Figure 2 - Site Plan
Figure 3 - Geologic Mapping
1.0 INTRODUCTION

Terraprobe was retained by the City of Barrie to conduct a Hydrogeologic Investigation for the proposed Bryne Drive/Commerce Park Drive Extension. The study site is located in the southern portion of the City of Barrie as presented in Figure 1 and 2.

In order to accommodate existing and future traffic needs in the southern portion of Barrie, the City is examining the need to connect Bryne Drive, located north of Harvie Road to Bryne Drive located south of Harvie Road as well as from Veteran’s Drive to Commerce Park Drive.

A hydrogeologic investigation is required to satisfy the Schedule “C” guidelines that are outlined in the Municipal Class Environmental Assessment (Class EA).
2.0 SCOPE OF WORK

The work program for this study consisted of the following:

1. **Detailed Site Inspection** - A detailed site inspection was conducted to assess the current site conditions. The site inspection included the assessment of surface soil types, inspection for visible evidence of groundwater discharge features such as phreatophytic vegetation (ie. vegetation that requires groundwater discharge such as water cress), springs, seeps and the like. In addition, surface drainage features and topography were assessed to determine potential groundwater recharge in the area.

2. **Review of available geologic mapping for the area** - This included a review of MOE well records, geologic and topographic mapping.

3. **Review of previous geotechnical reports** - Terraprobe Limited has conducted several soils investigations in the vicinity of the proposed Bryne Drive extension. The reports were reviewed to further assess existing geologic conditions around the study site.

4. **Review of Lake Simcoe Region Conservation Authority files** - The Lake Simcoe Region Conservation Authority was contacted to inquire about the hydrogeologic conditions associated with the Whiskey Creek and Lover’s Creek Tributaries. LSRCA provided excerpts from the Lover’s Creek and Hewitts Creek Master Watershed Plans and an electronic copy of the South Simcoe Municipal Groundwater Study. The Conservation Authority also provided the Lake Simcoe Region Conservation Authority Environmental Impact Statement, Terms of Reference, Recharge Discharge E.S.A.’s for review.

5. **Report preparation** - An engineering report was prepared following the completion of the site inspection and review of all available information.
3.0 SITE AND PROJECT DESCRIPTION

3.1 Study Area and Current Land Use

The study area is located in the southern portion of the City of Barrie along the Bryne Drive and Commerce Park Drive road alignment (Figure 1). The area is generally bounded by Essa Road to the north, Highway 400 to the east, Salem Road to the south and Veteran’s Drive to the west.

Land surrounding the proposed Bryne Drive extension is currently occupied by open field, commercial, residential and industrial developments. In the vicinity of Essa Road and Bryne Drive, in the northern portion of the study area, the land use consists mainly of residential and commercial developments. The land east of the study area is occupied by Highway 400 and various commercial and industrial properties. South of the site, in the vicinity of Bryne Drive and Commerce Park Drive, the land use is comprised of commercial and industrial developments. Immediately west of the study area along Veteran’s Drive, the lands are occupied by residential and commercial developments. The land immediately adjacent to the proposed alignment will be ultimately developed for industrial and commercial uses.

3.2 Project Description

The City of Barrie has identified a need to extend Bryne Drive to meet the increased traffic demands in the south end of Barrie. This involves connecting Bryne Drive in the north from Essa Road to Commerce Park Drive and in the south from Veteran’s Drive to Commerce Park Drive (Figures 1 and 2).

As part of the examination, the project is following the Schedule “C” guidelines contained in the Municipal Class Environmental Assessment, dated June 2000. The Class EA ensures that all natural, social, heritage, and economic environmental effects are considered during the planning stages of a project.

3.3 Site Topography and Drainage

The site is characterized by a flat to gently rolling topography that generally slopes towards Highway 400 in the east. Drainage across the study area is directed easterly. The study site is situated within the upper reaches of the Hotchkiss Creek, Lovers Creek and Whiskey Creek watersheds. It is situated immediately east of the drainage divide with the Nottawassaga watershed.
Hotchkiss Creek, Whiskey Creek and a Lover’s Creek Tributary are located in the northern portion of the study area. A stormwater management facility, out-letting into another Lover’s Creek Tributary is located in the southern portion of the study area (Commerce Park Drive). Hotchkiss Creek, Whiskey Creek and the two Lovers Creek tributaries drain easterly, under Highway 400 (Figure 2). Each water course ultimately empties into Kempenfelt Bay.

Whiskey Creek meanders in a north east direction towards Highway 400 in the vicinity of Harvie Road. Approximately 300 m upstream from Highway 400, and south of Harvie Road, in the vicinity of the new residential subdivisions, a stormwater management facility has been constructed within the creek alignment. A beaver dam was observed approximately 200 m upstream from Highway 400. A tributary to Whiskey Creek crosses under Harvie Road west of the proposed Bryne Drive extension where it meanders under a thick cover of vegetation, for approximately 100 m before joining the main channel of Whiskey Creek.

A Lover’s Creek Tributary is located approximately 600 m south of Whiskey Creek and Harvie Road. Within the proposed Bryne Drive alignment, the creek is intermittent and lacks a distinct form. A small woodlot is located east of the proposed Bryne Drive extension. At the eastern edge of this woodlot (approximately 100 m west of Highway 400) a more distinct channel feature develops. A minor amount of flowing water was present within a meandering channel during the site inspection.

The Hotchkiss Creek catchment extends into the northern portion of the study area. The channel of Hotchkiss Creek daylights south of Bryne Drive and east of the proposed Bryne Drive alignment. The area in the vicinity of Bryne Drive and Essa Road has generally been developed with commercial and industrial uses.

The study area south of Mapleview Drive is located in the headwaters for a Lovers Creek tributary that daylights east of Bryne Drive. Portions of the southern study area have generally been developed for commercial and industrial uses. Drainage in the area is directed to a stormwater management facility located in the north-east corner of Bryne Drive and Commerce Park Drive. The facility outlets into the Lover’s Creek tributary.

### 3.4 Local Geology

The study area is characterized by surficial, glaciofluvial deposits of fine to coarse sand and gravel with minor amounts of silt and clay. Geologic mapping for the Barrie area (Ontario Geologic Survey, *Quaternary Geology, Eastern Half of the Barrie and Elmvale Areas*, Map 2645, 1997) indicates that a surficial sandy deposit extends from the northern portion of the study area near Bryne Drive and Essa Road to the southern
Road and Whiskey Creek, the geologic mapping also indicates the presence of surficial glaciolacustrine silt and clay deposits. West of Commerce Park Drive, the surficial deposits are comprised of a silty sand to sand till.

Terraprobe has completed several geotechnical investigations in the vicinity of the study area. Review of the field information collected for these investigations confirms the soil conditions presented on the geologic mapping. The investigations generally encountered well drained sand to silty sand soils near Bryne Drive. Low permeability clayey silt to silty clay soils were encountered near Harvie Road.

3.5 Hydrogeologic Studies

The Lake Simcoe Region Conservation Authority (LSRCA) was contacted to obtain information relevant to the hydrogeologic investigation. Terraprobe received an excerpt from the, Lover’s Creek and Hewitts Creek Master Watershed Plan prepared by Cumming Cockburn Limited, dated December 1995. The LSRCA did not provide any information relating to the Whiskey Creek watershed. A summary of the Lover’s Creek excerpt is provided below.

- The Lover’s Creek watershed drains an area of approximately 58.2 km² in the Town of Innisfil and the City of Barrie. The watershed is characterized in the east by a gently rolling till plain and an area of ice contact granular and glacial till deposits in the west. Limestone bedrock underlies the overburden and is typically encountered approximately 130 m below the ground level.

- There are three main aquifer units that have been identified in the vicinity of Lover’s Creek. The aquifer units have been divided into an Upper, Intermediate and Deep aquifer.

- The Upper Aquifer system is the most relevant system for this study, as it provides interaction with the local surface water features. It is associated with the upland feature along the western portion of the watershed (i.e. the study area). The unit is typically encountered at an elevation of 310 to 250 m (geodetic) and characterized by sandy soils. In most cases the Upper Aquifer is exposed at the surface but can also be covered locally with less permeable silt and clay. The sandy soils allow for moderate to high infiltration rates.

- The Intermediate Aquifer occurs beneath the majority of the watershed and is found at elevations ranging between 250 to 220 m. The Deep aquifer underlies the north-east portion of the Lover’s Creek watershed and is encountered at elevations of approximately 180 to 160 m. With the exception
of the City of Barrie municipal wells there are few wells in the watershed that use this deep aquifer for supply. The Upper and Intermediate Aquifer units generally provide sufficient quantity for most uses.

- The entire western side of the watershed is considered an area of groundwater recharge. Groundwater flow in the Upper and Intermediate Aquifer units are considered to be important contributors to baseflow.

- The most significant discharge areas within the Lover’s Creek watershed are associated with the western, sandy soils exposed within the creek valleys. The discharge is diffuse and occurs mainly as broad zones of seepage.

The LSRCA also provided Terraprobe with a copy of the South Simcoe Municipal Groundwater Study (SSMGS) dated August 2004. Information from Appendix E (WHPA - City of Barrie) of the SSMGS is provided below.

- A total of 17 municipal wells have been constructed in the City of Barrie Since 1937. Only 13 of these wells are operational. Eleven wells are located within the central and lakeshore area of the city, three wells are located in the northern portion of the city and one well is located in the southern portion of the city (Well 10) along Huronia Road north of Big Bay Point Road.

- Fifteen of Barrie’s municipal wells are completed into lower aquifer. The remaining two wells were completed into the intermediate aquifer.

- The upper aquifer is largely unconfined and is susceptible to contamination from surface activities.

- Recharge within the City of Barrie is estimated to be low, approximately 164 mm/a (+/- 50 mm/a). The low recharge value is due to increased hard surface cover.

- Groundwater within the city limits flows towards Kempenfelt Bay. The groundwater flow divide corresponds with highland areas surrounding the city.

- Figure 4.4.4 - Potential Major Groundwater Recharge Areas (located in the main body of the report) indicates that a portion of the proposed Bryne Drive alignment from Commerce Park Drive to Veteran’s Drive is located outside of the major recharge area. This recharge area corresponds to the
limits of the surficial sandy soils and the silty sand till soils indicated in Figure 3 - Quaternary Geology Model Area (located in Appendix E). Further investigation during detailed design is required to identify the surficial soils located along the proposed road alignment.

The study area is situated in an urban portion of the City of Barrie. The area is serviced with municipal water obtained from municipal wells. The municipal wells are remote from the study area and do not obtain water from the upper aquifer zone. There is no evidence to suggest that there are any remaining private wells in the area of study.

### 3.6 Results of Site Inspection

A site inspection was conducted to assess the presence of features with potential hydrogeologic significance. In particular the two creeks were inspected to determine areas of significant groundwater seepage/discharge and areas of closed depressions or other topographic features that may suggest enhanced infiltration.

The study area is characterized by a rolling topography with areas of low topography around Hotchkiss Creek, Whiskey Creek and the Lover's Creek Tributaries.

Phreatophytic vegetation (water cress) was observed along the banks of Whiskey Creek from Highway 400 to a beaver dam located approximately 100 m upstream from Harvie Road (Figure 2). The presence of water cress along the inspected length of the creek indicates that there is consistent groundwater discharge or base flow in this area. The height and thickness of vegetation bordering Whiskey Creek made it difficult to observe the presence of any seeps or discharge that occur along the banks. The beaver dam and the stormwater management facility prevented further inspection of Whiskey Creek.

The Lover's Creek Tributary, located approximately 600 m south of Whiskey Creek was inspected in a similar fashion. In the vicinity of the proposed Bryne Drive alignment the Lover's Creek Tributary was dry. There was a distinct valley feature but no continuous channel. This portion of the creek likely supports flow during storm events and spring snow melt. The Lover's Creek Tributary travels through a small wood lot, approximately 100 m long, east of the proposed Bryne Drive alignment. At the eastern edge of the wood lot, approximately 100 m west of Highway 400, a distinct channel feature with minor flow was observed. Flow within the creek increased as the channel meandered towards Highway 400. An “oily” sheen was noted on the water surface in areas of ponded water. Further inspection revealed that the sheen was the result of iron reducing bacteria, indicating that there is consistent base flow or groundwater discharge in the area. No seeps or points of discharge were directly observed along the banks.
As noted previously, the southern portion of the study area is generally developed for commercial and industrial uses. A stormwater management facility located north-east of the Bryne Drive and Commerce Park Drive intersection collects runoff from the surrounding area. In the same area, north-east of Bryne Drive and Commerce Park Drive, a natural water feature supplies water to a Lovers Creek tributary.
4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Identification of Principle Hydrogeologic Features

Based on the results of the site inspection, the following are the principal hydrogeologic features for the study area:

- The study area is characterized by surficial deposits of ice contact sand and gravel soils. These granular soils are permeable and provide potential for moderate to high infiltration capacity.
- Hotchkiss Creek, Whiskey Creek and a Lover's Creek Tributary, located in the northern portion of the study area are situated in broad, low lying areas within the proposed Bryne Drive alignment. Surface drainage is directed towards these low lying areas.
- The presence of phreatophytic vegetation (water cress) in Whiskey Creek and iron reducing bacteria (“oily” sheen) in Lover’s Creek indicate that portions of these creeks receive baseflow from the surrounding soils.
- A natural water feature that supplies water to a Lovers Creek tributary was identified in the southern portion of the study area, south of Mapleview Drive.

4.2 Summary of Hydrogeologic Functions

Based on the hydrogeologic features outlined in Section 4.1, the hydrogeologic functions were assessed. The functions are summarized below:

- The surficial sandy soils provide significant groundwater recharge.
- The infiltration of water through the surficial sandy soils provide recharge of the Upper, Intermediate and Deep Aquifer units.
- The Upper and Intermediate Aquifers, where exposed at the ground surface will supply base flow to creeks and various water features.
4.3 Potential Impact of Proposed Undertaking

The extension of Bryne Drive has the potential to affect the local hydrogeologic features and function within the study area. Potential impacts to the hydrogeologic features are summarized below:

- Surficial sand and gravel soils are located across the study area. The permeability of these soil types permit significant groundwater recharge. Covering the ground surface with hard impermeable surfaces has the potential to decrease the volume of recharge supplied to the Upper, Intermediate and Deep Aquifer units.
- Decreasing the volume of recharge supplied to the Upper and Intermediate Aquifer units will affect the volume of water that can be discharged to creeks, wetlands and other local water features.
- The proposed development has the potential to affect groundwater quality in the study area. Various contaminants associated with road run-off can enter the groundwater system. These include de-icing agents (salts) and petroleum products.
- It is noted that the potential impacts generally apply to the northern portions of the study area. These portions are underlain by sandy soils and there are many natural drainage features. Portions of the southern study area have generally been developed. This area is located in the headwaters for another tributary for Lovers Creek. This tributary daylights east of Bryne Drive.

4.4 Mitigation Measures

The primary hydrogeologic function of the study area is infiltration of precipitation to recharge the aquifer units and supply baseflow to the local water features. In order to maintain the hydrogeologic function of the site, the following general recommendations are provided:

- Maintain pre-development infiltration across the study area by utilizing enhanced infiltration techniques. Infiltration across the site can be maintained by directing run-off to overland flow routes (to promote infiltration) and/or through the use of infiltration galleries.
- The continuity of sand zones must be maintained to ensure baseflow to the local water features. Excavations should be backfilled with material similar to that removed from the excavation in order to minimize the disruption of groundwater flow.
- All underground services should have clay cutoff plugs installed. The plugs will prevent drainage of groundwater along the granular bedding for the services.
- Creek crossings must be designed to minimize disruption of the discharge features of the banks.
• Stormwater quality measures should be put into place to minimize entry of contaminants into the groundwater system. This should include measures such as the use of lined treatment (quality) ponds or oil-grit removal systems. A pro-active de-icing plan should be implemented to minimize application of road salt or other de-icing agents. It is recognized that the City of Barrie currently has an active de-icing program which pro-actively applies a brine solution to roads in advance of adverse weather conditions. The City of Barrie has also installed two Advance Road Weather Information Systems (ARWIS) to optimize the application of road salts and brine solutions.

4.5 Requirements for Further Study or Monitoring

Additional detailed studies will be required during the design stages of development. These studies should include:

• A subsurface investigation and installation of monitoring wells to assess the groundwater elevations and shallow soil characteristics across the study site.
• Installation of mini-piezometers along the banks of Whiskey and Lover’s Creek. The piezometers will assess the creek function as it is related to the current groundwater regime.
• Provision of a site specific water balance should be conducted as design of the development proceeds. The water balance will help to determine requirements for stormwater management and/or enhanced infiltration techniques. Ultimately, the volume of recharge prior to development should be maintained.
• Development of a stormwater quality management plan for the project, which includes a pro-active road salt application procedure.
5.0 SUMMARY AND CONCLUSIONS

1. The study area is characterized by surficial deposits of sand and gravel with minor amounts of silt and clay. Along Harvie Road geologic mapping indicates that there is a surficial deposit of clay and silt. West of Commerce Park Drive, the surficial deposits are comprised of a silty sand to sand till.

2. Inspection of the Lover’s Creek Tributaries and Whiskey Creek confirms the presence of groundwater discharge.

3. The proposed development has the potential to impact groundwater characteristics such as recharge, discharge and water quality.

4. The main hydrogeologic function of the study area is to supply groundwater recharge. This recharge provides baseflow to local creeks, water features and deeper aquifer systems.

5. Mitigation measures are recommended to maintain groundwater recharge. Proper stormwater management techniques are needed to minimize the impact of stormwater run-off on groundwater quality.

6. Further study to assess the shallow soils and the groundwater flow systems must be conducted prior to the detailed planning stages of development.

7. Mitigation measures are available to prevent significant impacts to the hydrogeologic function and features within the study area. Application of these measures will ensure that the hydrogeologic function is maintained.

We trust this report meets with your requirements. Should you have any questions regarding the information presented, please do not hesitate to contact our office.

Yours truly,

Terraprobe Limited

Tom Bradley, B.Sc.
Environmental Scientist

Paul Bowen, P.Geo., P.Eng.
Principal
REFERENCES


Proposed Bryne Drive Extension, Barrie, Ontario

SITE LOCATION PLAN

FIGURE 1