



**Township of Springwater
Midhurst Secondary Plan Area**

**COMPREHENSIVE STORMWATER
MANAGEMENT PLAN**

FINAL REPORT

Volume 1 of 4

Main Body & Appendix A to C

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Township of Springwater Midhurst Secondary Plan Area

Comprehensive Stormwater Management Plan

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1. INTRODUCTION

The community of Midhurst in the Township of Springwater has a current population of approximately 3,500 people in 1,130 units with a small amount of industrial development along Snow Valley Road and commercial uses on Highway 26. During the preparation of the Midhurst Secondary Plan (MSP), a need for a Midhurst Comprehensive Stormwater Management Plan (MCSMP) was identified to guide development in the area. The Township of Springwater (Township), in conjunction with the Nottawasaga Valley Conservation Authority (NVCA) and the Developers' Group (MLG), have prepared this MCSMP associated with the proposed developments within the MSP area to define area wide criteria and targets for the stormwater management to assist with land management as per relevant policies and guidelines. The Township has retained Ainley & Associates Limited (Ainley) to undertake the MCSMP study in response to the proposed developments within the MSP.

1.1. Subject Area

The subject area consists of the MSP area, as defined under the Official Plan Amendment No. 38 (OPA 38), adopted by the Township in 2008, and approved by the County of Simcoe in 2011, as well as relevant adjacent subwatershed and catchment areas that will be required to characterize the existing conditions and identify the multi-discipline targets and management practices within the MSP area.

1.2. Study Objectives

The purpose is to produce a Storm Water Management Plan consistent with the requirements of Section 8.2 of OPA 38 and as per the requirements for the MCSMP in the Minutes of Settlement issued by the Ontario Municipal Board for Case Nos. PL100139, PL100144, PL00146, PL131125, PL131126, PL131127, PL131128, and PL131129 on October 29, 2014 (Minutes of Settlement). The MCSMP will provide clear guidance related to stormwater management for future submissions during both the draft plan and site plan approval stages. The MCSMP will serve as a guide for stormwater management to protect the health of the watershed ecosystem during detailed design and build out of the MSP area with regard for the environmental resources. Development of the Stormwater Management Strategy for the MSP area is critical to proper implementation of the development strategy. This study identifies the most effective, yet flexible in application and functions, approach and strategy to manage the stormwater from the existing community and proposed developments.

The Minutes of Settlement (see Appendix A), in particular Section 12, 13, and 15, outlines the key requirements that will guide the MSP development, including the Draft Plan component (Section 15) as follows.

- a) Provide characterization of the MSP area to assist in setting attainable goals for the future developments and management of the urban and natural environment, with consideration

for short and long-term municipal requirements, including planning, design and implementation of the plan.

- b) Identify recommended approaches for stormwater management and select the best possible blend of natural and technical measures for the stormwater management with the highest regard for the natural environment and the character of the surrounding area. Where applicable, natural features should be incorporated, into the overall stormwater management strategy to allow for passive and or active functions of the existing natural system.
- c) Integrate, with due considerations, background studies and stormwater management plans developed as part of the Draft Plans
- d) Evaluate the cumulative impact of stormwater from existing and planned development including flooding, erosion, thermal mitigation, hydrologic, hydraulic and environmental functions within the system, water quality and nutrient management.
- e) Develop an Implementation Plan providing clear guidance for existing, proposed and future developments, including performance benchmarks, to ensure the MCSMP is sustainable throughout the life cycle of the development. Thus, ensuring that the Township's servicing needs can be met with minimal disruption to the existing residents, business owners and to the natural environment. A key consideration for the Implementation Plan will be to identify future studies and responsibilities to ensure long-term sustainability of the MCSMP.
- f) Identify key components for consideration during the development of comprehensive Operation and Maintenance (O&M) Programs for stormwater management works during ongoing development within the Secondary Plan Area.
- g) Develop a comprehensive Adaptive Management Plan (AMP), including the key monitoring parameters, threshold values, management and monitoring mechanisms to ensure the integrity of the natural system with progressing urban development.

1.3. Study Approach

The comprehensive drainage planning process is to ensure that each individual development follows the development guidelines unique to the area and fulfils the requirements of the overall stormwater management strategy. Accordingly, each proposed development is required to demonstrate its integrity with respect to the physical, environmental, social and economic settings.

It is recognized that, through the AMP process, this framework may be expanded to include discipline specific criteria, technical analysis required, as well as long-term management objectives. Accordingly, the area-specific requirements have been also developed to meet the overall objectives for the MCSMP. Where identified, a detailed work program will be prepared (a few currently in progress) to address the study objectives and or more stringent technical requirements (e.g. phosphorous loadings, erosion, water balance, application of the Low Impact Development measures), including the type and level of details for the technical analysis.

Based on the work already completed in support of the development within the MSP area, the Township anticipates that the stormwater infrastructure projects will include the following:

- Construction of new municipal stormwater management facilities for the new growth areas;
- Construction of new municipal stormwater collection systems for the new growth areas; and
- Upgrades of existing municipal stormwater collection systems, where required as a result of new growth areas;

1.4. Guiding Principles, Policies and Documents

This MCSMP is guided by a number of the technical guidelines and urban development policy documents overseen and or enforced by the Township and respective Agencies, as well as the outcomes of the Ontario Municipal Board of Appeal (OMB) process concerning the MSP.

The key documents include the following:

Simcoe County Official Plan (Jan. 2013)

Township of Springwater Official Plan (OPA 38, Oct. 2011) and other Municipal Planning Policies

Township of Springwater Engineering Standards (Draft 2015)

NVCA Regulatory and Technical Guiding Documents

Ministry of the Environment & Climate Change/Ministry of Natural Resources Regulatory and Technical Guiding Documents

2003 Stormwater Management Planning and Design Manual;

1993 Integrating Water Management Objectives into Municipal Planning Documents;

1993 Subwatershed Planning;

1993 Water Management on a Watershed Basis: Implementing an Ecosystem Approach

Toronto and Region and Credit Valley Conservation Authorities Low Impact Development Stormwater Management Planning and Design Guide, 2010; and

OMB Minutes of Settlement for the Midhurst Development (October 29, 2014 and (NVCA July 2014).

1.5. Project Management Team

The development of the MCSMP was undertaken by the Township of Springwater who retained the Ainley Group to complete the project. The study involved a Project Management Team consisting of Municipal staff and Consultants with comments from applicable technical agencies. The Project Management Team consists of:

- Ms. Heather Coleman, C.E.T. - Director of Public Works
- Mr. Brent Spagnol - Manager of Planning
- Mr. Joe Mullan, P. Eng. - Ainley and Associates

Ainley's team also included additional persons representing various areas of expertise (i.e., Storm Water Management) on an as-needed basis. Ainley's Project Manager will liaise with the Township and with the consulting team staff for the purpose of completing specific tasks associated as the AMP work proceeds.

1.5.1. The Advisory Group

A Technical Advisory Group met throughout the course of the study, consisting of the following:

- The Project Team members
- Multi-discipline specialists, as required
- Representatives of the NVCA
- Representatives of the Midhurst Developers Group

The purpose of the Advisory Group was to:

- Assist with project direction;
- Provide landowners' input;
- Provide feedback for technical discussions and ideas; and,
- Assist the Project Team with technical and or policy input.

1.5.2. Project Team Roles and Responsibilities

Ainley led the study on behalf of the Township while the NVCA retained its regulatory and advisory role in the process. The MLG Consulting Team provided expertise to advance technical studies, also conducting supportive field investigations and or technical analysis, as required by Ainley, to complete the MCSMP.

The scope of this project involved many technical components and specialized teams have often worked concurrently to advance the study. The peer review, where required, has been provided by approved specialized companies and or professionals in the field of required expertise. Table 1 outlines the general structure of the project team, along with key roles and responsibilities.

Table 1: Project Team Roles and Responsibilities

Study Component	Roles & Responsibilities	Project Team	Contact Person
Project Management & MCSMP Development	Overall project management, technical and policy advisory role, QAQC	Ainley Group	Joe Mullan
	Day-to-day project activities, including agency consultation, development of technical guiding documents and technical review.		Richard Sloan
Advisory Group	Technical and policy advisory pre-consultation in required areas of expertise	Township of Springwater	Heather Coleman / Brent Spagnol
	Technical and policy advisory	NVCA	Chris Hibberd

Study Component	Roles & Responsibilities	Project Team	Contact Person
	Agency pre-consultation and technical reviews		Lee Bull/ Peter Alm
	Representation of Developers in implementation of the Minutes of Settlement	Geranium	Shauna Dudding/ Vimal Patel
		Rose Alliance	Alex Troop
Nutrient Management	Peer Review	XCG Consulting	Harold Chad/ George Zukovs
	Technical analysis, documentation and the implementation requirements	Hutchison Environmental	Neil Hutchison
		SCS Consulting Group	Steve Schaefer/ John Priamo
Fluvial-geomorphology	Peer Review	GeoProcess Research Associates	Jeff Hirvonen
	Technical analysis, documentation and the implementation requirements	GEO Morphix	Dr. Paul Villard
Various technical components	Technical analysis, documentation and the implementation requirements, as per approved work plan	SCS Consulting Group	Steve Schaefer /John Priamo
		C.F. Crozier & Associates	Chris Crozier/ Brendan Hummelen
		Ainley Group	Richard Sloan
Reporting	Preparation of discipline related report summaries and background information.	All project teams	As per project technical components
	Review and integration of the information	Ainley Group	Richard Sloan

2. DOCUMENT LAYOUT

The document has been prepared to include the required MCSMP components, which will in turn provide guidance in the approval of Draft Plan Applications. This work must be completed based on full build out (ultimate development conditions) of the Secondary Plan Area thereby looking at the cumulative impacts of the staged-development. The document addresses the following points outlined in the Minutes of Settlement.

The key components of the document are:

- Study Area Characterization
- Stormwater Management Approach / Strategy
- Implementation Plan
- Operation and Maintenance Plan
- Adaptive Management Plan

Discipline-specific detailed work programs (e.g. fluvial-geomorphology, nutrient management) have been developed by specialized teams to address the multi-objectives and technical requirements of the key study components. This document will contribute information on an ongoing basis to other disciplines, as required. The implementation priorities will be established by the project team and work will be overseen by a designated discipline specialist and or a reviewer.

2.1. Area Characterization

The following section provides the details regarding the existing conditions within the MSPA and surrounding area potentially impacted by the development. This section is a compilation of many of the previous reports completed in the study area, technical studies completed in support of the Phase 1 Draft Plans and the Environmental Study Report (ESR) associated with Water, Wastewater & Transportation for the MSPA.

2.1.1. Background Information

A significant amount of information pertaining to the study area has been compiled through the planning and technical studies completed within the Study Area, dating back to when it was first identified as the Midhurst Settlement Area in 1982, carried through to the County's and Township's Official Plans in 1998, the OPA 38 designation in 2008, and the completion of the Class EA in July 2018. These are listed below, and include the Source Water Protection, Environmental Assessment, Secondary Plan Area planning documents and Draft Plan developments. The following steps have been taken to ensure that all relevant information has been identified and integrated as part of this study. Including:

- Collecting, reviewing and documenting information pertaining to the study area including mapping, air photos, technical studies and other background and or guiding documents. (Secondary Plan)

- Identifying policy and technical information or directions provided in relevant provincial, municipal and agency documents including policies, regulations, guidelines, strategies and or manuals. (Guiding Documents)
- Conducting field reconnaissance, where applicable, to verify the key information, as well as field investigations, as identified by discipline specific requirements – work programs, to establish baseline conditions within the study area.
- Identifying information gaps and recommend data gathering and or required technical analysis and data collection networks.

The following list outlines the technical studies referenced in this study to describe existing and proposed conditions:

1. AECOM Limited (formerly Gartner Lee Limited). 2009a.
Final Surface Receiving Water Assessment for Doran Neighbourhood Development, Midhurst, Ontario. Prepared for Midhurst Doran Road Development Inc. February 2009.
2. Ainley Group. (2018)
Environmental Study Report, Class Environmental Assessment Study for Midhurst Water, Wastewater and Transportation Servicing Phase 3 And 4. Township of Springwater. June, 2018.
3. Aqualogic Consulting. (2008)
Geomorphic Development Setback Analysis, Carson Rd. Geranium Properties. Township of Springwater, Prepared for SCS Consulting Group Ltd October 15, 2008.
4. Aqualogic Consulting. (2014)
Erosion Threshold Analysis, Carson Road. Doran Road. Township of Springwater, Prepared for SCS Consulting Group Ltd. May 2, 2014.
5. Azimuth Environmental Consulting Inc. (2014).
Thermal impacts of proposed stormwater management outlets Midhurst Heights Development, Township of Springwater, Prepared for Midhurst Rose Alliance. June 16, 2014.
6. Beacon Environmental (2014).
Environmental Review of SWM pond outfall locations, Carson Road and Doran Road Neighbourhoods. Township of Springwater June 11, 2014
7. Beacon Environmental (2009).
Carson Road - Neighbourhoods 1 Environmental Impact Study, September, 2009.
8. Beacon Environmental (2009).
Doran Road - Neighbourhoods 2 and 3 Environmental Impact Study, September, 2009.
9. C.F. Crozier & Associates Inc. (2016).
Midhurst Master Drainage plan Technical Memo #1, Midhurst Heights Development. Prepared for Midhurst Rose Alliance Inc. May 20, 2015.

10. C.F. Crozier & Associates Inc. (2018).
Servicing and Stormwater Management Implementation Report, Midhurst Heights Development. Prepared for Midhurst Land Owners. March, 2018.
11. C.F. Crozier & Associates Inc. (2014).
Summary Documents for OMB Proceedings. Proposed Midhurst Heights Development. Prepared for the Township of Springwater. 218 pgs.
12. Chapman, L.J., and D.F. Putnam. 1984.
The Physiography of Southern Ontario, Third Edition, Ontario Geological Survey Special Volume 2. 270 pp.
13. GEO Morphix. Ltd (2014).
Opinion Regarding Stormwater Management and Instream Erosion, Midhurst Rose Alliance Development, Prepared for Midhurst Rose Alliance Inc. 2014.
14. GEO Morphix. Ltd (2017).
Geomorphological Monitoring of Matheson Creek in Support of Adaptive Management, Midhurst Rose Alliance Development, Prepared for Midhurst Rose Alliance Inc. December 22, 2017.
15. GEO Morphix. Ltd (2018).
Geomorphological Monitoring of Willow Creel and Black Creek in Support of Adaptive Management, Doran and Carson Road Development. February, 2018.
16. Corporation of the Township of Springwater. 2008.
Midhurst Secondary Plan - Official Plan Amendment No 38. October 29, 2008.
17. Golder Associates. 2014.
Hydrogeological studies in support of municipal water servicing for the Midhurst Secondary Plan area. Supporting Document Midhurst Class EA Township of Springwater, Ontario.
18. Golder Associates Ltd. 2016.
Hydrogeological Study, Midhurst Water Supply Exploration program, Township of Springwater, Ontario. June 2016.
19. Golder Associates Ltd. 2008.
Preliminary Hydrogeological Study and Development Assessment, Carson Neighbourhood, Township of Springwater, Ontario. Prepared for Midhurst Development Carson Road Inc. April 2008.
20. Hutchinson, & Ltd., E. S. (2018).
Baseline Aquatic Studies for Midhurst Secondary Plan - Midhurst Village. Prepared for Midhurst Landowner Group. January 2018.

21. Hutchinson, & Ltd., E. S. (2018).
Baseline Aquatic Studies for Midhurst Secondary Plan – Doran Road Development.
Prepared for Midhurst Landowner Group. January 2018.
22. Hutchinson, & Ltd., E. S. (2018).
Baseline Aquatic Studies for Midhurst Secondary Plan - Midhurst Heights Development.
Prepared for Midhurst Landowner Group. January 2018.
23. Hutchinson, & Ltd., E. S. (2018).
Baseline Aquatic Studies for Midhurst Secondary Plan – Carson Road Development.
Prepared for Midhurst Landowner Group. January 2018.
24. Hutchinson, & Ltd., E. S. (2018).
Midhurst Secondary Plan Area Phosphorus Budget – Update. Prepared for The
Township of Springwater c/o Ainley Group. May 2016.
25. Ian D. Wilson Associates Limited. 2008.
Consolidated Hydrogeologic Evaluation Proposed Residential Development, Midhurst
Rose Alliance, Township of Springwater, Ontario. July, 2008.
26. Nottawasaga Valley Conservation Authority. 2014.
Midhurst Developments - NVCA Minutes of Settlement.
27. Nottawasaga Valley Conservation Authority. 2001.
Willow Creek Subwatershed Plan.
Website:
<https://www.nvca.on.ca/Shared%20Documents/Willow%20Creek%20Subwatershed%20Plan.pdf>
28. Nottawasaga Valley Conservation Authority. 2013.
Willow Creek Subwatershed Report Card.
Website:
<https://www.nvca.on.ca/Shared%20Documents/2013%20Willow%20Creek%20SWHC.pdf>
29. SCS Consulting Group Ltd. 2009.
Functional Servicing Report, Doran Road, Midhurst. Prepared for Midhurst Development
Doran Road Inc. September 2009.
30. SCS Consulting Group Ltd. 2009.
Functional Servicing Report, Carson Road, Midhurst. Prepared for Midhurst
Development
Carson Road Inc. September 2009.
31. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan. Prepared for
Midhurst Land Owners. August 8, 2014.
32. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #1 Nutrient
Loading. Prepared for Midhurst Land Owners. August 8, 2014.

33. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #2 Peak Flows.
Prepared for Midhurst Land Owners. August 8, 2014.
34. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #3 Volume Control. Prepared for Midhurst Land Owners. August 8, 2014.
35. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #4 Extended Detention. Prepared for Midhurst Land Owners. August 8, 2014.
36. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #5 Maximize Infiltration. Prepared for Midhurst Land Owners. August 8, 2014.
37. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #6 Suitable Pond Outlet. Prepared for Midhurst Land Owners. August 8, 2014.
38. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #7 Thermal Mitigation. Prepared for Midhurst Land Owners. August 8, 2014.
39. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #8 Adaptive Management Plan. Prepared for Midhurst Land Owners. August 8, 2014.
40. SCS Consulting Group Ltd. 2014.
Midhurst Master Drainage Plan Phase 1, Midhurst Secondary Plan, Item #9 Hazard Assessment. Prepared for Midhurst Land Owners. August 8, 2014.
41. SCS Consulting Group Ltd. 2017.
Potential Municipal LID Options, Carson Road Phas1 Development-Midhurst, Township of Springwater. Prepared for Midhurst Land Owners. October 11, 2017.
42. Toronto Region Conservation Authority. (2010).
Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0".
Website: <https://wiki.sustainabletechnologies.ca>

Following the finalization of the MCSMP, it is anticipated that future reports or updates to the aforementioned reports, will be documented in the Adaptive Management Plan (AMP) that will be updated as development proceeds.

2.1.2. Watershed Context

The study area drains to three main creek systems, within the Willow Creek Subwatershed. These are the main branch of Willow Creek and its tributaries, Black Creek, and Matheson Creek.

Neighbourhood 1 drains to the main branch of Black Creek which is an NVCA regulated watercourse. Black Creek flows northwest past Carson Road, exiting the MSPA at Wilson Dr near Snow Valley Road. This watercourse flows through a Wooded valley that extends along the west side of Neighborhood 1(Beacon (1), 2009).

Midhurst Heights (and the rest of the northern portion of Neighbourhood 2) is currently draining into two unnamed tributaries of Matheson Creek which is the largest Willow Creek tributary based on the baseflow contribution (NVCA, 2001). Matheson Creek tributaries flow northwest, exiting the existing MSPA at Craig Road. The main branch of Willow Creek drains in a southwesterly direction, downstream of little lake, through the existing Midhurst community to exit the MSP at Wilson Dr. before it merges with Matheson Creek upstream of the Minesing wetland (NVCA, 2001).

The eastern portion of Neighbourhood 3 drains to one surface water feature defined in the Beacon, (2009) study as an *“unnamed headwater tributary to Willow Creek, that flows...off-site to the south where it meets the main branch of Willow Creek at Little Lake”*. This watercourse has its source just north of the site, arising as a spring at the intersection of Pooles road and Old 2nd Road South. From its origin the creek flows south and enters an on-line dug pond before continuing southward through a semi-open valley characterized by a meadow marsh floodplain and a grassed meadow with scattered trees and shrubs, until it reaches the end of the MSPA (Beacon, 2009). The western portion of Neighbourhood 3 drains to Pooles Road.

An Overall Drainage Plan of the MSPA is provided as Figure 1 at the end of this report.

2.1.3. Soil Conditions

The soil conditions for the MSPA have been established in numerous studies. Surficial geology has been obtained mainly from the NVCA Willow Creek Subwatershed plan, which has been supplemented through borehole data collected during the preparation of draft plans for some of the proposed developments within the MSPA. The study area is dominated by glacial deposits particularly sandy loams, and sand till and it is located in the Uplands and Lowlands of the Simcoe physiographic region. Around 75% of the Willow Creek subwatershed, including the Matheson Subwatershed is located in Simcoe Uplands whereas the Black Creek catchment is in Simcoe Lowlands. Generally speaking, within the Willow Creek subwatershed, the soil in Simcoe Lowlands is characterized by *“imperfectly and poorly drained loams, sandy loams, silty and marly clay, clay loams and muck soils.”* The Simcoe Uplands are characterized by well drained sands and sandy loams.

Soils within the Neighbourhood #1 area have been determined based on investigations through the Draft Plan Approval process. A total of 37 boreholes were advanced by Golder for the preparation of the Preliminary Geotechnical Investigations completed in April 2008. Soils in this area are predominantly silty sand till overlain by a layer of sand to silty sand, with some silty clays to clayey silt. Silty sand is the predominant soil in the area south of Carson Road and east of Anne Street.

Preliminary geotechnical investigations were completed in the portion of Neighbourhood #2, located north of Pooles Road by Ian D. Wilson Associates based on 38 test pits established between December 2004 and January 2006, with 4 deep test holes, drilled to the water table during January through March of 2008, and 11 boreholes drilled in March 2008. They determined that the soils on site were *“generally consistent with geologic mapping” and that soils were predominantly silty sand till with a “discontinuous lens of very compact to dense clayey silt...in the northwestern portions of the site...(and) in a small area at the extreme eastern end of the site.”* These lenses were found to be underlain by the sand till during the borehole investigations.

Based on the information provided on the soil map of Simcoe County (Chapman and Putnam 1984), the Midhurst Secondary Plan (MSP), NVCA 2011, and the reports completed by Golder for lands in Neighbourhood 3 (Doran Rd), soils are mainly sandy loam (Vasey) with the present of loamy sand and gravelly sandy loam (Sargent) in the north part by Snow Valley Road. Neighbourhoods 1, and 2 soils are sandy loam (Dundonald, Vasey) based on the Simcoe Upland map. The soil maps characterizing the MSP are included in Appendix C.

2.1.4. Natural Heritage

Natural Heritage designations form an integral component of the stormwater management strategy. Typically, environmentally protected areas dictate required setbacks and or transitional buffer zones for new or existing developments while other features may provide passive or active stormwater management opportunities. This may include strategic integration of less sensitive natural features into the stormwater strategy to further enhance their natural stormwater quality and or quantity control functions. Accordingly, all previously approved relevant natural heritage information compiled for the Secondary Plan has been reviewed and integrated into the applicable study components.

2.1.4.1. Aquatic Resources

The existing aquatic resources in the study area have been identified through three Baseline Aquatic Studies (2018) for Matheson, Black and Willow Creeks by Hutchinson Environmental Science Ltd, included in Appendix D, these are supplemented with background information obtained from the Willow Creek Subwatershed plan (NVCA, 2001). Additional information regarding the watershed has been obtained through the NVCA Watershed Health report cards which include results from their Biological Monitoring and Assessment Program protocols augmented with water chemistry temperature hydrometric, and bacteriological sampling. The

report cards are updated periodically by the NVCA, and, for the Willow Creek watershed the last update was in 2013. Based on the latest NVCA assessment, water quality and stream health in the Willow Creek subwatershed is generally considered to be in “unimpaired” to “below potential” stream conditions and meets the Ontario Water Quality objectives. During storm events Willow Creek experiences phosphorus levels which exceed PWQG for healthy stream conditions. This is typical throughout the NVCA watershed. The following sections provide a summary of the studies completed by NVCA and HESL for each of the three main watercourses and their tributaries which traverse, or are potentially impacted, by the proposed development of the MSPA.

Willow Creek and Tributaries

In total, HESL established 5 monitoring stations located on the main branch of the Willow Creek and its smaller tributaries. Samples were first collected at the stations on the tributary draining to Little Lake during 7 field visits from March to September 2008 with continuous temperature logging from mid-April to late September 2008. HESL resampled at these locations during 5 field visits from September 2014 to March 2016, with temperature loggers active for the 2014 and 2015 surveys. HESL also collected samples at 2 stations established in the main stem of Willow Creek, upstream and downstream of the existing Midhurst Village *“which were each visited monthly in the ice-free seasons of 2015 (June to September) and 2016 (May to October) and in March of 2016.”*

On the basis of their baseline monitoring program HESL have classified the main stem of Willow Creek as a cold water habitat, but noted high temperatures *“with greater diurnal variation upstream but were tempered downstream as likely response to groundwater inputs”*. With respect to water quality, total phosphorus and calculated unionized ammonia concentrations met PWQO. Total metals concentrations above PWQO were *“associated with high suspended solids and are therefore indicative of runoff and erosional events”*. However, dissolved oxygen concentrations were *“consistently above the temperature-dependent PWQO ...for cold water aquatic life.”* nitrate levels *“were significantly elevated downstream, and regularly exceeded the CCME Guideline for Protection of Aquatic Life”* The biotic index of the upstream reach was classified as “very poor” and “Good” downstream *“owing to the high abundance of pollution tolerant Amphipoda species at (the upstream station).* No environmentally sensitive EPT species were detected at either station.

The Doran Road South Development area contains a natural drainage course defined by HESL as *“a valley which has ephemeral flow during spring freshet and significant storm events and which forms part of the Willow Creek drainage, entering Willow Creek within Midhurst.”* Based on their analysis the tributary has been classified as *“a Coldwater intermittent stream whose small catchment and lack of significant groundwater inputs result in a marked decline in discharge values following spring freshet.”* Benthic habitat quality was found to be poor and only a single fish species, Northern Redbelly Dace, was found in this tributary. The phosphorus concentrations exceed the MOE guideline in 60% of the collected samples. Dissolved oxygen concentrations fell below the MOE requirements for protection

of Coldwater aquatic life. Levels above the PWQO were found for metals, including aluminium, iron, and zinc. The only existing species is Northern Redbelly Dace that is considered a “moderately sensitive to environmental pollution”. The Doran area contribution to groundwater was assessed as “non-significant”.

Matheson Creek

Three sites on Matheson Creek were established to produce baseline aquatic data for Midhurst Heights development as shown in the Figure (1) of the HESL study. Data was collected in 2015 and 2016 for water quality, flows, and aquatic resources. Based on the results of their analysis HESL concluded the following:

“Temperature profiles indicated that Matheson Creek was a cold-water stream at all three monitoring sites and dissolved oxygen concentrations were consistently above the temperature-dependent Provincial Water Quality Objectives. Total phosphorus concentrations were below the Provincial Water Quality Objective except 2 samples in which high total phosphorus concentrations were related to elevated suspended solids (HESL(4),2018). The aquatic monitoring results show that Matheson is Coldwater with fair water quality conditions. Phosphorus is below the PWQO and exceeds the guideline in just two samples. In general, the exceedance in nutrients and metal were determined as result of high TSS (Total Suspended Solid). As recommended by HESL, TSS should be reduced through storm management facilities in order to keep the nutrients level below the guidelines. Matheson Creek has sufficient base flow that can support benthic community and fish habitat. The benthic community was identified as “low species richness” with no sensitive species were detected. The main existing species in the Matheson are Brook and brown trout, Slimy sculpin, White Sucker and Central Mudminnows.

Black Creek

The monitoring system for baseline aquatic and water quality biology started in 2008 to assess water quality and benthic habitat. The assessment was done over the period 2008 to the end of 2017. Based on the results of their analysis HESL concluded that *“Black Creek is a cold water stream that contains sufficient base flow and habitat to support a varied benthic community and an environmentally sensitive brook trout population....Benthic invertebrate community indices indicated good to excellent water quality in Black Creek, which was supported by water quality data.”* A few exceedances in nutrients and metals associated with high suspended sediment loads, as well as elevated levels of dissolved oxygen were noted in the study.

2.1.4.2. Natural Hazards

As part of OPA 38 the Township has designated all lands with *“features that are Provincially mandated or regulated for protection, features that warrant protection based on the mandate of the Conservation Authority and typical buffers generally required to maintain those features”* as Environmental Protection Area I. The Township has also applied, the Environmental Protection Area II designation for lands that may be considered significant with respect to

natural features and functions. As such any areas associated with watercourses, associated flooding or erosion limits, steep slopes, and unstable soils requiring buffers from adjacent development for protection from natural hazards have been addressed under these land use designations. OPA 38 stipulates that “(a)ny development, including any necessary infrastructure and roads proposed within, or within 30 metres of the Environmental Protection Area I designation shall be required to prepare an Environmental Impact Study that will determine the actual buffer that will be required between the Environmental Protection Area designation and the limit of urban development.” In addition, as stipulated in OPA.38, “prior to any lands being considered for development within or abutting any area identified within the Environmental Protection Area II designation, an Environmental Impact Study is to be undertaken by the proponent in accordance with the policies of this Secondary Plan.” The land use designations were identified in Schedule A of OPA 38, included in Appendix A.

2.1.4.3. Significant Groundwater Features and Functions

Groundwater has a strong connection to surface water and it exists almost everywhere underground. It moves from recharge areas, where the precipitation percolates in the ground, to discharge areas, where it connects to surface water, and these characteristics are often controlled by the physiography and topography. According to the NVCA Subwatershed plan (2001), the Willow Creek subwatershed has sensitive groundwater inputs presenting in recharge/discharge area as well as opportunities for restoration. As described in Section 2.1.3, the well-drained soil is predominant in the subject area which provides potential for either discharge or recharge areas. The sensitive groundwater areas are associated with the stream Corridors, including Willow Creek, Matheson Creek, and Black Creek. Also, the headwaters, wetlands are considered a groundwater sensitive area and have been identified and protected.

Based on the NVCA subwatershed report groundwater is monitored through 16 wells within the Willow Creek subwatershed to measure water quantity and quality overtime. Monitoring data from 2003 to the present demonstrates the excellent conditions of groundwater that meet the Ontario Drinking Water Quality Standards.

Golder Associates were retained by MLG to complete the hydrogeological assessment for the development of the MSPA. The results of their analysis are, included in Appendix E. Their analysis was based on field work completed in 2013, and 2014 within the Midhurst Secondary Plan. The study consisted of a water supply exploration program and well development program as part of phase 3, and 4 of the Class EA for the MSPA, and prepared for the MLG to test different groundwater aquifers through various proposed wells within the subject area. The Golder hydrological report (2016) classified the aquifers in the MSPA into four regional aquifers A1 through A4. Aquifer A3 is the main source of potable water for the existing Midhurst area. This Aquifer is an extensive regional aquifer that present in Uplands and Lowlands. The Golder assessment identifies Aquifer A3 and A4 are the main target for water supply of MSP development.

A3/A4 is present throughout Neighbourhood 1 with notice of confined artesian conditions in the western part of the area. Multiple drilling sites were developed with 203 mm well diameter and constant rate pumping test. Moreover, Golder assessed the impact of development on groundwater by building a numerical model using FEFLOW to simulate groundwater flow and the impact of additional water supplies on the baseflow. All tested wells showed that groundwater is ‘fresh, bacteria free, and calcium bicarbonate hydrogeochemical type’. Water quality testing for A1 shows signs of chloride salt and concentrations decreasing with depth.

2.1.4.4. Source Water Protection

The Clean Water Act, approved 2006, is the Provincial government’s commitment to ensure safe drinking water is available for Ontario residents. Under the Clean Water Act, the objectives of a source protection plan are:

1. To protect existing and future drinking water sources in the source protection region.
2. To ensure that, for every area identified in the assessment reports as an area where an activity is or would be a significant drinking water threat;
 - a. The activity never becomes a significant drinking water threat; or
 - b. If the activity is occurring when the source protection plan takes effect, the activity ceases to be a significant drinking water threat;

Golder and Associates were retained to update groundwater modelling, with refinements in Midhurst and the surrounding Willow Creek watershed areas, and to estimate the hydrogeological effects of the Carson and Doran Road neighbourhoods. As per the report, the existing conditions model was updated “*in accordance with recent drilling, aquifer testing, and stream flow data.*”

Presently, Midhurst is serviced by eight wells in two wellfields (Golder, 2014). The capture zones for these wells were developed and shown on Figure 11 of the report (see Appendix E).

Golder Associates in (2016) conducted a study to address source water protection through the existing aquifer vulnerability mapping. The assessment reveals that ‘*the water supply system has a low vulnerability to surficial contamination and causes minimal interference to surrounding municipal wells*’. The aquifer vulnerability Index method was used to classify the aquifer vulnerability of Aquifer A3 and A4 as low vulnerability due to substantial thickness of clayey materials overlying Aquifer A3. see Appendix E. LIDs are recommended in the study to meet NVCA guideline of water quantity and quality control see Section 2.2.4.1.

2.1.4.5. Surface Water Features and Functions

A Surface Water receiving Assessment of Willow Creek was conducted by AECOM (2009) to identify the conditions of the Willow Creek tributary at the south end of the MSPA as it is classified as a coolwater stream. Baseline data, including water chemistry, flow, and temperature were assessed to identify sensitivity the tributary of Willow Creek. They

concluded that the Willow Creek Tributary is not considered to be highly sensitive, and the flow is limited specifically during summer. All Stormwater measures will be designed to MOE enhanced level to protect surface water and eliminate the impact of stormwater discharge.

Black Creek is a Coldwater stream that has sufficient base flow. The creek is in good water quality condition and requires high level of protection due to the present of brook trout population (HESL(1),2018). The water balance calculation from Golder (2014) estimated the annual infiltration in the Black Creek community to be 403,00 m³ while the annual runoff is 303,300 m³ approximately.

Matheson Creek provides Coldwater habitat and substantial drainage to Nottawasaga River and based on the NVCA report card (2013) *'Matheson Creek is considered unimpaired stream health from its headwaters downstream to west of Hwy 27. Near their confluence, Matheson and Willow Creeks are considered below potential, with stream health continuing to decline as Willow Creek enters an agricultural plain'*.

The main branch of Willow Creek is a cold water stream and its condition varies along the creek. The Creek is considered below potential when it flows through a rolling agricultural landscape before it enters Midhurst; however, the stream health improves along the forests downstream of Midhurst.

2.1.4.6. Existing Land Uses

The landscape of Willow Creek subwatershed is dominated by agricultural land and it forms around 90% of the total subwatershed. As part of preliminary Phosphorus budget calculations (2016) Hutchinson Environmental Sciences Ltd estimated the existing land use types within the MSP. The crop land forms above 70% of total MSP area. Environmental Protected Areas (EPA I and II) are defined in OPA 38 and account for 1,527 ha out of the total 2,813 ha of the MSP. They form corridors around both the existing development within Midhurst and the new proposed neighbourhoods. The commercial lands are only present along Bayfield road west of existing Midhurst community. The industrial land is located along Snow Valley road. As showing in land use map the Midhurst settlement area has abundant of forests and woody woodland. Schedule A from OPA 38 showing the existing land uses in the MSPA is included in Appendix A.

2.1.4.7. Existing Stormwater Infrastructure

As identified in a site walk meeting between representatives from the Township, NVCA, and MLG on May 8, 2014, there are three potential outlets to Municipal roads for the MSPA development lands:

1. Carson Road to Black Creek,
2. Midves Court, to the Frid Boulevard sewer network discharging to Willow Creek, and
3. Gill Road discharging to Matheson Creek.

Carson Road currently has a rural cross section with standard roadside ditches approximately 0.7m to 1m deep, which flow westward to an existing crossing at Black Creek. The existing development in Midhurst is serviced by a storm sewer network underneath Frid Boulevard to Willow Landing Road with an outlet to Willow Creek through an existing drainage easement. Gill Road is serviced by municipal ditches with outlets to a number of small tributaries of Matheson Creek. The capacity of these areas, and suitability to accommodate the proposed development, is discussed in more detail in Section 2.2.1.1.

2.1.4.8. Transportation Network, Related Facilities, and Other Utility Corridors

The key road network consists of Highway 26, County Road 27, Snow Valley Road, Wilson Drive, Carson Road, St. Vincent Street, Finlay Mill Road, Gill Road, Doran Road, Russell Road, Pooles Road and Forbes Road. County Road 27, Snow Valley Road, and Wilson Drive are under the jurisdiction of the County of Simcoe and are arterial roads, as identified in the County's Official Plan. St. Vincent Street, Finlay Mill Road, Gill Road, Doran Road, Russell Road, Pooles Road and Forbes Road are arterial or primary roads under the jurisdiction of the Township. Highway 26 is a provincial Highway and is under the jurisdiction of MTO.

As part of the Transportation EA, an analysis of the existing roads within the MSPA was completed based on 2015 traffic volumes. The results indicated, good levels of service (C or better) occur at most of the intersections under the existing weekday conditions except for the intersection of Highway 26 at CR 27 and Spence Avenue where a poor level of service "F" is provided during the PM peak hour. Additional turning lanes were recommended at the intersections of Wilson Drive and Snow Valley Road, Wilson Drive and Carson Road.

Based on ESR, the study analyzed the existing condition and addressed the transportation impact of proposed development in the MSP. The study recommended transportation improvements that are required for Midhurst development.

In accordance with OPA 38, any transportation improvements within EPA I or EPA II lands require the completion of an EIS to confirm no impact of this improvement on the environment. Any watercourse crossing affected by the proposed road improvements will require floodplain mapping, or updates to the existing floodplain mapping, along with an updated hydraulic model to demonstrate that there is no increase in upstream or downstream flood levels associated with the improvement. Details of the outlets to each watercourse will be required to ensure that the banks are adequately protected for the design service life of any proposed structures. Moreover, the EIS will need to include a list of potential LIDs to be incorporated in the road designs to enhance water quality as well as provide water quantity control, in accordance with Sections 2.3 and 2.5. As identified in the EA Study, the recommended LIDs for these improvements include, flat bottom ditches with check dams, catch basin filters, Goss traps, catch basin sumps, oil grit separators, and infiltration galleries (Ainley, 2018).

Watercourse crossing within the MSPA will also require further studies, as stated in ESR (2018), to assess water flow, temperature regime, and fish habitat. The major Watercourse crossings are listed as follows:

- Black Creek at Wilson Dr
- Black Creek at Carson Rd
- Willow Creek at Finlay Mill Rd
- Matheson Creek Tributaries at Craig Rd
- Willow Creek at St Vincent St

2.2. Stormwater Management Strategy

The requirements set out within this report will ensure that a comprehensive stormwater management plan is developed, which evaluates the cumulative impact of stormwater from existing and planned development including flooding, erosion, thermal mitigation, hydrologic, hydraulic and environmental functions within the system, water quality and nutrient management. Development in the area shall follow the guidelines presented in this document with consideration for potential cumulative environmental impacts of stormwater drainage from existing and planned development within the study area. Further assessment, based on clear targets set, as required, to ensure sustainability of natural features and existing conveyance systems will take place on an ongoing basis by adhering to the Adaptive Management process.

This requires an assessment of water balance, water quality (particularly phosphorus loadings) and water quantity (flood and erosion control) under various climate and stormwater management scenarios, for the following conditions:

- Existing conditions
- Phased future development and re-development scenarios

A Cumulative Impact Assessment Map will be developed by the MLG to support detailed analysis and establish requirements for any long-term monitoring programs. Considerations for the Stormwater Management Strategy are guided by existing environmental and municipal policies, and where applicable, specific requirements outlined in the OMB Minutes of Settlement. The following sections describe the key considerations to be adapted into the strategy for the MCSMP.

Stormwater management strategies are assessed based on the three watersheds as previously discussed, Black Creek, Willow Creek, and Matheson Creek to insure the satisfaction of all the requirements in the Minutes of Settlement issued by the Ontario Municipal Board (2014). As part of the OMB settlement, Draft Plans were approved for three main developments in the MSPA: Carson Road Development Inc. (Carson Road), Midhurst Development Doran Road Inc. (Doran Road), and Midhurst Rose Alliance Inc., Midhurst Rose Alliance Cooney Inc. & Midhurst Rose Alliance O'Brien Inc. (Rose Alliance). As noted in the Memorandum of Oral Decision delivered by M.C. Denhez on July 3, 2014 *"(b)y the time all the final adjustments were made, the draft conditions were (in the words of one expert planner) "more onerous than one would typically see", and even "a double sort of control. The list of supporting studies was three pages long. The*

proposed Zoning By-law amendments, the draft plans of subdivision and associated conditions of approval appear supported by technical studies including environmental impact studies, functional servicing studies addressing water, wastewater and storm water management, servicing, transportation assessments and archaeological assessments.” As a result, much of the strategy described within the sections below is based on work completed by the design consultants in support of the appeals resolved before the OMB. This section will be presented based on the key requirements to be addressed in accordance with the OMB decision and separated with respect to the effect on each of the significant watercourses.

Any future development proposals within the MSP will be required to demonstrate that the stormwater management strategy described in the following sections can be satisfied prior to obtaining Draft Plan approval as was required of the Draft Plans considered in the OMB settlement. This includes consideration for stormwater management quantity and quality controls, nutrient management, and water balance as described in this document and modified as required by the recommendations provided in the most current AMP for the MSP available at the time the application is to be approved.

An Overall Drainage Plan of the MSPA is provided as Figure 1 at the end of this report.

2.2.1. Water Quantity

2.2.1.1. Black Creek

■ Stormwater Peak Flow

As identified in the Minutes of Settlement, S.12.b: **‘At each outlet there will be no increase in peak flow for all storm events from the 2 year through the 100-year 4-hour Chicago and 24-hour SCS storms’**. The potential impacts of development with respect to increased rates of storm drainage within the Black Creek tributary area are identified, along with proposed mitigation measures in the **August 8, 2014 Technical Memorandum Midhurst Master Drainage Plan - Phase 1. Item #2 Peak Flow Control** prepared by SCS (SCS (2), 2014), included in Appendix F. In order to assess the impact of development and establish target flows at each of the proposed outlets from the development, a hydrology model was created using the VO software package. The simulation was run for the 25 mm and 2 through 100-year 4-hour Chicago and 24-hour SCS storm events.

For the purposes of this assessment, three nodes along the main branch of Black Creek adjacent to the development were considered: Upstream of Carson Road; between Wilson Drive and Snow Valley Road, and upstream of Snow Valley Road (See Figure 1 included in Appendix F).

Table 2: Existing Flows: Black Creek

Return Period	Existing - Chicago m ³ /s	Existing - SCS m ³ /s
Upstream of Carson Road		
2 Year	2.586	3.488
5 Year	5.416	7.466
10 Year	7.640	10.597
25 Year	10.803	14.994
50 Year	13.367	18.506
100 Year	16.127	22.162
Between Wilson Drive and Snow Valley Road		
2 Year	3.261	4.410
5 Year	6.848	9.471
10 Year	9.677	13.469
25 Year	13.711	19.098
50 Year	16.990	23.609
100 Year	20.524	28.309
Upstream of Snow Valley Road		
2 Year	4.064	5.580
5 Year	8.654	12.089
10 Year	12.305	17.303
25 Year	17.553	24.701
50 Year	21.847	30.664
100 Year	26.496	36.917

Any future design for any development or road improvement within the MSP which is draining to Black Creek will be required to demonstrate that there will be no increase in the expected flows at these locations.

Runoff Volume Control

As identified in Minutes of Settlement S.12.c: ***'At each outlet there will be no increase in the volume of post development runoff from the pre development runoff, however some post development storm runoff increases may be permitted for infrequent storms, if it is demonstrated that there will be no cumulative downstream impacts, taking into consideration all of the subdivisions in the Midhurst Secondary Plan area.'*** The potential impacts of development with respect to increased volumes of storm drainage within the Black Creek tributary area are to be identified for any lands within the MSP conveying stormwater runoff to Black Creek. This is to be identified through a water balance assessment and mitigated through the use of low-impact development (LID) techniques for any new development within the MSP.

In addition to the required volume control calculations, detailed geomorphic assessments, as described in Section 2.2.3 of this report, are underway, as described in Section 2.2.4.2 to develop a specific erosion threshold for the creek as an update to the information provided in 2014.

Storm Outlet Assessment

As identified in the Minutes of Settlement S.12.f: ***'The Appellants will provide conceptual information on how each stormwater management pond outlet is conveyed to a suitable outlet assessing the impacts of diversions.'***

A suitable outlet was defined by the NVCA as an outlet directly to a permanent watercourse or municipal drainage conduit which outlets to a permanent watercourse. No major stormwater outfall is to be conveyed through private lands.

All lands within the MSP are to demonstrate that a suitable outlet is provided for each SWM facility accompanied by a fluvial geomorphology assessment addressing potential impacts of any stormwater diversions (if applicable) using estimates of discharge rates.

2.2.1.2. Willow Creek

Stormwater Peak Flow

As identified in the Minutes of Settlement, S.12.b: ***'At each outlet there will be no increase in peak flow for all storm events from the 2 year through the 100-year 4-hour Chicago and 24-hour SCS storms'***. The potential impacts of development with respect to increased rates of storm drainage within the Willow Creek tributary area are identified, along with proposed mitigation measures in the **August 8, 2014 Technical Memorandum Midhurst Master Drainage Plan - Phase 1. Item #2 Peak Flow Control** prepared by SCS (SCS (2), 2014). To identify the post development impact of stormwater peak flow, target flows were established at the proposed outlet in the VO hydrology model to determine peak flows for the 4-hour Chicago and 24-hour SCS storm for 2 through the 100-year storm events. Based on the assessment there is no increase in peak flows at Pooles Road location as shown in Table 4:

Table 3: Willow Creek Peak Flows at Pooles Road

Location	Existing 100 year-SCS (m ³ /s)	Proposed 100 year-SCS (m ³ /s)
Existing Culverts at Pooles Road	2.598	1.863
Existing Midves Court Municipal Ditch System	3.224	2.769
Catch basin at end of Midves Court	3.546	3.545

Any future design for any development or road improvement within the MSP which is draining to Willow Creek will be required to demonstrate, as a minimum, that there will be no increase in the expected flows at this location. In addition, any development proposals in the vicinity of Neighbourhood 3 will be required to establish existing conditions and flow targets along the unnamed tributary to Willow Creek as part of the Draft Plan Approval process should these lands be deemed suitable for development in the future.

Runoff Volume

As identified in the Minutes of Settlement S.12.c: ***'At each outlet there will be no increase in the volume of post development runoff from the pre development runoff, however some post development storm runoff increases may be permitted for infrequent storms, if it is demonstrated that there will be no cumulative downstream impacts, taking into consideration all of the subdivisions in the Midhurst Secondary Plan area.'***

The potential impacts of development with respect to increased volumes of storm drainage within the Willow Creek tributary area are identified, along with proposed mitigation measures in the **August 8, 2014 Technical Memorandum Midhurst Master Drainage Plan - Phase 1 Item #3 Volume Control** prepared by SCS (SCS (3), 2014), included in Appendix F. Based on the hydrology model utilized for the assessment of peak flows, and with reference to the annual precipitation established in the water balance report prepared by Golder, 2014, it was determined that, through the incorporation of LID measures described in detail in Section 2.3, the post development runoff volumes for the Doran Road neighbourhood will still exceed the pre-development volumes by 26%. Presently, it has been demonstrated that mitigation of the additional volume could be provided through extended release of extended detention flow volume over 72 hours for 2 to 100 years storm events. The following table shows the pre- & post development volumes. In addition to the volume control calculation detailed geomorphic assessments, as described in Section 2.2.3 of this report, are underway, to develop a specific erosion threshold for the creek, thereby providing a more specific target to complement this analysis and as outlined in Section 2.2.4.2 of this report. It was generally agreed during discussions with NVCA that erosion would be addressed mainly through these extensive infiltration activities. This will be verified as part of the fluvial assessments.

Table 4: Runoff Volumes to Willow Creek

Strom Event	Existing Runoff Volume (m ³)	Post-Development Runoff Volume(m ³)	Extended Detention (25 mm runoff-72 hr release) (m3)	Total Remaining Post-Development Runoff Volume(m ³)
Annual	80 mm	46.7 mm	-	46.7 mm
2 Year	7,995	11,053	2,806	8,248
5 Year	21,787	26,147	2,806	23,341
10 Year	25,954	37,866	2,806	35,060
25 Year	37,476	54,252	2,806	51,447
50 Year	46,833	67,354	2,806	64,549
100 Year	56,685	81,011	2,806	78,205

Any future design for any development or road improvement within the MSP which is draining to Willow Creek will be required to demonstrate that there will be no increase in runoff volumes as a result of any proposed development in accordance with the procedure described in this section and adhering to the requirements of the latest fluvial assessments completed at that time.

Stormwater Outlet Assessment

As identified in the Minutes of Settlement S.12.f: ***‘The Appellants will provide conceptual information on how each stormwater management pond outlet is conveyed to a suitable outlet assessing the impacts of diversions.’*** The potential outlets for the proposed stormwater management facilities discharging to Willow Creek are identified, along with proposed mitigation measures in the ***August 8, 2014 Technical Memorandum Midhurst Master Drainage Plan - Phase 1 Item #6 Suitable Pond Outlets*** prepared by SCS (SCS (4), 2014), included in Appendix F-1. The assessment of the proposed stormwater outlet within Doran Road Neighborhood was supplemented with additional studies performed in conjunction with Black Creek as referenced in Section 2.2.1. The environmental review of the SWM ponds was completed by Beacon study in (2014) using EIS (2009) as background to confirm the feasibility of the pond outlet. See Appendix F-1.

Russell Road Pond

The Russell Road pond is proposed to be located on the west side of Russell Road and north of Pooles Road. This pond controls runoff from the northwest portion of the proposed development and it will outlet to the existing drainage feature located on the north side of Pooles Road. The pipe outlet and emergency spillway locations were agreed by NVCA to be on the south side of the pond to direct the flow to existing municipal system which will be provided along the Midves Court. Emergency overflows, will be directed to the existing Pooles Road drainage feature that is connected to the Midves Court ditch and downstream municipal storm drainage system. ‘Although this outlet has been agreed to in principle, further assessment to confirm available capacity within the existing drainage features will be undertaken in the detailed design’. In addition, the ongoing geomorphological studies will assess the impact, if any, from the proposed collection and discharge of the existing ponding area, and determine if additional controls are required for this purpose as part of the detailed design.

Pooles Road Ponds

Future development ponds within neighborhood 3 were determined and *“they all drain to the Pooles Road Drainage features and will be directed via pipe to drain to Willow Creek, west of Old Second South”*, (SCS, 2009). This represents the same system which has generally been accepted as the proposed outlet for the Russell Road Pond, as discussed above. As such, the additional investigations of the existing systems and geomorphologic studies along the main branch will provide additional commentary regarding the viability of accommodating this drainage, should these lands be developed in the future.

2.2.1.3. Matheson Creek

Stormwater Peak Flow

As identified in the Minutes of Settlement, S.12.b: ***‘At each outlet there will be no increase in peak flow for all storm events from the 2 year through the 100-year 4-hour Chicago***

and 24-hour SCS storms’. As identified in Minutes of Settlement S.12.c: **‘At each outlet there will be no increase in the volume of post development runoff from the pre development runoff, however some post development storm runoff increases may be permitted for infrequent storms, if it is demonstrated that there will be no cumulative downstream impacts, taking into consideration all of the subdivisions in the Midhurst Secondary Plan area.’** The potential impacts of development with respect to increased rates of storm drainage and runoff volume within the Matheson Creek tributary area are identified, along with proposed mitigation measures in the **summary document of OMB proceedings (2014), May 20, Crozier technical memo of Midhurst Height Development (2016).** See Appendix H. To assess the impact of development and establish target flows at the proposed outlets from the development, a hydrology model was created using the VO software package to simulate expected post-development peak flows and runoff volume in comparison to pre-development flow and runoff volumes under various buildout scenarios. In order to establish the pond storage requirement for Midhurst Heights development, future external development scenarios were set up with and without the impact of onsite LIDs (See Appendix H). Due to the proposed diversion to the main branch of Matheson Creek, the model was calibrated and validated to determine peak flows at the proposed Gill Road outlet based on monitoring data collected at the time. The resulting simulated, pre-development peak flows are summarized in Table 5.

Table 5: Pre-Development Peak Flow to Matheson Creek

Strom Event	Matheson Creek at Wilson Road		Matheson Creek at Gill Road Outlet	
	Chicago Storm (m ³ /s)	SCS Storm (m ³ /s)	Chicago Storm (m ³ /s)	SCS Storm (m ³ /s)
2 Year	2.3	5.1	0.4	0.8
5 Year	5.2	11.1	0.9	1.8
10 Year	7.4	15.9	1.3	2.6
25 Year	10.7	23.1	1.9	3.8
50 Year	13.4	29.1	2.5	4.8
100 Year	16.3	35.6	3.0	5.9
Regional	89.2		15.7	

The Post development scenario was simulated at Gill Road outlet for the 100-year storm event to estimate the flow to Gill Road pipe (Crozier,2014) is summarized in Table 6. The use of LIDs was not considered in the peak flow assessment.

Table 6: Post Development Flow at Gill Road

Scenario	Description	100 Year Flow to Gill Road Pipe (m ³ /s)	Timmins Flow to Gill Road Outlet (m ³ /s)
Post development	Midhurst Heights and Frankcom Lands Contribute to SWMF	4.1	6.6
Post development Interim	Midhurst Heights, Frankcom Lands and undeveloped lands south of Doran Road contribute to SWMF	5.3	8.3
Ultimate Development	Midhurst Heights, Frankcom Lands and Johns Lands contribute to expanded SWMF	5.1	6.6

Stormwater Outlet Assessment

As identified in the Minutes of Settlement S.12.f: ***‘The Appellants will provide conceptual information on how each stormwater management pond outlet is conveyed to a suitable outlet assessing the impacts of diversions.’*** The potential outlets for the proposed stormwater management facilities discharging to Matheson Creek are identified, along with proposed mitigation measures in the *in the ‘Summary Document For OMB Proceedings Proposed Midhurst Heights Development (May, 2014)’* prepared by C.F Crozier & Associates Ltd., and included in Appendix H-1. The originally proposed outlet, a Matheson Creek tributary, located just west of the proposed Midhurst Heights development, was considered by NVCA as insufficient outlet in the site walk (May 8, 2014) due to concerns with regards to erosion and potential impact to the tow existing receiving watercourses (GEO Morphix, 2014). Therefore, an alternative outlet was located at the intersection of the main branch of Matheson Creek with Gill Road. It is proposed to construct an outlet pipe to convey stormwater from the proposed development to the Matheson Creek at Gill Road. In order to confirm the feasibility of this alternative outlet, GEO Morphix conducted an assessment of the impacts of the stormwater outfall on the geomorphology of the Matheson Creek at the proposed outlets. GEO Morphix concluded that *“further detailed field characterization should be computed for sensitive reaches using standard protocols such as those allowed by TRCA/CVC, 2012; TRCA, 2012).”* The location of the pond outlet discharging to a proposed 100-year storm sewer along Gill Road has been agreed to in principle but design details of this storm sewer system will be required with further analysis and information to finalize the outlet assessment taking into account additional outlets for external areas as part of the detailed design. Further assessment of the proposed outlet was supplemented with additional studies including:

- ***GEO Morphix Ltd. (2017). Geomorphological Monitoring of Matheson, Midhurst Rose Alliance Development, Midhurst, Ontario. December 22, 2017.***
- ***GEO Morphix Ltd. (2014). Opinion Regarding Stormwater Management and Instream Erosion Midhurst Rose Alliance. (2014).***

- **Azimuth Environmental Consulting, Inc. (2014). Thermal impacts of proposed stormwater management outlets. Midhurst Heights Development. (June 16, 2014)**

Gill Road SWM Pond

Currently, the proposed stormwater management pond is located at the west corner of property (southeast of the intersection of Gill Road and Craig Road) and has been sized to accommodate each of the scenarios described in Table 6 (above). In addition, the pond is proposed to outlet into the Matheson Creek at Gill Road through a 3 km pipe. The current configuration represents the most conservative land requirements for the pond size. However, the design of the proposed facility will be adjusted through detailed design following additional geomorphological assessment of Matheson Creek, and considering the south Doran Road contribution and Frankcom and Johns Lands see section 0 .

2.2.2. Water Balance

As identified in the Minutes of Settlement, S.12.e: ***‘As much water as possible, consistent with a healthy hydrologic cycle, will be infiltrated back into the ground, aiming for the first 25 mm of rainfall’***; and

Therefore; all proposed development within the MSP is to aim to meet the target of infiltrating the runoff from the first 25 mm of rainfall. This target is required to be confirmed through a geomorphological assessment to ensure that the potential increase in infiltration does not have a negative impact on the downstream receiver. To achieve this target, LID’s within the municipal realm will be required. The configuration of LIDs required to achieve the criteria for water balance and nutrient management are described in detail in Section 2.2.4.1.

2.2.3. Fluvial Geomorphology

The goal of this work is to demonstrate that there will be no additional erosion or sediment loading downstream of the development on any of the receiving watercourses. The Minutes of Settlement identify the following:

S.13 *‘The Appellants agree to ensure that all development is to be located outside of natural hazard areas and significant natural heritage features.’*

Geomorphological monitoring reports of Willow Creek and Black Creel have been conducted by GEO Morphix in February, 2018 as part of the adaptive management plan to assess and characterize baseline conditions of Willow and Black Creek. The monitoring system began in the Fall of 2014 and were reassessed in Fall, 2015 and 2016. Different methods have been used to assess the fluvial geomorphology, including cross-sections measuring, erosion pins, and grain size analysis. The results of GEO Morphix study show a *“minor change in channel conditions’ in Fall 2016 compared to Fall 2014, and 2015, and Few centimetres of erosion and deposition were recorded. ‘Over the tested period, the channel generally has remained stable with no major change in the cross section of Willow and Black Creek”*(GEO Morphix, 2018).

A similar geomorphological assessment was produced for Matheson Creek (December, 2017) as part of the first steps in establishing an Adaptive Management Plan. The assessment characterized the existing geomorphology within Matheson creek and its tributaries. Monitoring began in the Fall of 2014 and reassessed in Fall 2015, and Fall 2016. The methods were similar to ones used for Willow and Black Creeks; however, the results revealed a *“change in the channel bed in few cross-sections with a minor change within the banks”*(GEO Morphix, 2017).

To continue the Adaptive Management Plan process, as described in Section 5.1, the ongoing studies of these Creeks will be utilized to establish erosion thresholds and trigger mechanisms for ongoing development within these watersheds.

2.2.4. Water Quality

2.2.4.1. Nutrient Management

As identified in the Minutes of Settlement, S.12.: ***‘No additional nutrient loading downstream from both the land development and the waste water treatment plant (WWTP) ensuring no additional nutrient loading or impacts.’*** Phosphorous loadings have been identified by the NVCA as the most significant water quality issue within their watershed (NVCA, 2013). In 2016, Hutchinson Environmental Services Ltd. Prepared the ***“Midhurst Secondary Plan Area Phosphorus Budget – Update”*** (HESL, 2016) to address *“the cumulative impacts of stormwater management and municipal effluent discharge on water quality in Willow Creek and the Minesing wetland in connection with the Midhurst Secondary Plan Area.”* This study has been included as part of Appendix C. The study was completed to assess the cumulative impact of phosphorous from stormwater management ponds, consider the cumulative impacts of phosphorous loading of the proposed Wastewater Treatment Plant (WWTP) and stormwater, along with developing mitigation measures to ensure no net increase in phosphorous loading to the Minesing Wetland. As stated in the report, Phosphorus budgets were completed to determine the annual phosphorus loading to Willow Creek from the proposed Midhurst WWTP in combination with the development of the MSPA under two separate scenarios: Phase 1, which considers only the 300ha currently approved for residential development; and “Full Build Out”, which considers that all lands within the “Developable Areas” of the MSPA are developed in accordance with the original zoning from OPA 38.

The results of the analysis show that, in the absence of any on-site stormwater management on the development properties, the phosphorous loading to Willow Creek, based on the combined effect of the developed lands and the WWTP, would increase from 46 kg/yr to 331 kg/yr under the Phase 1 scenario, and from 134 kg/yr to 797 kg/yr under the “Full Build Out” scenario. To establish the impact of the proposed LID measures on site, designed to treat the increased volume of runoff from the development directly at the source, additional analysis was completed to assess the impact of infiltrating the first 20 mm of rainfall, or the first 25 mm of rainfall under each development scenario. The analysis was completed under the assumption of increased runoff accounting for climate change, as described in Section 2.2.6

The results of this analysis are summarized in Table 7.

Table 7: Summary of Phosphorous Loadings (kg/yr) from Development of MSPA

	Phase 1			Full Build out		
Infiltration	None	20 mm	25 mm	None	20 mm	25 mm
Pre- Development	46	46	46	134	134	134
Runoff	213	21	11	663	66	33
Change in Phosphorus Load from Runoff	167	-25	-35	529	-68	-101
WWTP Load	118	118	118	134	134	134
Total Post Development	331	139	129	797	200	167
Change in P export	285	93	83	663	66	33

On this basis, HESL concluded that “overall, the implementation of effective LID techniques for stormwater management resulted in reduced phosphorous loadings to the Willow Creek subwatershed from the developed lands for both Phase 1 and Full Build Out compared to existing pre-development loads. These reductions partially offset the increased loadings from the discharge of treated effluent from the WWTP.” The results of the analysis demonstrated that the net change from urban land development and the WWTP would be an increase of 93 kg/yr under the Phase 1 scenario in comparison to existing conditions, and 66 kg/yr under the “Full Build Out” scenario. However, they also determined that “minor increases in phosphorous loadings from both the 20 mm and 25 mm scenario would have no effect on the Minesing Wetland...(and that) the TP limit of 0.03 mg/L for discharge of treated municipal effluent would reduce the 75th percentile phosphorous concentrations in Willow Creek thus improving water quality.”

The design of the LIDs proposed within the Phase 1 lands is based on discussions between the Township and the MLG to establish requirements for LIDs on private and public lands. Several types of LIDs have been proposed in these developments to meet the water balance targets described in earlier and to achieve the phosphorous loading objectives. These include:

- Private soakaway pits located in front and rear yards;
- Rear-lot catch basins connected to exfiltration trenches;
- Infiltration galleries in public Park Blocks;
- Exfiltration trenches within SWM Blocks;

- Catch basin exfiltration in the Municipal Road Allowance;
- Rain gardens located in the boulevards;
- Bioswales within the boulevards; and
- Increased topsoil depth.

Any future development within the MSPA will be required to achieve the same standards for water balance and nutrient management, and will therefore require that LIDs of this nature are considered as part of the design. Generally speaking, the design of any LIDs within the MSPA must comply with the recommendations provided in the latest publication by TRCA/CVC (currently the 2010 “**Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0**” or at <https://wiki.sustainabletechnologies.ca>), and the latest available Township Standards. Based on the Engineering review of the Phase 1 developments the Township has identified the following requirements for each type of LID.

Private Soakaway Pits

All individual soakaway pit details should be provided on the Grading Plans, and designed to intercept roof drainage from each private lot. Rear yard swale gradients of less than the Township Standard of 2% will only be accepted where infiltration galleries are proposed. The Township will not require easements for infiltration galleries. The Township has recommended that, in order to prevent construction of any accessory buildings or landscaping within the infiltration gallery zone, each Offer of Purchase and Sale identify this constraint to prospective buyers.

Rear Lot Catch Basins

Municipal easements will be required for any rear lot catch basins and any associated leads, at a minimum width of 4 m. Any RLCB leads must be connected directly to maintenance hole structures within the road allowance.

Infiltration Galleries in Public Park Blocks

Infiltration galleries within Park Blocks should be designed to follow natural contours and should have a footprint of less than 50% percent of the Block area.

Exfiltration within SWM Blocks

Exfiltration trenches should be located near the pond outlet to provide a measure of thermal mitigation to pond outflows.

Catch Basin Exfiltration, Rain Gardens, and Bioswales in the Municipal Road Allowance

Details need to be provided for any boulevard LIDs to demonstrate that individual services (storm, sanitary, water) and Utility duct banks crossing the boulevard clearly showing the depth and vertical separation to demonstrate that the integrity of the LIDs can be protected during servicing stages. All LIDs should include anti-seepage collars at appropriate spacing to prevent longitudinal flow and failure of the system due to potential migration of fines and boulevard settlement. Rain gardens should be avoided adjacent to residential properties.

Boulevard bioswale depressions would be generally acceptable within lot flankages or in areas with no lot frontages, but would not typically be feasible along residential frontages due to close spacing between driveway aprons. Raised catch basins and perforated subdrains should be provided to relieve any nuisance ponding within the boulevards.

Increased Topsoil Depth

Increased topsoil depths (minimum 300mm) should be clearly stipulated on all appropriate drawings, to be adopted through the development, in situations where the practice is required to achieve the water balance/infiltration targets.

2.2.4.2. Erosion Control

S.12.d: ***‘The Appellants will demonstrate the ability of the stormwater management system to hold back the 25 mm storm runoff for 48 hours.’***

This requirement needs to be implemented in conjunction with findings and recommendations of the fluvial-geomorphic analysis. Local creeks and or ravines may require more stringent controls based on their sensitivity to erosion and stormwater discharges. In addition, specific guidelines related to erosion and sediment control plans for development will be provided as part of the MCSMP.

The NVCA applies the guidelines from Erosion & Sediment Control Guidelines for Urban Construction, (GTA Conservation Authorities, December 2006). Additional recommendations may be identified through this study for site-specific areas based on the area environmental sensitivity and or recommended construction protocol.

2.2.4.3. Infiltration Measures

S.12.e: ***‘As much water as possible, consistent with a healthy hydrologic cycle, will be infiltrated back into the ground, aiming for the first 25 mm of rainfall.’***

To determine the maximum infiltration volume that can be achieved in the MSP, infiltration analysis was completed by SCS in (SCS (5),2014). ***Midhurst Master Drainage Plan- Phase 1. Maximize Infiltration. Midhurst, Ontario.*** A model was built using Initial Abstraction parameters to assess the existing hydraulic conductivity of the soils. Based on proposed LIDs (private lot level LID’s and LID’s within the public realm) and the additional requested LIDs, the potential infiltration volume is estimated as the following table.

Table 8: Estimated infiltration (mm) based on proposed LIDs

SWM Pond	Weighted IA with NO LID's	Weighted IA with Lot Level LID's	Weighted IA with Lot Level and Municipal LID's	Resultant Rainfall Event with no Runoff
North Pond	2.8	9.9	20	23.3
Carson Road North Pond	2.8	12	18.7	22.5
Carson Road South Pond	2.7	9.2	20.3	23.4
South Pond	2.9	10.6	21.5	23.0
Russell Road Pond	2.7	8.9	23.5	24.6

As stated in section b the Midhurst Heights Development proposed that all runoff from the Phased 1A and 1B will be infiltrated onsite through the implementation of LIDs, and therefore the infiltration requirement of the Minutes of Settlement will be achieved (Crozier,2018).

2.2.4.4. Thermal Impact Mitigation

Minutes of Settlement, S.12.h: ***‘Through the ecological and engineering review, a suite of thermal mitigation techniques for stormwater management pond discharge will be implemented to protect aquatic systems. The effectiveness of these techniques will be assessed through the AMP (Adaptive Management Plan) through comparison of discharge temperatures with upstream and downstream receiver temperatures.’***

The characterization of baseline conditions of the receiving three creeks has been completed by Hutchinson Environmental Science (2014), and Azimuth Environmental (2014) to show that all creeks are cool water, and significant thermal mitigation strategies need to be provided to insure all the outlet locations will be managed as cold-water fisheries. The main thermal mitigation measures provided for the three Creeks (Black Creek, Willow Creek, and Matheson Creek) are:

- “Bottom draw outlet from SWM pond (no deeper than 2.5 m to avoid anoxic conditions which would stimulate the release of phosphorus) (at least 0.5m off the bottom to avoid removal of finer sediments on the pond bottom)
- Underground stone cooling trench at the SWM pond outfall.
- Shade planting for the SWM facilities and the outlet areas.
- Use of LIDs techniques to capture, infiltrate and reuse the initial runoff from urban areas.

All above-mentioned approaches have been agreed by NVCA and confirmed to be sufficient to mitigate thermal impact.

2.2.5. Hazard Assessment

Natural Hazards assessments were completed for all properties in the vicinity of lands designated as EPA I or through EPA 2 lands, as per the requirements originating from OPA 38, as described in Section 2.1.4.2.

2.2.5.1. Carson Road/Black Creek

The floodplain limits of Black Creek were established based on the HEC-RAS model provided in the Carson Road FSR (SCS(1), 2009). Development setbacks along Black Creek were established in the Environmental Impact Study (EIS) completed by Beacon (2009) and updated in 2017 (see Appendix A). In addition, an Erosion Hazard Assessment, in accordance with MNRF Standards, was prepared by Aqualogic (also included in Appendix C). As discussed in Section 2.1.4, no development is permitted within EPA I lands, as stated in OPA 38 and confirmed in the Beacon EIS Study; and, any proposed development within 30 m of EPA I and within EPA II is subject to the completion of an EIS to determine the setbacks of draft plans from any natural hazard area. Black Creek is identified as EPA I in OPA 38 and its features (two drainage features) identified as EPA II designation; However, based on their analysis, Beacon concluded that the two ephemeral drainage features 'do not warrant an EPA II designation'. Beacon also confirmed that Black Creek will be contained as natural open space (corridor) up to 100 m wide and all the draft plans will be out of floodplain; and that the north Drainage feature of Black Creek will be contained in 60 m wide corridor as floodplain boundary (Beacon(1),2009). 'The Willow Creek tributary and its associated floodplain will be retained in an Environmental Protection II designation and buffered from adjacent development with a 6 m setback from the top-of-bank' (Beacon,2009). The erosion hazard assessment completed by Aqualogic concluded that the rate of 100-year erosion is 11.2 m for main branch, 5 m for 1st order tributaries. this result was applied in the Carson Road Development as demonstrated in the appended document see Appendix I. Further discussion of these studies is provided in, SCS, (2014/2017). Midhurst Master Drainage Plan-Phase 1. Hazard Assessment, included in Appendix I.

2.2.5.2. Doran Road/Willow Creek

As shown in Appendix I, SCS completed a slope stability assessment of the slopes north of Pooles Road just west of Russell Road and concluded that they were stable under the proposed Draft Plan configuration of the development. In addition, as part of the 2009 FSR, flood plain mapping was completed for the portion of the property which was formerly to be developed under OPA 38 draining southward to a tributary of Willow Creek, crossing Old Second Road just south of Pooles Road. Based on the results of the model a development setback of 6 m from the floodplain was considered to insure no impacts on the proposed development land from the determined flood line.

2.2.5.3. Midhurst Heights/Matheson Creek

There are no EPA I or II designations on the Midhurst Heights property, so Natural Hazards assessments have not been required at this location.

Natural Hazard assessments will be required for all other lands, not part of the MSP Phase 1 lands, to comply with the requirements of OPA 38.

2.2.6. Climate Change

To address climate change and potential impacts that it could have on the existing and proposed infrastructure it is agreed that storm events would be increased by 15% in accordance with the development standards for the Township. IDF curves with intensities adjusted for climate change are included in Appendix G. Further recommendations can be made with respect to climate change policies and design procedures for future developments based on the study findings and as per current policy and design recommendations.

2.2.7. Hydrologic Analysis

The following will guide any future hydrologic analysis of relevant MCSMP components:

- a. Pre- and post-development modelling would be based on the same sub-watersheds as identified in the models completed for Phase 1 developments. If there is a minor revision in the sub-catchment shape and size due to road layout, the changes in area should be made in both post development models (the gaining and the losing model)
- b. Total runoff from the development area will be the sum of all sub-catchments
- c. The sub-catchment delineation will account for the outlets at the discharge point from the most downstream development block.
- d. The entire secondary plan area would be broken up into sub-catchments (separate from the main Willow Creek).
- e. Work in support of the MCSMP would be prepared using the latest version VO. Other modelling tools such as PCSWMM model might be applied at the site level analysis.
- f. Low Impact Development measures proposed for the subject area to be modelled in the VO model using the route reservoir command on a lumped basis per sub-catchment. Proper safety factors should be set to account for a lump sum approach when simulating effectiveness (quantity control) of the LID measures. If another method is preferred, then it would need to be approved by Township/NVCA.

Hydrologic analysis in support of the MCSMP is to be prepared using the latest version of VO. Other modelling tools such as PCSWMM model might be applied at the site level analysis. Rainfall intensity duration frequency will be based on the Springwater Township Engineering Standards. For Subwatershed delineation, NVCA has already delineated Willow Creek Subwatershed in Willow Creek Subwatershed Plan (NVCA, 2001), and any other catchment delineation within MSP would consider these boundaries to perform hydrologic models. DEM

(Digital Elevation model) is provide by NVCA and there are different sources that could be used for future hydrologic parametrization which are the following:

- NVCA Topographic maps (NVCA, 2012)
- NVCA Land Use maps (NVCA, 2008)
- NVCA Technical SWM Guidelines (NVCA, 2013)

The current developed OTTHYMO Models as part of Midhurst development were used to identify the peak flows and runoff volumes across the three proposed neighborhoods as well as the required storage and based on specific boundary of subwatersheds. As per NVCA standards, a 4-hour Chicago and 24-hour SCS storm distributions based on Barrie gauging station were applied into the model for existing and proposed conditions. the model parameters are determined based on NVCA guidelines. Any new updates of current hydrologic models will follow NVCA guidelines and will require calibration and verification processes to improve the model performance and efficiency.

In the Stage 1 of Crozier technical memo (2015), the hydrology model has been calibrated based on four parameters which are: Time to peak (T_p), Curve Number (CN), Initial Abstraction, and N value. The calibration was completed at the confluence of Matheson and Willow Creek. Using a variety of rainfall data, the model was able to be calibrated and validated based on different statistical approaches, see Appendix G.

3. HYDRAULIC ANALYSIS

Where applicable, i.e. impact on the flood limits, hydraulic modeling must be provided as outlined in the NVCA Natural Hazard Technical Guide. The preferred hydraulic model is the U.S. Army Corps of Engineers HEC-RAS in the most recent version of the software. To date HEC-RAS models have been developed for Black Creek and for the small tributary of Willow Creek west of Old 2nd Road as part of the 2009 Functional Servicing Reports for the Carson and Doran Road developments. The models are included in Appendix L.

Any development in EPA I or EPA II lands near defined watercourses within the MSPA will require an updated hydraulic model and associated floodplain mapping to establish development limits and to ensure no increases in water surfaces upstream or downstream of the development area, for all events up to the Regional storm. Updated HEC-RAS models will be based on the existing hydraulic models and updated flow data from Visual OTTHYMO models.

4. IMPLEMENTATION PLAN

The MCSMP establishes the initial framework for the development criteria within the MSP. Currently, Phase 1 lands of the MSP Draft Plans have been approved using the stormwater management strategy detailed in Section 2.2 of this document. The principles and objectives of the MCSMP will be followed through the detailed design of all phases of these developments through the Township's Development review process. Similarly, any future residential development within the MSP area will be required to follow this same process from the development of Draft Plans through to assumption of the subdivision by the Township to ensure long-term preservation and enhancement within the Willow Creek subwatershed. The following Implementation Plan outlines the procedure regarding how the components of the overall strategy will be orchestrated throughout the development of the MSP based on the following

- a. Although, the 100-year pipe conveying flow along Gill Road to Matheson Creek has been agreed to in principle, additional geomorphology studies are underway to assess the potential benefit of providing maintenance flow to the two original receiving tributaries of Matheson Creek. As a result of this additional study, recommendations will be provided for modifications to the design of this storm system to ensure sustainability of base flow contribution, as well as water balance and ecological functions along the existing outlet routes, with consideration for alternative outlets for external areas to account for any potential interference with conveyance capacities.
- b. Following confirmation of the proposed outlet to Matheson Creek, and as part of the detailed design, the design of the facility proposed to service the Midhurst Heights property and, potentially, the Frankcom and Johns Land, with consideration for additional contribution from south of Doran Road in the interim condition, as necessary, is to be finalized. The drainage areas should be maintained to the greatest possible extent to support the local hydrologic and ecological systems and their functions. Any adjustments to the design must be included in the next report developed as part of the AMP.
- c. The selection and feasibility of the outlets to Municipal roads proposed for the Carson Road, Doran Road and Midhurst Heights Developments require further examination during detailed design. The design must address any potential conflicts with existing infrastructure, soil stability, pipe depth, and existing profiles of the roads, completing any additional survey or field studies as necessary to identify these aspects. In addition to these unique site requirements, the design should consider the possibility of potential modifications identified during the future studies (i.e. erosion control thresholds, refined water quality targets, other environmental constraints) and provide appropriate flexibility in the design.
- d. Future residential development proposals within the MSP will be required to demonstrate that the stormwater management strategy described in Section 2.2 can be satisfied prior to obtaining Draft Plan approval. This includes consideration for stormwater management quantity and quality controls, nutrient management, and

- water balance as described in this document and modified as required by the recommendations provided in the most current AMP for the MSP available at the time the application is to be approved.
- e. Future commercial property developments within the MSP will be required to demonstrate that the stormwater management strategy described in Section 2.2 can be satisfied prior to obtaining Site Plan approval. This includes consideration for stormwater management quantity and quality controls, nutrient management, and water balance as described in this document and modified as required by the recommendations provided in the most current AMP for the MSP available at the time the application is to be approved.
 - f. In addition to satisfying the stormwater requirements described in Section 2.2 of this report with respect to stormwater management quantity and quality controls, nutrient management, and water balance, the detailed design requirements for the Transportation servicing of the MSP will include provisions to ensure that any proposed watercourse crossings ensure protection of the natural watercourse and do not cause negative impacts with respect to water levels upstream and downstream of any proposed structures.
 - g. All developments will be required to develop a plan for interim conditions providing details on how the design features require to achieve these objectives are constructed with respect to such aspects as the phasing of the remainder of the development, flow management strategies, protection of LIDs during construction, and performance of any existing infrastructure during the interim period
 - h. An Adaptive Management Plan will be developed as part of the detailed design of the Phase 1 lands to establish objectives that would safeguard the system downstream of the proposed development with no negative impacts as a result. The plan would allow for an adaptive approach to mitigate potential changes downstream and implement necessary adjustments. Flexibility in the approach is important to allow the new information, technology or creative ideas to address the uncertainty and change. Further information regarding the AMP is provided in Section 5.1. The AMP will be updated annually and will provide any recommendation, as necessary, regarding any changes to the development requirements within the MSP area.
 - i. Continuation of the monitoring program originally initiated for the purpose of establishing baseline conditions. The AMP will involve continuous data collection and annual reporting. The program is expected to continue following assumption by the Township as described in Section 1.5.
 - j. Operation and Maintenance requirements for the proposed stormwater works required to satisfy the objectives outlined above, will be identified during the detailed design, including implementation and enforcement mechanisms.

5. FUTURE STUDY REQUIREMENTS

The MCSMP establishes the requirements for residential developments within the MSPA. For Phase 1 lands of the MSP, Draft Plans have been developed based on the requirements outlined in this document. The principles and objectives of the MCSMP will be followed through the detailed design of all phases of these developments through the Township's Development review process. Any future residential development within the MSP area will be required to develop Draft Plans in keeping with the requirements of this document and adhering to those design principles through the subdivision review process.

A key factor to ensure that the goal of protecting the health of the watershed ecosystem throughout the build out of the MSP area will be the development of an adaptive management plan. The Adaptive Management approach can be defined as: A systematic, rigorous approach for deliberately learning from management actions with the intent to improve subsequent management policy or practice. The adaptive management plan will confirm that the agreed upon measures have been met and recommend and implement changes if necessary, to mitigate any impacts based on the results of a monitoring and reporting program as per the methodology described in this section.'

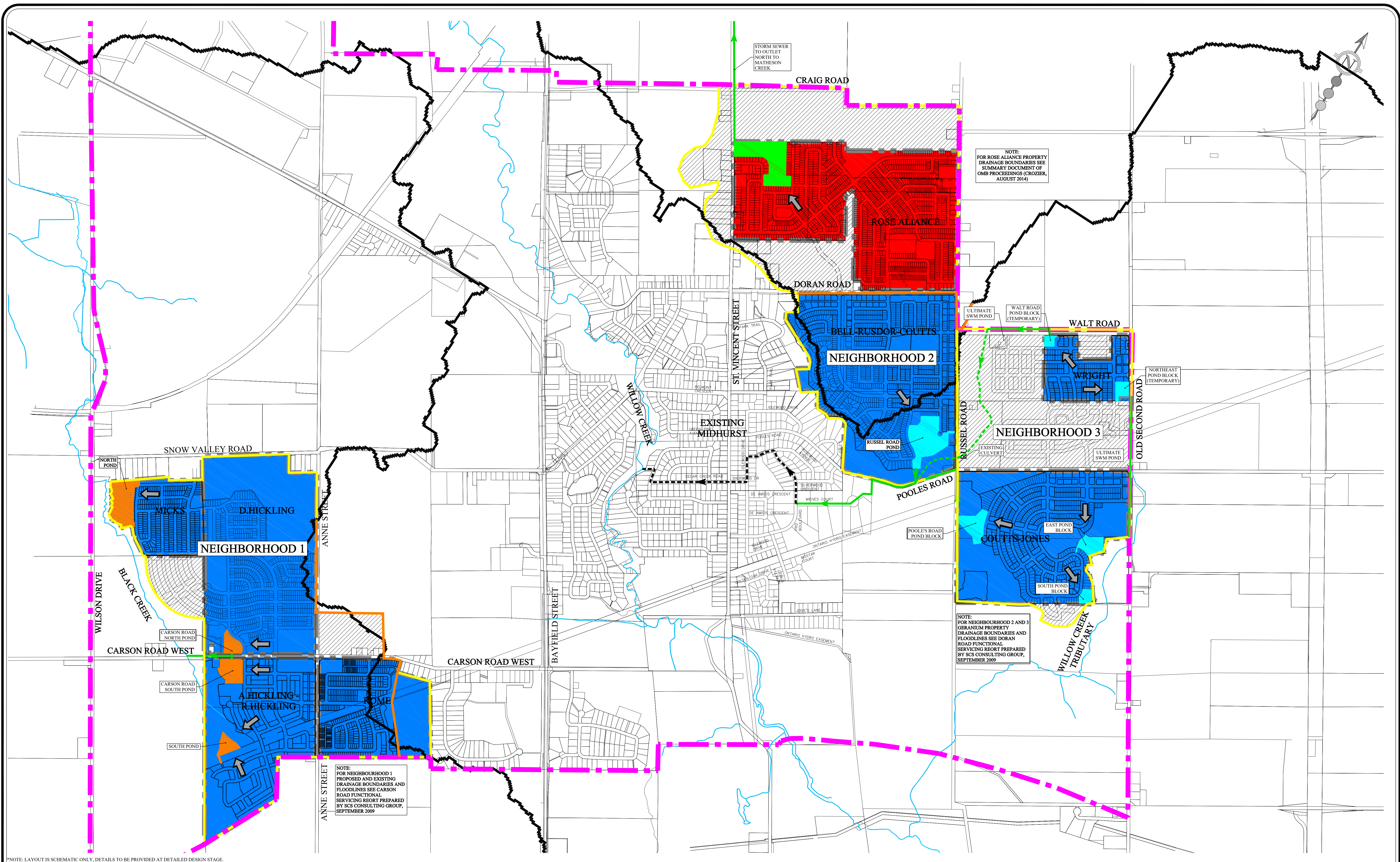
5.1. Adaptive Management Program

The target for the comprehensive Adaptive Management Plan (AMP) is to monitor conditions within the receiving watercourses as developments proceed within the MSP in accordance with the stormwater management Draft Plan conditions and minutes of settlement and to adjust or modify stormwater management in the development sites to achieve the desired results. The adaptive management plan includes the following:

1. Establish baseline conditions for the receiving watercourses with respect to the baseline chemical and biological conditions, as establishing erosion thresholds to maintain channel stability. This baseline information has been completed by Hutchinson Environmental and GEO Morphix and described in Sections 2.1.4.1 and 2.2.3 above.
2. Establish targets and triggers to maintain water quality, flow, ecological indicators, and channel stability. These targets will be established based on Provincial and Federal guidelines as well as median baseline observations made during the baseline monitoring program and are set as the maximum desirable limits. Trigger levels will be set such that early indicators of unexpected variations in the monitoring data can be assessed in a proactive approach with management plans within the watershed can be developed and implemented prior to approaching target values. The targets and triggers will be established during the detailed design of Phase 1 properties.
3. Continue the monitoring program and provide annual reports to document observed conditions within the receiving watercourse, assess the performance relative to original baseline conditions and the established targets and triggers, and provide

recommendations for adaptive management strategies as necessary to preserve existing conditions within Willow Creek and its tributaries. The monitoring plan is summarized in the Environmental Monitoring Matrix and described in Appendix M.

4. Present the findings from the annual reports to the Project Management Team, as described in Section 1.5, and issue any necessary Addendums to update the MCSMP.



NOTE: LAYOUT IS SCHEMATIC ONLY; DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

LEGEND:

- SECONDARY PLAN BOUNDARY
- DRAFT PLAN BOUNDARY
- NEIGHBORHOOD BOUNDARY
- WATERCOURSE

- ROSE ALLIANCE LANDS
- GERANIUM LANDS
- SWM FACILITY TO BLACK CREEK

- SWM FACILITY TO WILLOW CREEK
- SWM FACILITY TO MATHESON CREEK
- NON-PARTICIPATING LAND OWNER

- PROPOSED STORM SEWER
- EXISTING STORM SEWER
- NATURAL DRAINAGE PATH

- PROPOSED WATERSHED BOUNDARY
- EXISTING WATERSHED BOUNDARIES
- OVERLAND FLOW PATH FROM POND OUTLET



30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

MIDHURST GROWTH STUDY

DESIGNED BY: M.T.C.
SCALE: 1:10000

CHECKED BY: J.M.P.
DATE: MAY 2020

OVERALL DRAINAGE PLAN

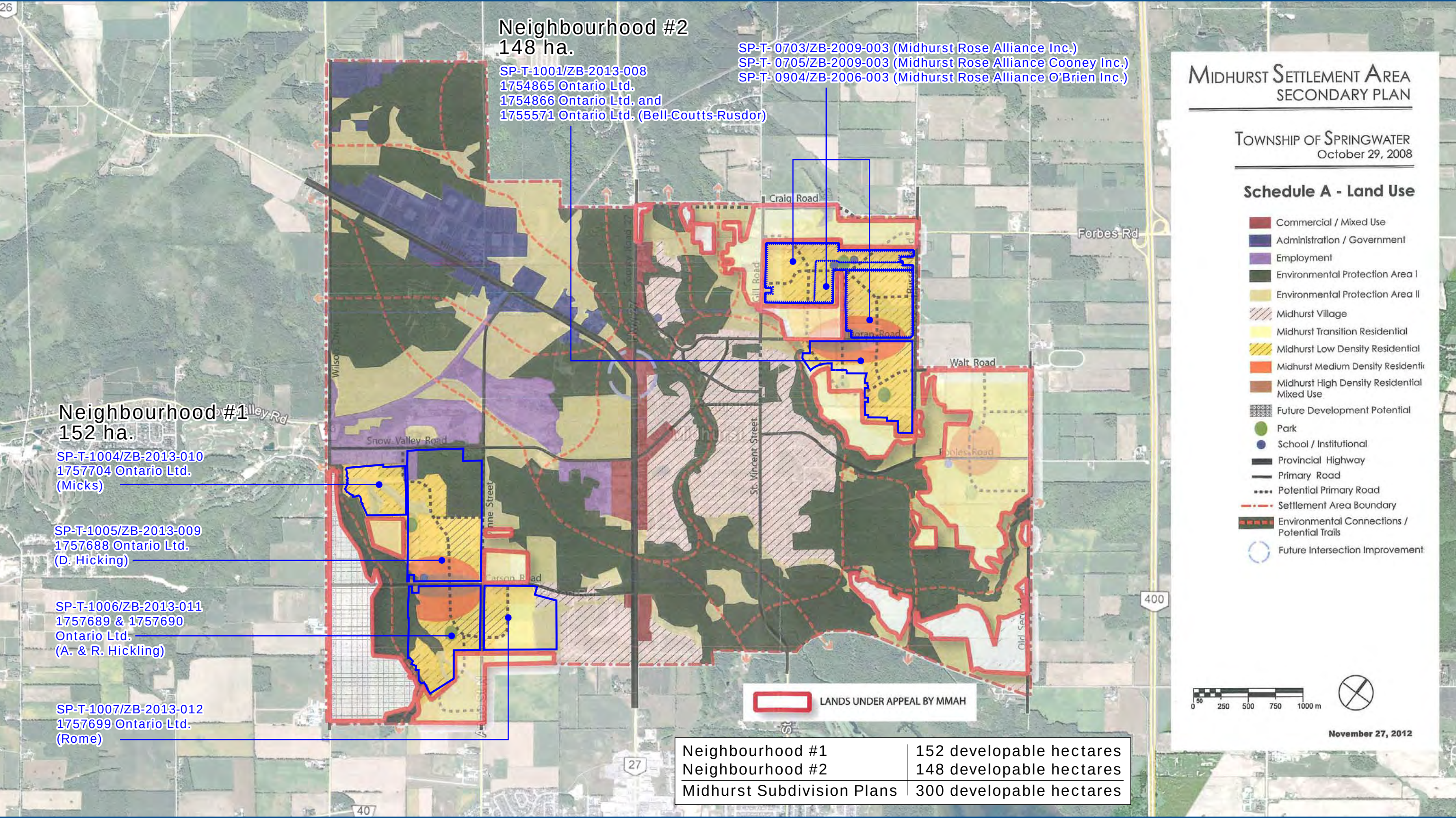
PROJECT No:
1212

FIGURE No:
1

Appendix A:

- **OPA 38 Schedule A**
- **NVCA Minutes of Settlement**

SCHEDULE 'A' - LAND USE



O.M.B. Case Nos. PL131125 et. al.

ONTARIO MUNICIPAL BOARD
Commission des affaires municipales de l'Ontario

OMB File Nos. PL131125, PL101066, PL131126, PL101071,
PL131127, PL101070, PL131128, PL101072, PL131129, PL101073, PL100139, PL100140, PL100144,
PL100145, PL100146, PL100147

MINUTES OF SETTLEMENT

B E T W E E N:

MIDHURST DEVELOPMENT DORAN ROAD INC.
(hereinafter referred to as "MDDRI")

and

CARSON ROAD DEVELOPMENT INC.
(hereinafter referred to as "CRDI")

and

**MIDHURST ROSE ALLIANCE INC., MIDHURST ROSE ALLIANCE COONEY INC. & MIDHURST ROSE
ALLIANCE O'BRIEN INC.**
(hereinafter referred to as "ROSE ALLIANCE")

and

THE NOTTAWASAGA VALLEY CONSERVATION AUTHORITY
(hereinafter referred to as the "NVCA")

WHEREAS MDDRI is the registered owner of the lands described as Part of Lots 13 and 14,
Concession 3, in the Township of Springwater, County of Simcoe (the "MDDRI Lands");

AND WHEREAS MDDRI appealed the following applications for the MDDRI Lands to the Ontario
Municipal Board (the "Board"):

- (i) Application for a Plan of Subdivision No. SP-T-1001 (O.M.B. File No. PL101066); and

- (ii) Application for a Zoning By-law Amendment No. ZB-2013-008 (O.M.B. File No. PL131125) (collectively, the “MDDR Appeals”);

AND WHEREAS CRDI is the registered owner of the lands described as Part of Lots 14, 15, 16 and 17, Concession 6 and Part of Lot 16, Concession 5 in the Township of Springwater, County of Simcoe (collectively, the “CRDI Lands”);

AND WHEREAS CRDI appealed the following applications for the CRDI Lands to the Board:

- (i) Application for a Plan of Subdivision No. SP-T-1004 (O.M.B. File No. PL101070);
- (ii) Application for a Zoning By-law Amendment No. ZB-2013-010 (O.M.B. File No. PL131127);
- (iii) Application for a Plan of Subdivision No. SP-T-1005 (O.M.B. File No. PL101071);
- (iv) Application for a Zoning By-law Amendment No. ZB-2013-009 (O.M.B. File No. PL131126);
- (v) Application for a Plan of Subdivision No. SP-T-1006 (O.M.B. File No. PL101072);
- (vi) Application for a Zoning By-law Amendment No. ZB-2013-011 (O.M.B. File No. PL131128);
- (vii) Application for a Plan of Subdivision No. SP-T-1007 (O.M.B. File No. PL101073); and
- (viii) Application for a Zoning By-law Amendment No. ZB-2013-012 (O.M.B. File No. PL131129) (collectively, the “CRDI Appeals”);

AND WHEREAS Rose Alliance is the registered owner of the lands described as PT LT 11 CON 3 Vespra as in R01385820, PT LT 11 CON 3 Vespra as in R01343811, T/W R01343811, PT LTS 11 & 12 CON 3 Vespra PT 1 51R36114 SAVE & EXCEPT PT 1 51R36610, PT LT 11 CON 3 Vespra; PT LT 12 CON 3 Vespra as in R0581105; Springwater; in the Township of Springwater, County of Simcoe (collectively, the “Rose Alliance Lands”);

AND WHEREAS Rose Alliance appealed the following applications for the Rose Alliance Lands to the Board:

- (i) Application for Plan of Subdivision SP-T-0703 (OMB Case No. PL100140) and application for zoning by-law amendment (OMB Case No. PL100139). [Midhurst Rose Alliance Inc.]
- (i) Application for Plan of Subdivision SP-T-0705 (OMB Case No. PL100145) and application for zoning by-law amendment (OMB Case No. PL100144). [Midhurst Rose Alliance Cooney Inc.]

- (ii) Application for Plan of Subdivision SP-T-0904 (OMB Case No. PL100147) and application for zoning by-law amendment (OMB Case No. PL100146). [Midhurst Rose Alliance O'Brien Inc.]
(collectively, the "Rose Alliance Appeals");

AND WHEREAS the CRDI Appeals, the MDDRI Appeals and the Rose Alliance Appeals are collectively referred to herein as the MLG Appeals;

AND WHEREAS MDDRI, CRDI and Rose Alliance, (hereinafter, 'the Appellants') and the NVCA (individually a "Party" and collectively, the "Parties") have agreed to resolve the MLG Appeals in accordance with these Minutes of Settlement and the Zoning By-law Amendments (the "ZBLAs"), Plans of Subdivision and Conditions for the MDDRI Lands, the CRDI Lands and the Rose Alliance Lands, as set out in the attached Schedules;

AND WHEREAS this settlement is based on the fact that the Parties hereto have agreed to a process (the 'Process') the particulars of which are set out below, by which the Appellants will provide information to NVCA in its review of the matters under appeal;

AND WHEREAS the Process employs conservative assumptions regarding the potential impacts of the proposed developments and sets high standards for the environmental outcomes of such development from natural hazard and natural heritage perspectives;

AND WHEREAS the material provided to the NVCA to date, pursuant to the Process, has satisfied NVCA that, subject to the adoption of certain conditions of draft plan approval and the commitment of the Appellants to the Process, it can support the approval of the plans of subdivision which are under appeal in this proceeding;

NOW THEREFORE in consideration of the mutual covenants contained herein the Parties agree as follows:

1. The Recitals above are true.
2. The attached Schedules form part of these Minutes.
3. The Parties will jointly request that the Pre-Hearing Conference scheduled for July 3 and 4, 2014 with respect to the MLG Appeals be converted to a settlement hearing (the "Settlement Hearing").
4. These Minutes and the Schedules will be submitted by the Parties as an exhibit at the Settlement Hearing.
5. The Parties will support the agreement set out in these Minutes at the Settlement Hearing, and will jointly recommend and request that the Board issue a Decision and

Order approving the ZBLAs and the Plans of Subdivision subject to the Conditions attached in the Schedules.

6. The Parties shall not encourage or assist any person or persons to oppose the settlement or approval by the Board of the ZBLAs, the Plans of Subdivision and/or the Conditions.
7. Any material amendment to the ZBLAs, the Plans of Subdivision and/or the Conditions relevant to the matters set out in this Agreement must be agreed to by the Parties in writing.
8. The support of the Parties for the ZBLAs, the Plans of Subdivision and/or the Conditions is based on a significant body of planning, scientific, environmental and technical studies reports and memoranda.
9. The Appellants shall provide such evidence as the Board may require in support of the ZBLAs, the Plans of Subdivision and the Conditions, and the NVCA shall provide supporting evidence.
10. The Process is based upon the agreement of the Parties that in lieu of extensive field studies to support the cumulative impact assessment of the proposed Midhurst development plan prior to draft plan approval, the Parties have adopted a conservative assumption that the downstream water courses are extremely sensitive and cannot accept any additional impacts. This assumption applies to water quality, quantity (peak flows and volume), and temperature.
11. In accordance with the agreed upon draft plan conditions, the Appellants agree to complete the cumulative impact assessment prior to commencement of detailed design for the proposed subdivision developments.
12. The Parties agree that the following studies will be completed, the following techniques will be applied and the following standards achieved at every stage prior to final plan approvals:
 - a) No additional nutrient loading downstream from both the land development and the waste water treatment plant (WWTP) ensuring no additional nutrient loading or impacts;
 - b) At each outlet there will be no increase in peak flow for all storm events from the 2 year through the 100 year 4 hour Chicago and 24 hour SCS storms;

c) At each outlet there will be no increase in the volume of post development runoff from the pre development runoff; however some post development storm runoff increases may be permitted for infrequent storms, if it is demonstrated that there will be no cumulative downstream impacts, taking into consideration all of the subdivisions in the Midhurst Secondary Plan area ;

d) The Appellants will demonstrate the ability of the stormwater management system to hold back the 25 mm storm runoff for 48 hours;

e) As much water as possible, consistent with a healthy hydrologic cycle, will be infiltrated back into the ground, aiming for the first 25 mm of rainfall;

f) The Appellants will provide conceptual information on how each stormwater management pond outlet is conveyed to a suitable outlet assessing the impacts of diversions;

g) The Appellants shall present a comprehensive adaptive management plan (the AMP), developed through consultation with the Parties, and will demonstrate how the results of the monitoring are to be implemented and acted upon. The adaptive management plan will confirm that the agreed upon measures have been met and recommend and implement changes if necessary to mitigate any impacts; and,

h) Through the ecological and engineering review, a suite of thermal mitigation techniques for stormwater management pond discharge will be implemented to protect aquatic systems. The effectiveness of these techniques will be assessed through the AMP through comparison of discharge temperatures with upstream and downstream receiver temperatures.

13. The Appellants agree to ensure that all development is to be located outside of natural hazard areas and significant natural heritage features.

14. The Appellants agree to produce and/or assist with producing a Summary Document within 45 days (i.e by August 12, 2014) that summarizes the agreed upon targets, technical studies completed to that date as per 12 above) and specifying next steps to be taken in the Process.

15. The Appellants agree that if required the draft plans will be revised in order to meet the requirements of the above conditions including, but not limited to, loss of lots to provide for

larger/additional stormwater pond block(s), flooding /erosion setbacks and/or providing blocks for Low Impact Development measures to the satisfaction of the Nottawasaga Valley Conservation Authority and the Township of Springwater.

General

16 If the Board does not approve the ZBLAs, the Plans of Subdivision and the Conditions, or revised versions thereof which are acceptable to the Parties, the agreement documented in these Minutes shall be at an end, and the Parties shall no longer be bound by the obligations hereunder.

17 The Parties acknowledge that they have received legal advice in connection with these Minutes.

18 The Parties each agree not to request a costs award from the Board against each other in respect of any aspect of the MLG Appeals.

19 The Parties agree that they are contractually bound to the terms of these Minutes, and that the obligations and benefits thereof are immediately enforceable by civil action should a Party be in breach of them.

20 These Minutes shall be binding and enure to the benefit of the Parties, their successors and assigns.

21. Subject to applicable law, the Parties shall execute diligently and expeditiously such further documents and take such further action as may be reasonably required in order to implement and give full legal force and effect to the terms of these Minutes.

22 The Parties agree to act reasonably and with good faith in respect of all dealings between the Parties pursuant to these Minutes.

23 If any provision of these Minutes is deemed illegal, invalid or unenforceable, by an arbitrator or any court of competent jurisdiction from which no appeal exists or is taken, that provision will be severed from these Minutes and the remaining provisions will remain in full force and effect.

[illegible]

Date: , 2014

) Position
)
) I have authority to bind the Corporation
)
) **Midhurst Rose Alliance O'Brien Inc.**
)
) Per: 
) Position President
)
) I have authority to bind the Corporation

Date: , 2014

)
) **The Nottawasaga Valley Conservation**
) **Authority**
)
) Per: 
) Position CHAIR
)
) Per: 
) Position Secretary Treasurer
)
) We have authority to bind the Corporation

Appendix B

- **Doran Road- Neighborhood 2 and 3 Environmental Impact Study**
-
- **Carson Road- Neighborhood 1 Environmental Impact Study**



GUIDING SOLUTIONS IN THE
NATURAL ENVIRONMENT

Carson Road – Neighbourhood 1 Environmental Impact Study

Prepared For:

Carson Road Development Inc.

Prepared By:

Beacon Environmental

Date: Project:

September 2009 208005

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1. Introduction

1.1 Background

This report is submitted in connection with four draft plans of subdivision filed by Carson Road Development Inc. (CRDI) in December 2008 for a total of 208.3 ha (514.7 acres) of land in the Midhurst Settlement Area, in the Township of Springwater, Simcoe County.

In January 2008 CRDI filed an Official Plan Amendment (OPA) Application for these lands, which are located in what is referred to as Neighbourhood 1. As per the Midhurst Secondary Plan (OPA 38), Neighbourhood 1 is a potential total future development area of approximately 235.3 ha (581.4 acres) located in the southwest quadrant of the Midhurst Settlement Area.

Neighbourhood 1 is generally bounded by Snow Valley Road to the north, a wooded area and existing estate residential development to the east, the Midhurst Settlement Area boundary to the south, and a Black Creek (a tributary of Willow Creek) to the west.

The Township of Springwater began a Secondary Planning process for the entire Midhurst community in the summer of 2007 in order to plan for the growth and future land use designations and policies for the community over the next 20 years. The Township is also undertaking Environmental Assessment (EA) processes in tandem with its Secondary Planning process. The Midhurst Secondary Plan was adopted by the Township of Springwater in November, 2008. The EA process, which deals with future servicing and transportation improvements for Neighbourhood 1, was filed on July 9, 2009.

1.2 Study Scope and Objectives

Beacon Environmental has been retained by CRDI to conduct a review of natural heritage features associated with five separate properties (totalling 208.3 ha) that lie within Neighbourhood 1 and to assess the impact of development of these properties on the natural environment. These five properties are known as the D. Hickling, Micks, A. Hickling, R. Hickling and Rome Development Corporation properties. The respective locations of each of these properties within Neighbourhood 1 and the Midhurst Secondary Plan Area as a whole are shown in **Figure 1**.

This report, therefore, represents an Environmental Impact Study (EIS) submitted in connection with four draft plans of subdivision for these five properties, which have been prepared by Gatzios Planning (June 2009). The four draft plans cover the following properties (hereafter collectively referred to as the “study area”):

1. D. Hickling (84.20 ha) – north of Carson Road and west of unopened Anne Street road allowance;
2. Micks (23.96 ha) – south of Snow Valley Road and east of Wilson Drive;
3. A. & R. Hickling (60.11 ha) – south of Carson Road and west of Anne Street; and
4. Rome (40.03 ha) - south of Carson Road and east of Anne Street.

The overall objective of this EIS is to identify the presence of natural features on and adjacent to the subject properties that may pose constraints to their future development, as well as to identify those areas that, due to an absence of environmental constraints, would appear to present opportunities for development. An assessment of the potential impacts of development on natural heritage features is also presented, based on the four area-specific draft plans (Gatzios Planning, June 2009) referred to above.

The specific objectives of this EIS are to:

- Confirm the boundaries of the natural features to be protected;
- Carry out detailed inventories of the subject property (flora and fauna, physical setting, ecological attributes and functions, species and communities of conservation concern, degree of connectivity);
- Assess the sensitivity of natural heritage features and their ecological functions to the proposed development;
- Assess the potential impacts of the proposed development on the features and functions of the natural area; and
- Identify appropriate mitigating measures to protect the feature from impacts associated with the proposed development of the CRDI lands.

2. Methodology

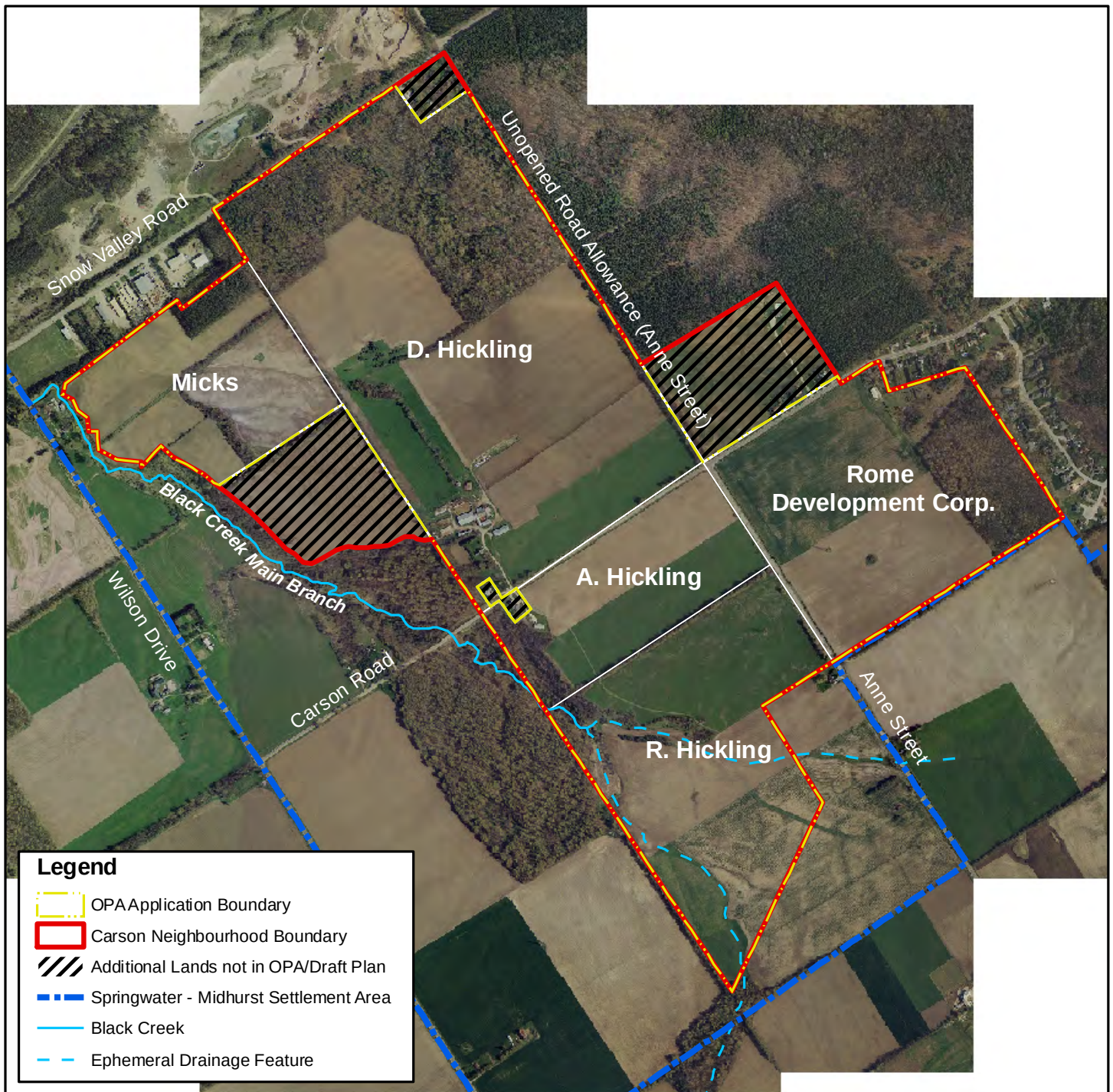
2.1 Background Review

Prior to undertaking any site specific field investigations, Beacon Environmental reviewed the applicable natural heritage policies of the Provincial Policy Statement (PPS 2005), the Township of Springwater Official Plan (2001), the County of Simcoe Official Plan (2007), as well as the Nottawasaga Valley Conservation Authority's regulations (NVCA 2006) respecting watercourses, wetlands and valleylands. It should be noted that although this application was initiated prior to the adoption of the County Official Plan (OP) by County Council on November 25, 2008, the relevant policy direction provided in this latest (2008) version of the County's OP has been considered even though the COP is not approved, as the policies reflect the most recent view of the County.

The applicable policies contained within the Midhurst Secondary Plan (OPA 38), which is also not approved, were also, reviewed and considered for the same reason. They represent the Township's most recent views with respect to natural heritage matters.

A number of sources were consulted for information relating to the Neighbourhood 1 study area and the Midhurst area in general, including the following:

- County of Simcoe Official Plan (Office Consolidation 2007);
- Proposed County of Simcoe Official Plan (November 2008);
- Township of Springwater Official Plan (2001);
- *Master Environmental Report for the Midhurst Secondary Plan Area* (Azimuth Environmental 2003);



Site Location and Subject Properties

Figure 1

Environmental Impact Study
Midhurst Carson Neighbourhood 1

Ortho Photo Base 2002

UTM Zone 17 N, NAD 83

0 125 250 500 Meters



1:15,000

Project 208005
June 2009

- Midhurst Secondary Plan – Official Plan Amendment No. 38 (The Planning Partnership 2008);
- Growth Management Memo – Midhurst Secondary Plan Study (The Planning Partnership 2008);
- Draft Environmental Mapping – Midhurst Secondary Plan Study (Bird & Hale 2008);
- Nottawasaga Valley Conservation Authority (NVCA) natural heritage resource information (regulated area mapping, *2007 Willow Creek Subwatershed Report Card*); and
- Ministry of Natural Resources' Natural Heritage Information Centre (NHIC) rare species database.

Other sources of information, such as aerial photography and topographic maps, were also consulted prior to commencing on-site field investigations.

2.2 Field Investigations

Field investigations of the five properties were undertaken by Beacon Environmental ecologists on the following 11 dates:

- November 21, 2007 – preliminary reconnaissance survey from local roads
- November 29, 2007 – confirm top-of-bank staking with NVCA; winter birds
- January 10, 2008 – reconnaissance survey of four properties (R. Hickling, A. Hickling, D. Hickling, Rome)
- April 17, 2008 – breeding amphibian survey (visit 1)
- May 12, 2008 – top-of-bank and feature staking on Hickling and Rome properties with NVCA
- May 13, 2008 – breeding amphibian survey (visit 2)
- June 16, 2008 – breeding bird survey (visit 1)
- June 30, 2008 – breeding bird survey (visit 2)
- July 11, 2008 – top-of-bank staking of Black Creek floodplain (Micks property)
- July 17, 2008 – confirm top-of-bank staking on Micks property with NVCA
- July 29, 2008 – ELC vegetation community mapping and floral inventory

During these field visits, the existing conditions with respect to natural habitats and drainage features within various portions of the study area, as described above, were examined and some feature limits (particularly on the A. Hickling, R. Hickling and Micks properties) were staked and surveyed. Two of the above dates (May 12 and July 17, 2008) involved site visits with ecology and planning staff of the NVCA to review and determine valley top-of-bank lines and other feature limits.

2.2.1 Breeding Amphibians

Two nocturnal surveys for breeding amphibians were carried out within the study area: on April 17 and May 13, 2008. On the first survey the air temperature was 12°C and clear with no wind. Conditions were calm on the second survey, with an air temperature of 17°C. During each of the two surveys the following locations were surveyed (Figure 1):

- the small cattail marsh wetland at the confluence of unnamed headwater tributaries of Black Creek (situated on the R. Hickling property near the south end of the study area);
- at the Carson Road crossing of Black Creek;
- at the Wilson Road crossing of Black Creek (in the northwest corner of the study area);
- along the south side of Snow Valley Road at the D. Hickling property; and
- in the dry wooded valley south of Snow Valley Road and west of the unopened Anne Street road allowance in the northeast corner of the study area.

The amphibian survey followed the standard sampling protocol for southern Ontario, adapted from the Wisconsin Index (Mossman *et al.* 1998), whereby calling anurans (frogs and toads) were identified to species, and chorus activity was assigned one of the following codes:

- 0..... no calls
- 1..... individuals of one species can be counted, calls not simultaneous
- 2..... some calls of one species simultaneous, numbers can be reliably estimated
- 3.....full chorus, calls continuous and overlapping

Amphibian surveys on the tablelands within the study area were not required due to the absence of any suitable amphibian habitat conditions (i.e., no breeding ponds are present).

2.2.2 Breeding Birds

Two visits to the subject properties within Neighbourhood 1 were made in the early mornings of June 16th and June 30th, 2008 to survey the breeding bird community. All representative habitats within the study area were surveyed on foot. Only the five properties owned by participating landowners were surveyed. For non-participating landowners within Neighbourhood 1 or for properties adjacent to the study area, observations were made from property lines or roadsides/public rights-of-way. All birds seen or heard in suitable habitat and showing some evidence of breeding (e.g., territorial behaviour) were assumed to be breeding (see Section 4.3.2 for additional information).

2.3 Vegetation Communities and Flora

Vegetation communities within the study area were described and mapped (see **Figure 2**) on July 28, 2008 following the Ecological Land Classification (ELC) System for southern Ontario (Lee *et al.* 1998). Vegetation community descriptions are contained in Section 4.4. For non-participating or adjacent properties ELC was either determined from roadside/property edge observations or follows the earlier work of Azimuth Environmental (2003), who mapped ELC communities at a very broad scale throughout the Midhurst Secondary Plan Area as part of the *Master Environmental Report for the Midhurst Secondary Plan Area*.

Detailed inventories of the flora found within study area were also carried out in late July 2008. The inventory was conducted by random sampling within the various vegetation communities that occur within the study area. This survey effort allowed for a detailed assessment of the floristic community.



Existing
Conditions

Figure 2

Environmental Impact Study
Midhurst-Carson Neighbourhood 1

Legend

- Carson Neighbourhood Boundary
- Butternut (*Juglans cinerea*)
- OPA Application Boundary
- Additional Lands not in OPA
- Springwater - Midhurst Settlement Area
- Black Creek
- Ephemeral Drainage Feature
- "Significant" Hedgerow (Azimuth Environmental, 2003)
- ELC Communities

Code	Description
CUM 1-1	Dry-Moist Old Field Mineral Cultural Meadow
CUP 3-1	Coniferous Plantation Red Pine
CUT 1-1	Sumac Cultural Thicket
FOD 5-2	Dry-Fresh Sugar Maple Beech Deciduous Forest
FOD 5-3	Dry-Fresh Sugar Maple Oak Deciduous Forest
MAS 3-1	Cattail Organic Shallow Marsh

Ortho Photo Base 2002

UTM Zone 17 N, NAD 83

0 125 250 500 Meters

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ENVIRONMENTAL

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June 2009

2.3.1 Incidental Wildlife Observations

Any other wildlife species identified within Neighbourhood 1 during field investigations were recorded as an incidental observation for the purposes of the EIS.

2.3.2 Aquatic Habitat

There is one surface water drainage feature within Neighbourhood 1, the main branch of Black Creek that flows from south to north through the westerly portion of the study area (see Figure 1). A general description of the aquatic habitat conditions associated with Black Creek is found below in Section 4.6. However, it should be noted that a more detailed discussion of the aquatic habitat conditions of this watercourse, from both a fisheries and water quality perspective, is contained in the companion *Surface Receiving Water Assessment* report which has been prepared in support of this development plan by AECOM Limited (2009a).

2.3.3 Landscape Connectivity

An assessment of landscape connectivity was made using information gathered on the subject property, aerial photography and topographic mapping. The results of this assessment are discussed in Section 4.7.

3. Policy Context

The following sections provide the provincial, regional and local policy context for this assessment.

3.1 Provincial Policy Statement (2005)

Policy 2.1 of the *Provincial Policy Statement* (PPS) (OMMAH 2005) provides direction to municipalities regarding the protection and management of natural heritage features and resources. The PPS defines seven natural heritage features, providing planning policies for each. The *Natural Heritage Reference Manual* (OMNR 1999) is a technical document used to guide in the assessment the seven PPS natural heritage features listed below:

- significant wetlands;
- significant habitat of endangered and threatened species;
- significant woodlands;
- significant valleylands;
- significant Areas of Natural and Scientific Interest (ANSIs)
- significant wildlife habitat; and
- fish habitat.

Each of these features is afforded varying levels of protection subject to guidelines, and in some cases, regulations. Significant wetlands and ANSIs are to be identified by the Ministry of Natural

Resources. Significant habitat of threatened and endangered species is also to be determined by the Ministry of Natural Resources, if a threatened or endangered species is known to occur/have occurred on a given property, or has been identified through site specific investigations. Fish habitat is governed by the federal *Fisheries Act* and variously applied by Fisheries and Oceans Canada (DFO) with Conservation Authorities often acting on their behalf. The identification of the other three PPS natural heritage features (i.e., significant woodlands, significant valleylands and significant wildlife habitat) is the responsibility of the municipality (i.e., planning authority).

3.2 County of Simcoe Official Plan (2008)

In November 2008, the County of Simcoe adopted the *Proposed Official Plan County of Simcoe* (County of Simcoe 2008), which proposes to replace its earlier OP (County of Simcoe 2007). Although the OPA application was initiated prior to the adoption of the 2008 County Official Plan, which has yet to be approved by the Ontario Ministry of Municipal Affairs and Housing (OMMAH), it provides policy direction to the current draft plan of subdivision applications.

The 2008 County Official Plan identifies a Natural Heritage System comprised of natural heritage features that are collectively referred to as “Greenlands”. The Greenlands designation generally encompasses the following natural heritage features: significant habitat of endangered and threatened species; wetlands greater than 0.5 ha; significant woodlands, valleylands, significant wildlife habitat, and Areas of Natural and Scientific Interest (ANSIs).

Under the new Official Plan (County of Simcoe 2008), no development of any kind is permitted in wetlands greater than 2 hectares or the significant habitat of endangered or threatened species. Also, no residential development of the type proposed by the four draft plans of subdivision for the CRDI lands is permitted in the Greenlands designation. However with respect to lands within Settlement Areas, Greenlands boundaries can be refined through an Environmental Impact Statement.

Within designated Settlement Areas such as Midhurst, development shall be directed away from Greenland areas and development proposed within specific distances of Greenlands features (i.e., within 120 m of a wetland or 60 m from a significant woodland and/or valleyland) must be supported by an EIS. The EIS must demonstrate that the proposed development will not have any negative impacts on the nearby features and their functions.

3.3 Township of Springwater Official Plan (2001)

The Township of Springwater Official Plan (2001) presently identifies a Natural Heritage System comprised of Category 1 and Category 2 Environmental Protection Lands. Category 1 Lands are composed of the following natural heritage features/areas:

- provincially and locally significant wetlands;
- ANSIs;
- significant habitat of threatened and endangered species; and
- significant watercourses and ravines.

These Environmental Protection 1 lands are depicted on the Land Use Plan (Schedule A of the Springwater Official Plan) and are areas where development is not permitted.

Category 2 EP Lands include the following:

- lands adjacent to Category 1 Lands;
- unique and significant wildlife habitat;
- forests and woodlots;
- natural connections through valley corridors or other linkages between core areas;
- groundwater recharge and discharge; and
- natural fish habitat.

These areas are shown on Schedule B of the Official Plan (Natural Heritage) as Category 2 EP Lands and are areas where development may be permitted, subject to the findings of an Environmental Impact Assessment (which is synonymous with an EIS).

Within the Midhurst Settlement Area, the land use designations, including the EP1 and 2 Lands, in the 2001 Official Plan have been amended by the Midhurst Secondary Plan (The Planning Partnership 2008), also known as Official Plan Amendment (OPA) No. 38. The relevant environmental policies of OPA 38 are discussed in detail in the following section.

3.4 Midhurst Secondary Plan – OPA 38 (2008)

In 2007 the Township of Springwater initiated a Secondary Planning process for the Midhurst community. The Midhurst Secondary Plan (The Planning Partnership 2008), also known as OPA 38, was approved by Township of Springwater Council in early November 2008. It has not received approval from the County, but represents the most current view of the Township and, as such, is being considered in this analysis. In conjunction with this Secondary Plan process, the Township is also undertaking Class Environmental Assessments to determine the most appropriate servicing plan and arterial road network for the Midhurst Settlement Area.

The natural heritage component of the Secondary Plan has involved mapping the significant features and assigning either an Environmental Protection Area I designation or an Environmental Protection Area II designation to each. The definitions of EPA I and EPA II as they apply to the Midhurst Secondary Plan are not the same as EP Category 1 and EP Category 2 lands, as defined in the Township's Official Plan (2001).

For the purposes of the Midhurst Secondary Plan, lands within the Environmental Protection Area designation "include features that are Provincially mandated or regulated for protection, features that warrant protection based on the mandate of the Conservation Authority and typical buffers generally required to maintain those features" (p.19). This is interpreted to refer to natural heritage features identified by the Provincial Policy Statement (e.g., significant wetlands, significant woodlands, significant wildlife habitat, etc.), as well as those features (i.e., watercourses, wetlands, and valleylands) that are regulated by NVCA. From a land use planning perspective, EPA I lands are fully protected (i.e., no development is permitted within them), even though some development may have been permitted in these areas (subject to an EIS) under the policies of the PPS (MMAH 2005).

Any development proposed within 30 m of an EPA 1 is subject to the preparation of an EIS, which is to be carried out in accordance with the technical requirements of the Township and the NVCA and ultimately requires the Township's approval. Very detailed guidelines as to the required scope and content of an EIS are contained in Section 9.7.2 of OPA 38. One of the primary objectives of the EIS is to determine the actual width of a buffer between the EPA 1 land and the edge of development.

The Environmental Protection Area II designation "includes areas that may [emphasis added] be considered significant with respect to natural heritage features and functions" (p.19). Based on the mapping of natural heritage features in Schedule B of the Midhurst Secondary Plan, it appears that EPA II areas are generally comprised of the following: valleylands, smaller woodlands and plantations.

EPA II lands are areas where some development or land use change may be permitted, subject to the findings of an EIS that has examined the significance and function of these areas in greater detail and determined "the nature and extent of the feature and the determination of any buffer that may be required between the feature and the limit of urban development" (p.19).

3.5 NVCA Watershed Policies and Regulations (2006)

The NVCA regulates hazard lands, including creeks, valleylands, shorelines, and wetlands. It is also responsible for administering many aspects of the federal *Fisheries Act* on behalf of the federal Department of Fisheries and Oceans (DFO).

Under NVCA's (2006) *Ontario Regulation 172/06 (Development, Interference with Wetlands and Alterations to Shorelines and Watercourses)*, a permit is required from the Authority before any development proposals that are located within: 1) 15 m of a watercourse; 2) 120 m of a Provincially Significant Wetland or a wetland area greater than 2 ha; or 3) 30 m of a wetland less than 2 ha in area can proceed.

The 15 m, 30 m or 120 m area around the feature defines the area that is subject to the regulations (i.e., the "regulated area"). For development applications that encroach within the regulated area, the NVCA typically requires that an EIS be prepared to its satisfaction.

Generally, development within the flood limit of a watercourse is not allowed. However, subject to conformity with the Township's Official Plan and the completion of appropriate studies, some development *may* be permitted within the fill regulated area. The NVCA generally requires that watercourses remain in their natural state with respect to development proposals.

The NVCA also generally requires that all watercourses be protected from adjacent development by a vegetative buffer that will be measured from the annual high water mark. In the case of warmwater systems, the minimum buffer is 15 m on each side of the watercourse, while in the case of coolwater or coldwater systems the buffer requirements are 30 m on each side of the watercourse. In situations where thermal regimes and fish populations have not yet been studied and determined, the NVCA may also request 30 m buffer zones.

The presence of any watercourses or wetlands on or in close proximity (i.e., "adjacent lands") to areas proposed for development would trigger the need for an EIS. The EIS may recommend that wetlands be maintained in their existing location and/or for protective buffers to be placed on wetlands and watercourses within the study area.

It should be noted that with respect to “adjacent lands” from a natural heritage feature, the NVCA’s definition of the “regulated area” (e.g., 30 m or 120 m from a wetland) is greater than the Township’s definition of a proximity distance before the requirement for an EIS is triggered (e.g., 30 m from an EPA I area). Notwithstanding this difference, however, it is our expectation that in cases where a development application adjacent to a feature triggers the need for an EIS, the scope of the study will be established such that the requirements of both the Town and the NVCA are satisfied in a single document.

The NVCA also has a Level 2 agreement with DFO, meaning that it has responsibility for identifying if a “*Harmful Alteration, Disruption or Destruction*” (HADD) of fish habitat is likely to occur as a result of a development proposal. If the HADD cannot be mitigated, then a Fisheries Act authorization is required and the file is referred to DFO by NVCA.

4. Existing Conditions

4.1 Soils and Topography

From a topographic perspective, the village of Midhurst is located in the Simcoe Upland and Lowland physiographic regions as defined by Chapman and Putnam (1984). The area generally lies at an elevation below approximately 230 metres above sea level (masl) and is occupied by Little Lake, Black Creek, Willow Creek and Matheson Creek, all of which form part of the Willow Creek watershed (Nottawasaga Valley Conservation Authority), and all of which flow north and west to Minesing Swamp.

The surficial soils within Neighbourhood 1 are characterized by the oldest Quaternary aged silty sands and sand till that occupy the Black Creek valley. The slope situated to the north of Carson Road is underlain by sand and gravel of glaciofluvial origin and these deposits also occupy the steep slopes north and east of the R. Hickling property, and extend north to Snow Valley Road. The soils found on the tablelands that lie east and west of Anne Street are characterized by fine grained glaciolacustrine deposits of Lake Algonquin origin (Barnett 1992).

4.2 Hydrogeological Conditions

The following description of hydrogeological conditions within Neighbourhood 1 is summarized from the information contained in a companion hydrogeology report prepared by Golder Associates Ltd. (2008).

Golder Associates Ltd. used the Ministry of the Environment (MOE) digital water well database and digital topographic maps to determine the relative locations of four major (regional) aquifers that underlie the study area. These aquifers have been classified into four regional aquifers: Aquifers A1 through A4. The upper A1 Aquifer is unconfined and is present at elevations above 240 masl; it either pinches out or merges with Aquifer A2 in lowland areas to the north. The private wells providing water supply to residences along Carson Road and Anne Street tap into both Aquifer A1 and A2. The wells

drawing from Aquifer A1 wells are 9 to 45 m deep, while Aquifer A2 wells are 27 to 49 m deep. There is a strong vertical downward hydraulic gradient between Aquifers A1 and A2.

The village of Midhurst obtains its water from wells drilled down into Aquifer A3, a confined artesian aquifer. This aquifer is thought to be continuous throughout the Willow Creek Valley and to the north in the Matheson Creek Valley, including the Anten Mills area (Golder Associates Ltd. 2008). The aquifer is under confined artesian conditions and is overlain by a lacustrine silt and clay confining layer approximately 35 to 40 m thick. Aquifer A3 is also the primary water supply for local central Simcoe communities such as Angus, Barrie, CFB Borden, Hillsdale, Anten Mills and Wasaga Beach.

Aquifer A4 is the deepest of the four regional aquifers and generally present at elevations below 140 masl. Very few wells in the area receive their water from this deep aquifer.

4.3 Wildlife Communities

4.3.1 Amphibians

The breeding amphibian surveys revealed the presence of one species of frog, Spring Peeper (*Hyla crucifer*), and American Toads (*Bufo americanus*) calling at various sites within Neighbourhood 1. Only peepers were recorded at all survey stations on the first sampling night (April 17, 2008), at chorus levels of 2 to 3. Both peepers and toads were recorded on the D. Hickling property on the second visit (May 13, 2008), at chorus levels of 2 to 3. However, on that night, no amphibian activity was noted elsewhere in the study area.

4.3.2 Breeding Birds

A total of 48 species of birds exhibiting some evidence of breeding were recorded in the study area. These are listed in **Appendix 2**, along with estimated numbers of breeding pairs. It should be noted that the Wild Turkey (*Meleagris gallopavo*), Barn Swallow (*Hirundo rustica*), Tree Swallow (*Tachycineta bicolor*) and Cliff Swallow (*Petrochelidon pyrrhonota*) numbers refer to birds seen only, not breeding pairs.

The breeding bird community associated with study area properties and the adjacent forest/valleylands is quite rich but is also relatively typical of old field, forest interior/forest edge and riparian habitats in rural areas. The breeding bird community is also characterized by many species that are relatively urban-tolerant.

Given the size and relatively mature condition of the forested Black Creek valley along the west side of the study area and the woodland tract on and adjacent to the D. Hickling property in the northeast corner, it is not surprising that a relatively rich breeding bird community occupies this area, including a number of area-sensitive forest birds (i.e., birds that require relatively large areas of specialized habitat in which to breed) (OMNR 2000; see Appendix 2). Forest area-sensitive species for which more than a single breeding pair was recorded include: Hairy Woodpecker (*Picoides villosus*), Veery (*Catharus fuscescens*), Black-throated Blue Warbler (*Dendroica caerulescens*), Black-throated Green Warbler (*D. virens*), Pine Warbler (*D. pinus*), American Redstart (*Setophaga ruticilla*), Ovenbird (*Seiurus aurocapillus*), and Scarlet Tanager (*Piranga olivacea*). The vast majority of these birds were recorded in the large forest block at the north end of the D. Hickling property.

The margins of the agricultural fields and the outer edges of the woodlands support several grassland breeding birds, including some area-sensitive species such as Savannah Sparrow (*Passerculus sandwichensis*) and Eastern Meadowlark (*Sturnella magna*). All the area-sensitive bird species recorded within the study area, both forest and grassland, are ranked S4 or S5.

Across the entire study area the most numerous breeding bird species present are:

- Red-eyed Vireo (*Vireo olivaceus*), forest edge/interior – 23 pairs;
- Indigo Bunting (*Passerina cyanea*), forest edge – 18 pairs;
- Song Sparrow (*Melospiza melodia*), grasslands, forest edge – 17 pairs;
- Red-winged Blackbird (*Agelaius phoeniceus*), grasslands/wetlands – 15 pairs;
- Savannah Sparrow, grasslands – 14 pairs; and
- Eastern Wood-Pewee (*Contopus virens*), forest edge/interior – 12 pairs.

The majority of breeding bird species recorded within the study area, including many of the forest interior specialists, is represented by only one or two pairs.

None of the breeding birds recorded within the study area or within the adjacent forests/valleylands is endangered, threatened or nationally or provincially rare. All of the breeding bird species are ranked S4 (common) or S5 (very common) by the Ontario Ministry of Natural Resources (NHIC 2008).

4.3.3 Other Wildlife

Due to the predominance of open field habitat on the five properties that are the subject of these draft plan applications, and the proximity of the study area to several busy adjacent roadways and residential development to the east, the mammal species associated within the study area are those generally adapted to suburban and rural environments.

Some common wildlife species use the subject property, mostly visiting the tablelands from the wooded valleylands. For example, White-tailed Deer (*Odocoileus virginianus*) tracks were noted at various locations on the site. Striped Skunk (*Mephitis mephitis*) and Raccoon (*Procyon lotor*) tracks were also noted in places. The latter two species are very common in natural areas close to human habitation.

Based on the habitat available in the Cultural Meadow and Cultural Thicket (CUM1-1 and CUT1-1) communities and along the forest/field interfaces it is likely that common mammal species such as the Meadow Vole (*Microtus pennsylvanicus*), Gray Squirrel (*Sciurus carolinensis*), Eastern Cottontail (*Sylvilagus floridanus*) and Red Fox (*Vulpes vulpes*) are also present within the study area.

Based on the existing habitat, amphibian and reptile species that use old field habitat in summer, such as Eastern Garter Snake (*Thamnophis sirtalis*) and Northern Leopard Frog (*Rana pipiens*), may be present given that suitable breeding habitat exists elsewhere in the valley system. These species are both very common in southern Ontario.

4.4 Vegetation Communities

Vegetation communities on the subject property were described and mapped on July 29, 2008 following the ELC classification system for southern Ontario (Figure 2).

Dry – Fresh Sugar Maple – Beech Deciduous Forest (FOD5-2)

This community type makes up the largest forested portion of the subject area and is found within the Black Creek valley and on the north end of the D. Hickling property (Figure 2). The canopy is dominated by Sugar Maple (*Acer saccharum*) and also includes American Beech (*Fagus grandifolia*) Red Oak (*Quercus rubra*) and White Pine (*Pinus strobus*). Some areas of this forest unit contain a fair amount of Eastern Hemlock (*Tsuga canadensis*). The sub-canopy is mostly Ironwood (*Ostrya virginiana*) and Paper Birch (*Betula papyrifera*). The shrub layer is dense where breaks in the canopy occur but otherwise quite sparse. It is made up mostly of Maple-leaved Viburnum (*Viburnum acerifolia*) and young, regenerating maple and beech saplings. The groundcover is mostly Wild Sarsaparilla (*Aralia nudicaulis*), Poison Ivy (*Rhus radicans*), False Solomon's Seal (*Maianthemum racemosum*) and Wild-lily-of-the-valley (*Maianthemum canadensis*). Sedges also feature prominently in the ground layer, including *Carex arctata* and *C. rosea*. There are also many large deadfalls scattered across the forest floor.

Dry – Fresh Sugar Maple – Oak Deciduous Forest (FOD5-3)

This woodland is a fragmented piece of remnant forest situated on the east side of the Rome Development Corporation property (Figure 2). This unit once extended in an easterly direction onto the adjacent property, where there is now a residential subdivision. It is dominated by Sugar Maple and Red Oak, although there are areas where Large-tooth Aspen (*Populus grandidentata*) features prominently. Other canopy species include Black Cherry (*Prunus serotina*), American Beech, and White Ash (*Fraxinus americana*). Ironwood and Paper Birch make up the sub-canopy. The understorey is predominately young ash, maple and beech saplings. The groundcover layer includes Trillium (*Trillium grandiflorum*), Downy Solomon's Seal (*Polygonatum pubescens*), Yellow Avens (*Geum allepicum*), White Baneberry (*Actaea pachypoda*), Mayapple (*Podophyllum peltatum*), Wild-lily-of-the-valley and Partridgeberry (*Mitchella repens*). Garlic Mustard (*Alliaria petiolata*) has begun to invade the edges of the community, where it carpets the ground.

Red Pine Coniferous Plantation (CUP3-1)

An extensive area of planted Red Pine (*Pinus resinosa*) occupies the area east of the unopened road allowance for Anne Street (Figure 2). A much smaller Red Pine plantation also occupies the northeast corner of the Micks property. The dense canopy of this unit is almost entirely comprised of even-aged pine and allows little light to penetrate to the lower strata. As a result there is generally little understorey or groundcover present.

Dry – Moist Old Field Meadow (CUM1-1)

Regenerating old field occurs where former agricultural areas have been abandoned and allowed to succeed naturally. Common forbs present in these communities include Viper's Bugloss (*Echium vulgare*), Evening Primrose (*Oenothera biennis*), Self-heal (*Prunella vulgaris*), Rough-fruited Cinquefoil (*Potentilla recta*), Common Plantain (*Plantago major*), Colt's Foot (*Tussilago farfara*) and Common Burdock (*Arctium minus*), along with grasses such as Reed-canary Grass (*Phalaris arundinacea*) and Awnless Brome (*Bromus inermis*).

Much of the area within the Ontario Hydro easement that lies north of the deciduous forest (FOD5-3) on the Rome Development Corporation property is occupied by this community (Figure 2).

Sumac Cultural Thicket (CUT1-1)

This community is dominated by shrubs, including Staghorn Sumac (*Rhus typhina*), Common Apple (*Malus pumila*) and hawthorns (*Crataegus* sp.). It occupies a wide swath adjacent to the downstream end of Black Creek on the Micks property (Figure 2). Other species present in this community include Virginia Creeper (*Parthenocissus vitacea*), non-native Highbush Cranberry (*Viburnum opulus*) and an assortment of terrestrial forbs and grasses. There are also scattered American Elms (*Ulmus americana*) and White Pines present. The groundcover is predominately Meadow Timothy (*Phleum pratense*) and Awnless Brome, with a variety of terrestrial forbs.

Three Butternut (*Juglans cinerea*) trees were also encountered in this community, growing beside the creek at the rear of the Micks residence at Wilson Drive (see Figure 2). Butternut is a provincially and nationally endangered species (COSEWIC 2005; NHIC 2008). The status of Butternut and its relevance to this study is discussed further in Section 4.5.

Cattail Organic Shallow Marsh (MAS3-1)

This community is dominated by Broad-leaf Cattail (*Typha latifolia*). The relatively deep organic soils also support Ostrich Fern (*Matteucia struthiopteris*), Sensitive Fern (*Onoclea sensibilis*), Joe-Pye Weed (*Eupatorium maculatum*), Jewelweed (*Impatiens capensis*), Marsh Marigold (*Caltha palustris*), Climbing Nightshade (*Solanum dulcamara*) and Green-headed Coneflower (*Rudbeckia laciniata*).

Hedgerows

There are several deciduous hedgerows that mark the limits of agricultural fields, as well as a small stand of planted White Spruce (*Picea glauca*) in the west-central portion of the D. Hickling property. None of these treed features is significant from an ecological perspective and do not pose constraints to development.

The A. Hickling property is separated from the property immediately to the south (R. Hickling) by a mature deciduous hedgerow. This hedgerow has been identified as a "significant" hedgerow by Azimuth Environmental (2003) (Figure 2). These features are not considered to be important from an ecological perspective, but rather provide aesthetic benefits to the rural character of the area.

In addition to the hedgerow that separates the R. Hickling property from its northern neighbour, there is a second, smaller north-south hedgerow adjacent to Anne Street that is not considered ecologically significant.

4.5 Species of Conservation Concern

As noted in Section 4.1 under the discussion of ELC vegetation community CUT1-1, three Butternut trees were encountered during 2008 field investigations. All three specimens were found in the same general area, adjacent to the downstream end of Black Creek near Wilson Drive by the existing residence. The Butternuts are actually located outside (i.e., approximately 40-50 m west of) the boundary of the study area and the area subject to the CRDI subdivision application (see Figure 2).

Although this species is still fairly widespread in Southern Ontario, the provincial Butternut population is experiencing a rapid and noticeable decline due to infestation by a fungal pathogen known as Butternut Canker (*Sirococcus clavigignenti-juglandacearum*). The fungus is spread aggressively by rain and insects. It may infect any part of the tree where there is a wound, but the most common point of entry is leaf scars, especially at the tops of trees. The disease then spreads down the tree every time it rains. The ultimate cause of death is cankers that eventually girdle the tree. There is no known cure for Butternut Canker or any measures that can be applied to prevent the spread of the disease.

As a result, Butternut is now considered Endangered in Ontario (COSEWIC 2003; Province of Ontario 2008), and is therefore subject to the *Endangered Species Act* (2007) and the Provincial Policy Statement (2005) policy 2.1.3 regarding significant portions of the habitat of threatened or endangered species. This policy states that:

“Development and site alteration shall not be permitted in:

- a. *significant habitat of endangered species and threatened species.*”

In regard to the habitat of endangered species and threatened species, the PPS (2005) defines “significant habitat” as “the habitat, as approved by the Ontario Ministry of Natural Resources, that is necessary for the maintenance, survival, and/or the recovery of naturally occurring or reintroduced populations of endangered species or threatened species, and where those areas of occurrence are occupied or habitually occupied by the species during all or any part(s) of its life cycle”.

Ontario’s new *Endangered Species Act* (2007) came into effect on June 30, 2008. The Act generally prohibits the killing or harming of a threatened or endangered species, as well as the destruction of its habitat. However, there is an exception to the *Endangered Species Act*, (2007) that specifically pertains to Butternuts that are affected by the Butternut Canker. In a recent (May 15, 2008) *Ontario Regulation* made under the *Endangered Species Act* (2007), the Act does not apply to a Butternut tree that has been adjudged to be affected and therefore “not likely to make a significant contribution to the protection or recovery of the butternut species in Ontario”.

The habitat protection provisions under Section 10 of the *Endangered Species Act* (2007) currently do not apply to Butternut, as the species is listed on Schedule 3 of the Act and therefore currently has no habitat regulations. General habitat protection under the ESA will not come into force until June 30, 2013, unless species specific habitat regulation is developed prior to this date. Protection of significant habitat for Butternut is therefore currently provided only through the PPS (2005).

While Butternuts are typically found on rich, well-drained forest sites, they can also occur in a range of different habitat types. Unlike many other species of rare plants and wildlife, which are under threat and in decline due to loss of habitat (and often the loss of very specific habitat types), suitable habitat for Butternut is widespread and common throughout southern Ontario. The identification of significant habitat for Butternut can therefore be challenging, given the species' habitat variability and shade intolerance. Therefore, Beacon Environmental proposes that in the case of the Butternuts encountered on the Micks property (Figure 2), the significant habitat requirements should be defined as the immediate site where the tree is growing (i.e., the 5 m radius contained within the tree dripline) plus an additional 5 m radius surrounding the tree, resulting in a combined 10 m radius habitat protection zone, as measured from the crown of the tree.

This approach to identifying habitat protection zones for Butternuts has recently been adopted on a development project in the Town of Georgina (Region of York) where the habitat protection zone was identified as a radius of approximately 10 m around healthy butternut specimens. This approach was reviewed and accepted by the OMNR.

Notwithstanding the above, the three Butternuts found within the floodplain of Black Creek on the Micks property (Figure 2) will be retained *in situ*, regardless of the fact that all three show obvious signs of infection by the canker. All three trees grow very close to the creek and are situated approximately 40-50 m from the edge of the nearest proposed development (i.e., a Wastewater Treatment Plant block; see Gatzios Planning Dwg. DP2-2) to the east of this area. Therefore, no disturbance to these Butternuts or their 10 m radius habitat protection zones will occur (see also Section 7.1).

4.6 Aquatic Features

The discussion of watercourses as an aquatic feature is made separately from a discussion of fish habitat, as there is a set of discrete policies and regulations that apply to a watercourse as a feature, and another policy regime that relates to the presence or absence of fish or fish habitat.

Following the definition of the *Conservation Authority Act*, a “watercourse” means an identifiable depression in the ground in which a flow of water regularly or continuously occurs. Based on this definition, a watercourse may be: 1) ephemeral, supporting flow for a short period during the spring freshet or during major rain events; 2) intermittent, maintaining flows from the spring freshet for a number of months, typically to mid-summer; or 3) a permanently flowing brook, creek or river.

4.6.1 Black Creek Main Branch and Intermittent Drainage Features

The main branch of Black Creek (which forms part of the Willow Creek Subwatershed) flows through a wooded valley that runs up the west side of Neighbourhood 1 (Figure 2). Black Creek flows in a northwesterly direction, exiting Neighbourhood 1 and the entire Midhurst Secondary Plan Area at Wilson Drive. It eventually joins with Willow Creek in the Minesing Swamp, situated approximately 8 km downstream to the northwest. According to the *Willow Creek 2007 Subwatershed Report Card* (NVCA 2007) stream health in the headwater areas of Black Creek is “variable”, as they are impacted by agricultural land uses.

However, the composition of the benthic invertebrate community suggests that the water quality in the main branch of Black Creek in the vicinity of the proposed development is “generally good” (AECOM Limited 2009a).

The flow regime in Black Creek is defined by AECOM Limited (2009a) as intermittent south of Carson Road and permanent north of Carson Road. The increased flows encountered as one moves downstream are attributable to groundwater inputs that maintain baseflow and maintain cool water temperatures.

Two ephemeral drainage features (referred to as Drainage Feature A and Drainage Feature B), both associated with Black Creek, originate within the agricultural field at the south end of the R. Hickling property (Figure 2). Both of these features are cultivated, evidence that they are completely dry much of the year.

Drainage Feature A is a low flat area situated between two small wooded ridges. It conveys ephemeral flows during the spring freshet and after major storm events (Figure 2). Drainage Feature B lies to the west of Drainage Feature A. It also lacks a defined channel and is cultivated through.

4.6.2 Fish Habitat

Given the lack of sustained flows, an absence of channel definition and riparian cover, it is highly unlikely that Drainage Features A and B support fish or provide direct fish habitat at any time. The flow in Black Creek increases as a result of groundwater inputs where these poorly defined features enter the wooded valley (at the western limit of the study area). AECOM Limited (2009a) found adult brook trout (*Salvelinus fontinalis*), a sensitive coldwater indicator fish species, in the main branch of Black Creek as far upstream as the point where the watercourse intersects with the western edge of the study area.

The findings of AECOM Limited (2009a), as reported in its *Surface Receiving Water Assessment* report generally confirms the NVCA's (2001) characterization of Black Creek as providing coolwater to coldwater habitat, particularly downstream of Wilson Drive (i.e., outside the Midhurst Secondary Plan Area).

Additional discussion of the water quality, fisheries and aquatic habitat conditions of Black Creek, and the potential impacts of development on these features and functions, is contained in the companion *Surface Receiving Water Assessment* report prepared in respect of these draft plan of subdivision applications by AECOM Limited (2009a).

4.7 Landscape Connectivity

Landscape connectivity, including the concept of wildlife corridors, has become recognized as an important part of natural heritage planning. Although there is not universal agreement on the net benefits of corridors, a wide range of benefits can be attributed to maintaining connectivity within the natural landscape. In the fragmented landscape of southern Ontario, connectivity functions range from low, where major development features (e.g., highways, railways) fragment a pathway, to high, where natural features dominate the landscape and are more or less contiguous.

Neighbourhood 1 occurs in an area where the local landscape is dominated by a mix of agricultural fields and an extensive tract of unbroken forest that extends north and east for several kilometres on both sides of Snow Valley Road.

At a regional level, south–north connectivity functions are also supported by the densely wooded creek valley and floodplain associated with the main branch of Black Creek. The forest block and this valley feature are likely locally important corridors that provide for the movement of wildlife species at all seasons, and many migrant bird species in the spring and fall. There is limited habitat connectivity from Neighbourhood 1 to the south or west, where the land use is presently agricultural and recreational (golf course), respectively.

4.8 Summary of Functions and Attributes

The majority of the study area is represented by active agricultural fields, with adjacent lands (especially to the north and east) characterized by wooded valleys and extensive blocks of woodland/wetland. The woodlands that lie adjacent to several of the subject properties are identified as Environmental Protection Area I in the Midhurst Secondary Plan (The Planning Partnership 2008).

The main branch of Black Creek is an NVCA-regulated feature by virtue of being a watercourse. It also provides fish habitat as defined by the PPS (2005).

No Provincially Significant Wetlands or Areas of Natural and Scientific Interest (as identified by the OMNR) have been identified on or within 120 m of the study area. One plant species encountered on the site, Butternut, has been listed in the regulations under the Province's *Endangered Species Act* (2007). None of the other plant or animal species recorded within the study area has been designated as Endangered, Threatened or as a Provincial "Species at Risk", nor do any species considered rare in the County of Simcoe occur on-site. No provincially rare vegetation communities (NHIC 2009) were found.

Although the Black Creek valley has not been designated by the Township of Springwater as a "significant valleyland" as defined by the PPS, this area, as well as the large deciduous forest block that occupies the northern portion of the D. Hickling property, are both designated Environmental Protection Area I on Schedule A - Land Use of the Midhurst Secondary Plan (The Planning Partnership 2008) (**Figure 3**). No development is permitted or proposed within these significant natural areas.

The most westerly of the two ephemeral drainage features associated with Black Creek (Drainage Feature B) is also shown on Schedule A - Land Use of the Midhurst Secondary Plan as EPA I: however, this "feature" merely exists on the ground as a low swale through cultivated fields that conveys runoff only during snow melt and following major storm events. Beacon Environmental and SCS Consulting, the project engineers, have examined this area on the ground and are both of the opinion that the EPA I designation on this feature has been made by the Township's consultants without the benefit of any on-site confirmation ("ground-truthing") and that this area is not worthy of either an EPA I or EPA II designation. This is discussed further in Section 7.3.

The remnant deciduous woodlot on the Rome Development Corporation property is designated EPA II, as is the large Red Pine plantation on the east side of the unopened road allowance for Anne Street. The most easterly of the two ephemeral drainage features associated with Black Creek

(Drainage Feature A) is presently designated EPA II on Schedule A of the Midhurst Secondary Plan. Drainage Feature A is virtually identical in character and function to Drainage Feature B; it is an unvegetated swale that conveys surface runoff through cultivated fields. Based on joint field observations, Beacon Environmental and SCS Consulting are of the opinion that this swale does not warrant an EPA II designation, as discussed in Section 7.3.

Schedule A also shows an EPA II “feature” on the Micks property that does not exist on the ground, as confirmed through a site walk by Beacon Environmental and SCS Consulting. The area in question is an agricultural field with an east to west-trending slope characterized by a series of ridges. This “feature” is shown on Schedule A as being physically connected to the downstream end of Black Creek. However, there is no surface water drainage feature in this area and there are no significant natural features that would meet the definition of an EPA II.

Table 1 provides a summary of the key natural heritage features and their functions, their sensitivities and general location within the study area.

Table 1. Key Natural Heritage Features and Functions, CDRI Lands

Feature or Function	Sensitivity Level	Reason for Sensitivity	Location(s)
Butternut (provincially Endangered)	Low	Several trees exhibiting evidence of infection by Butternut canker Situated approximately 40-50 m from edge of proposed development (waste water treatment plant) at closest point	ELC vegetation community CUT1-1 associated with Black Creek floodplain on Micks property near Wilson Drive (external to subdivision application area; see Figure 2)
Coldwater Fish Habitat	Moderate	Some sensitivity to changes in water quality	Main Branch of Black Creek (refer to AECOM Limited [2009a])
EPA I Woodlots (Township of Springwater)	Low	Existing forest edge adapted to open conditions (agricultural fields)	Located within areas to be retained and fully protected, situated adjacent to development areas
EPA I “watercourse”	Low	Unvegetated swale through agricultural fields with ephemeral flows	“Drainage Feature B” of Black Creek; R. Hickling property
EPA II Woodlots (Township of Springwater)	Low	Existing forest edge adapted to open conditions (agricultural fields)	Located within areas to be retained and fully protected, situated adjacent to development areas
EPA II “watercourses”	Low	Unvegetated swale through agricultural fields with ephemeral flows Undefined “drainage feature”	“Drainage Feature A” of Black Creek; R. Hickling property Micks Property



**Environmental
Features**

Per Midhurst Secondary
Plan 2008

Figure 3

Environmental Impact Study
Midhurst-Carson Neighbourhood 1

Legend

- OPA Application Boundary
- Carson Neighbourhood Boundary
- Springwater - Midhurst Settlement Area
- Black Creek
- Ephemeral Drainage Feature
- Environmental Protection Area I
- Environmental Protection Area II

Ortho Photo Base 2002

UTM Zone 17 N, NAD 83

0 125 250 500 Meters



1:12,000



Project 208005
June 2009

5. Policy Implications

The following sections describe those significant natural heritage features and functions associated within the study area in the context of applicable policy documents and briefly discuss the implications of each on future development of the five properties that form the basis of these draft plans of subdivision applications.

5.1 Provincial Policy Statement (2005)

Three of the seven natural heritage features addressed by the PPS (2005) occur on or adjacent to the five subject properties within the study area. These are:

1. significant habitat of an endangered species (Butternut);
2. significant woodlands (i.e., EPA I woodlands); and
3. fish habitat.

5.1.1 Significant Habitat of an Endangered Species

The occurrence of three Butternut trees in the northwest corner of the study area adjacent to Black Creek is discussed in detail in Section 4.5 above. These trees will remain *in situ* and will not be adversely affected by the proposed development (see Section 7.1).

5.1.2 Significant Woodlands

As noted in Section 3.4, the Midhurst Secondary Plan (OPA 38) identifies Environmental Protection Area I lands as “features that are Provincially mandated”, which is interpreted to refer to natural heritage features as addressed by the PPS, such as “significant woodlands”. Under the PPS (OMMAH 2005), development is permitted within and adjacent to significant woodlands if it can be demonstrated to the satisfaction of the planning authority (municipality) that it will not result in negative impacts to the feature and its functions. However, the Midhurst Secondary Plan does not permit development within EPA I lands; therefore these woodlands will be maintained and protected within the draft plans.

5.1.3 Fish Habitat

Direct fish habitat is associated with the main branch of Black Creek from the western edge of Neighbourhood 1 downstream. Based on summer 2008 fish collections in Black Creek at Carson Road and Snow Valley Road (AECOM Limited 2009a), as well as NVCA fish collection data from 1983-2000 (as cited in Azimuth Environmental [2003]), this system supports a healthy fish population, including brook trout.

However, the portion of Black Creek that provides direct fish habitat lies within mature deciduous woodland situated to the west of the three Hickling properties. Only the extreme eastern edge of this woodland occurs within the study area (Figure 3). The creek is well buffered by the surrounding forest.

The two drainage features that lie immediately upstream of the woodlot (referred to as Drainage Feature A and Drainage Feature B) have ephemeral flow regimes and lack any defined channels or riparian cover (Figure 2). As such, they are considered to provide indirect fish habitat (i.e., they convey surface runoff after spring snow melt and rainstorm events to the main branch of Black Creek, but lack the habitat conditions necessary to support fish populations).

The westernmost Drainage Feature (B) is also shown as EPA I on Schedule A of the Midhurst Secondary Plan (see Figure 3). However, based on the findings of this EIS, Beacon Environmental is of the opinion that this “feature” does not meet the definition of an EPA I and does not warrant protection in its current state or location. This is discussed further in Section 7.3.

The main branch of Black Creek downstream of its confluence with Drainage Features A and B on the R. Hickling property provides direct fish habitat given its permanent flow regime, cool to coldwater temperature and extensive forest cover. Surface flows in both Drainage Features A and B are ephemeral which, combined with a lack of riparian cover, means that these features do not provide a direct fish habitat function.

The significance and function of Black Creek as fish habitat, as well as the impacts of the proposed development of the CRDI lands on it, are addressed as part of the companion *Surface Receiving Water Assessment* report prepared by AECOM Limited (2009a).

5.2 County of Simcoe Official Plan (2008)

As noted in Section 3.2, the new County OP contains policies regarding the identification and protection of Greenlands and requires the preparation of an EIS for development proposed on land adjacent to these areas.

Schedule 5.1 (Land Use Designations) of the proposed 2008 County Official Plan identifies two distinct Greenland areas within Neighbourhood 1 of the Midhurst Settlement Area: 1) the woodland in the northern portion of the D. Hickling property, and 2) the wooded valley containing the main branch of Black Creek from the R. Hickling property north to Wilson Drive. These areas are also identified as Environmental Protection Areas (EPAs) in the Midhurst Secondary Plan (see Section 5.3).

Accordingly, this EIS addresses the potential for impacts associated with the proposed development of the four draft plans of subdivision on these Greenland/EPA areas, as required by policies contained within both the proposed County of Simcoe Official Plan (2008) and the Township of Springwater Official Plan (2001), as amended by the adopted Midhurst Secondary Plan OPA 38 (2008).

5.3 Midhurst Secondary Plan (2008)

As discussed in Section 3.4, Schedule A of the Midhurst Secondary Plan (The Planning Partnership 2008) identifies portions of Neighbourhood 1 as Environmental Protection Area I and Environmental Protection Area II.

The mature Sugar Maple – Beech Deciduous Forest (FOD 5-2) which occupies the north end of the D. Hickling property, as well as the entire Black Creek wooded valley extending from the R. Hickling property north to Wilson Drive, are designated EPA I (i.e., no development permitted) in the Midhurst Secondary Plan (Figure 3). These woodland areas are fully protected in the draft plans, as discussed further in Section 7.2.

Drainage Feature B is also shown as EPA I on Schedule A (Figure 3). However, based on the findings of this EIS, Beacon Environmental is of the opinion that this “feature” does not meet the definition of an EPA I and does not warrant protection in its current state or location. This is discussed further in Section 7.3. The Midhurst Secondary Plan makes allowance for minor adjustments to the boundaries of the Environmental Protection Area I without an Amendment to the Secondary Plan subject to an EIS that has been approved by the Township and the NVCA.

The Red Pine plantation (CUP3-1) to the east of the D. Hickling property (outside of Neighbourhood 1), as well as the deciduous woodlot on the east side of the Rome Development Corporation property, are both designated EPA II lands (i.e., development may be permitted subject to the findings of an EIS; see Figure 3) in the Midhurst Secondary Plan. The intent of the EIS is to determine whether, on the basis of their features and functions, these EPA II lands warrant full or partial protection or whether some or all of these areas could be developed the analysis contained in this EIS concludes that the woodlot on the Rome property is significant and worthy of protection. Therefore, no development is proposed within this feature (see Section 7.2).

Drainage Feature A (on the R. Hickling property) is identified as an EPA II on Schedule A of the Midhurst Secondary Plan (Figure 3). Due to the ephemeral nature of the flows that pass through this area, the lack of a defined channel and the absence of any riparian vegetation, Beacon Environmental concludes that this feature is not significant and can be removed, provided that its intermittent flows are still conveyed downstream to the Black Creek via a piped system. This is discussed further in Section 7.3 of this EIS and in the companion *Functional Servicing Report* (FSR) prepared by SCS Consulting Ltd. (2009).

A completely dry (i.e., no flow) depressional feature originating in an agricultural field at the west edge of the D. Hickling property that extends off-site to the west onto the Micks property is also shown on Schedule A – Land Use of the Midhurst Secondary Plan as an EPA II. However this “feature” provides no ecological or hydrological function and has no physical connection to the downstream end of Black Creek, contrary to how it is depicted on Schedule A. It is concluded, therefore, that the EPA II designation assigned to this area has been made in error and that this area should be re-designated to permit residential development.

5.4 NVCA Watershed Policies and Regulations

As summarized above in Section 3.5, the NVCA regulates wetlands, watercourses and floodplains. Within Neighbourhood 1, the NVCA's regulation mapping applies to the main branch of Black Creek and the two ephemeral drainage features (A and B).

In the case of regulated features within the NVCA jurisdiction the Regulation mapping is very general and is based on 1:10,000 scale aerial photography. Furthermore, the text of the Regulation takes precedence over the mapping. Therefore, any feature that meets the definition of a regulated feature must be taken into consideration. In that regard, the small cattail marsh (MAS3-1) situated at the confluence of the two ephemeral drainage features with Black Creek is a regulated feature by virtue of being a wetland.

6. Development Proposal

The proposed development of the CDRI lands within Neighbourhood 1 is depicted on four separate draft plans of subdivision (Gatzios Planning, June 2009) for the five properties described in Section 1.2. Although the plans have been generated separately, they are fully integrated with each other in terms of land use type, densities and municipal servicing. Collectively, the four plans are consistent with the Midhurst Secondary Plan, as illustrated on Schedule A – Land Use, with high and medium density residential and mixed use development concentrated along Carson Road west of Anne Street, and low density residential uses occupying the bulk of the remaining developable lands (i.e., those unconstrained by environmental features). A total of 2,614 units are proposed among the four draft plans.

Beacon Environmental provided input to the project planning consultants (Gatzios Planning) and engineering consultants (SCS Consulting) throughout the preparation of the four draft plans of subdivision with respect to significant features to be avoided, and the appropriate locations of various infrastructure facilities from a natural heritage perspective. These include stormwater management ponds (SWMP) and the waste water treatment plant (WTP).

6.1 Water Supply

The following information is taken from the *Functional Servicing Report* prepared in connection with of this application by SCS Consulting Group Ltd. (2009), which should be consulted for further details.

A new water supply will be required to accommodate the projected growth in Neighbourhood 1. Based on a number of previous hydrogeological studies it appears that there is a significant amount of groundwater available in the regional A3 aquifer to the east and northeast of Midhurst, as well as in the Anten Mills area, situated to the northwest of Midhurst. The location of a well or wells will be confirmed as part of a Class Environmental Assessment that is presently being undertaken by the Township of Springwater. This will entail a municipally-owned well site and water treatment plant, with a storage facility and a distribution system which conveys the water to individual units via a local watermain system utilizing the existing and future road network.

6.2 Wastewater Treatment

A Class Environmental Assessment is currently being undertaken by the Township of Springwater for the overall Midhurst Secondary Plan to confirm the final wastewater treatment scheme, plant type, location and sizing. The wastewater treatment plant for the Midhurst Settlement Area is proposed to be a municipally-owned facility that will provide service for all residential and commercial/employment/administrative land uses included within the Secondary Plan area.

Wastewater flows from Neighbourhood 1 are proposed to be collected via a series of gravity sewers and conveyed to a 9.59 ha site (Block 207) in the northwest quadrant of Neighbourhood 1, which is where the Midhurst Waste Water Treatment Plant (MWWTP) is proposed to be constructed.

Treated effluent discharge to surface waters has been identified as the preferred wastewater disposal option for Neighbourhood 1 through the Municipal Class EA. Treated effluent from the MWWTP will be conveyed via a subsurface pipe system and discharged to Willow Creek at Highway 26. This location was identified as the preferred alternative for effluent discharge due to increased stream flows and resultant greater assimilative capacity (AECOM 2009b, 2009c). The presence of the Minesing Swamp, immediately downstream of this location, will also buffer increased flow from the MWWTP discharge and would polish nutrients in the effluent during the summer growth season.

6.3 Stormwater Management

Stormwater runoff from the proposed development will be managed in four pond facilities: 1) on the west side of the Micks property; 2) on the north side of Carson Road adjacent to the Black Creek valley; 3) on the south side of Carson Road opposite pond 2; and 4) adjacent to the Black Creek valley upstream of where Drainage Features A and B meet the main branch. All four ponds will not only be designed to achieve the highest level of quality control for suspended solids (Level 1 or enhanced level treatment [MOE 2003]) but additional measures are proposed to reduce flows from individual lots and provide thermal mitigation (e.g., cooling to groundwater temperatures via subsurface gravel “soak away” pits) prior to discharge to Black Creek (see SCS Consulting Group Ltd. 2009 and AECOM Limited 2009a, 2009b).

For additional details regarding the proposed servicing and surface and groundwater management of Neighbourhood 1 development the reader is referred to the companion *Functional Servicing Report* prepared by SCS Consulting Group Ltd. (2009), the surface water/aquatic resources report by AECOM Limited (2009a, 2009b) and the hydrogeological evaluation report prepared by Golder Associates Limited (2008).

7. Impact Assessment and Mitigation

7.1 Significant Portions of the Habitat of Endangered Butternut

A total of three Butternut trees were encountered within the Neighbourhood 1, growing in relatively close proximity to each other adjacent to the downstream end of Black Creek near Wilson Road.

These trees are within the floodplain of the creek, within which no development will encroach. At their closest point the Butternuts are located approximately 40-50 m away from the Waste Water Treatment Plant block (Block 143) in the northwest corner of the Mick's property (see Gatzios Planning Dwg. DP2-2). The proposed development will not have an impact on the habitat of an endangered species and accordingly, no mitigation is required for the Butternuts.

7.2 Significant Woodlands/Valleylands

The woodland containing the main branch of the Black Creek is an EPA I area and therefore considered to be significant woodland by the Township of Springwater. This woodland is also associated with a well-defined valley that contains the watercourse. The valley presents an additional constraint to development of this area. As such, no intrusion into this feature by the proposed development is proposed. It will be fully retained and protected by the greater of 6 m from the top-of-bank or 5 m from the dripline of the edge trees (see Gatzios Planning Dwg. DP2-3). In virtually all cases this buffer is the 5 m from the dripline, as the edge of the woodlot typically extends slightly beyond the top-of-bank onto the adjacent tableland.

On the A. Hickling and R. Hickling properties the proposed land use adjacent to this wooded valley is a mix of high density/mixed use residential and two SWMP blocks, one located immediately south of Carson Road West and the other a smaller SWMP facility located just upstream of the confluence of the main branch of Black Creek and Drainage Feature A. This second pond is situated adjacent to a small cattail marsh (MAS3-1) and will be set back from this regulated wetland feature by 30 m (see Gatzios Planning Dwg. DP2-3).

The locations of these SWM ponds will provide substantial additional buffering to the valley system of at least 50 m and considerably more (up to several hundred metres) in other places. All the SWM pond facilities should also be naturalized with the planting of native trees and shrubs. This will add to the overall availability of habitat within the SWM blocks. The stormwater facilities are located such that they will reduce pedestrian access to the valley and will further separate the development from the EPA I woodland/valleyland system, in turn creating wider buffers between the feature and adjacent residential development.

North of Carson Road a small portion of this woodland/valley extends onto the south end of the D. Hickling property. The land uses proposed adjacent to this feature include a Park and a SWMP block (see Gatzios Planning Dwg. DP2-1). These are compatible uses adjacent to an EPA I area.

The eastern edge of the woodland/valleyland should be fenced (including adjacent to SWMP pond blocks, community parks and residential lots) to discourage people from accessing the EPA I. This will also reduce, but not eliminate entirely, access for household pets (especially cats) that are known predators on ground-nesting birds. Fencing will also reduce the amount of yard waste that is disposed in the valley.

The erection of a fence along the eastern edge of this feature will also act as a safety measure, particularly along the section on the A. Hickling property immediately south of Carson Road where the valley walls are very steep in some areas (see Gatzios Planning Dwg. DP2-3).

The mature deciduous forest situated at the north end of the D. Hickling property is also EPA I significant woodland in the Midhurst Secondary Plan. Beacon Environmental concurs with this

designation. No intrusion by development into this feature will occur and it will be fully retained and protected as Open Space within plan of subdivision. The dripline of this woodlot was staked and surveyed in the field with staff of the NVCA in May 2008. A 5 m buffer is proposed between the dripline of the trees and rear lot lines of the low density residential units proposed in this area. It is recommended that this buffer be planted with appropriate native edge species to provide additional protection and that the rear lot lines be fenced along the entire interface with the woodlot, for the reasons described above.

Subject to grading requirements it is the intent of the plan to retain sections of the relatively wide, east-west hedgerow that separates the A. Hickling and R. Hickling properties. Where possible, a mix of deciduous tree species will be retained within narrow park blocks adjacent to the south side of Street B (see Gatzios Planning Dwg. 2-3). This hedgerow, while too narrow to act as a wildlife corridor and therefore not important from an ecological perspective, was identified as an aesthetically “significant” feature by Azimuth Environmental (2003) and attempts will be made to retain as much of it as possible, subject to detailed grading plans. Some trees within the hedgerow will be removed, however.

The small deciduous woodlot on the east side of the Rome Development Corporation is designated EPA II in the Midhurst Secondary Plan. This wooded feature represents an isolated natural area that once formed part of a larger woodland area that extended to the east along the south side of Carson Road. It has since been bisected by the hydro corridor and a residential subdivision has been built immediately to the east. As a result, this area no longer provides any connectivity to adjacent or nearby woodlands, and will be surrounded on two sides by residential development once Neighbourhood 1 is fully built out. Notwithstanding this, the woodlot is of relatively high quality and does provide some habitat for edge breeding bird species and habitat generalists. As a result, Beacon Environmental has concluded that this feature is worthy of full retention within the draft plan for the Rome property. It is also recommended that a 5 m buffer be established between its edge (dripline) and the rear of the adjacent low density residential lots proposed in this area (see Gatzios Planning Dwg. DP2-4).

7.3 Watercourses

As noted above, Black Creek is regulated by NVCA. That section of Drainage Feature A upstream to a point just south of the Ontario Hydro easement will be contained within a natural Open Space “corridor” that measures up to 100 m wide. Drainage Feature B will be retained in a maximum 60 m wide corridor as far upstream as the hydro easement (see Gatzios Planning Dwg. DP2-3). These Open Space areas will contain the low flow “channel” plus its associated floodplain.

Downstream of the Ontario Hydro easement these “corridors” will continue to perform an overland flow conveyance function post-development. Upstream of the easement, the intermittent flows that presently cross cultivated fields on the R. Hickling property will be captured by the proposed storm sewer system that directs runoff to the SWM pond in Block 360 (see Gatzios Planning Dwg. DP2-3). Further details regarding the management of stormwater from this area are documented in the companion *Functional Servicing Report* prepared by SCS Consulting Group Ltd. (2009).

A SWM pond (Block 142) will also be constructed on the west side of the Micks property, and situated outside the floodplain of Black Creek (see Gatzios Planning Dwg. DP2-2). As a general protection measure, the SWMP will be designed to meet MOE Level 1 criteria with respect to total suspended

solids (SCS Consulting Group Ltd. 2009). Construction works such as grading, grubbing and excavation have the potential to result in the off-site movement of sediment into the adjacent Black Creek. As a result, a sediment control plan will be prepared for review and approval by the Township and NVCA prior to the start of construction works. AECOM Limited (2009a) has concluded that fish populations and their habitat are unlikely to be affected given that the limit of development will be located greater than 30 m from the creek and the above mitigation measures will be implemented.

7.4 Loss of Habitat for Area-sensitive Grassland Birds

The proposed development will occur on existing agricultural areas. As a result of the rapid future urbanization of the Village of Midhurst, there is expected to be an overall reduction in the population of some grassland breeding birds that are associated with agricultural landscapes. Within Neighbourhood 1 two such species are Savannah Sparrow and Eastern Meadowlark, both of which are considered area-sensitive (see **Appendix 1**) but also common in southern Ontario.

Habitat for grassland nesting species such as these is difficult to preserve in areas experiencing urban growth. Several pairs of Savannah Sparrows are expected to persist as nesters within the Ontario Hydro easement, which will be placed in an Open Space designation and will continue to be maintained as an open, grassed (i.e., treeless) habitat.

The federal *Migratory Bird Treaty Act* protects the nests, eggs and young of most bird species from harm or destruction. As the breeding bird season in southern Ontario generally extends from mid-April through mid-July, the clearing of grassland field vegetation to accommodate the development should be completed outside of these dates. For any proposed clearing of vegetation within these dates, or where birds may be suspected of nesting outside of typical dates, an ecologist should undertake detailed nest searches immediately prior to site alteration to ensure that no active nests are present.

7.5 Summary

Natural heritage features to be retained and protected within the five properties within Neighbourhood 1 are shown on the draft plans of subdivision (Gatzios Planning Dwgs. DP2-1 through DP2-4) as Open Space Blocks and coloured dark green. The outside limits of the features include a buffer, as described above and summarized in **Table 2** below:

Table 2. Buffers Proposed from Natural Heritage Features

Feature	Location in Neighbourhood 1	Buffer and Additional Comments
Butternut	Floodplain of Black Creek near Wilson Drive, just outside Neighbourhood 1 boundary	- Trees will be retained in situ and buffered by existing vegetation adjacent to creek - Situated 40-50 m from edge of SWMP block at closest point
Significant Woodland (EPA I and EPA II)	- North end of D. Hickling property - West side of A. & R. Hickling properties - East side of Rome Development Corporation property	- no new edges to be created 5 m from the staked dripline - planted with native edge species - fenced
Steep slopes	- West side of A. & R. Hickling properties - Southeast corner of Micks property	6 m top-of-bank setback - Fenced - Slope Stability Analysis required for steep slopes may result in greater setbacks from top-of-bank
Main Branch Black Creek Floodplain	West side of Micks and three Hickling properties	greater of 30 m from watercourse or limit of floodplain as per NVCA requirements
Drainage Feature A	Cultivated fields on R. Hickling property	approx. 100 m wide "corridor"
Drainage Feature B	Cultivated fields on R. Hickling property	approx. 60 m wide "corridor"
Unevaluated wetland – (regulated) feature	Cattail marsh (MAS3-1) near Black Creek valley	30 m from wetland edge - buffered by SWM pond

8. Conclusions

Based on the findings of this EIS and the other technical studies prepared as part of the draft plan applications, specifically the surface water study, hydrogeological assessment and stormwater management report, the following conclusions have been reached:

- The results of this site-specific EIS confirm the findings of the previous Natural Environment Evaluation completed by Beacon Environmental (2008) in support of the Official Plan Amendment application.
- All the significant natural heritage features and functions associated with the subject properties are identified as either EPA I or EPA II features on Schedule A - Land Use in the Midhurst Secondary Plan. Except as otherwise discussed in this report, Beacon Environmental agrees with this identification.
- No development will occur within the EPA I and II woodlands and valleylands and these features will be buffered from adjacent development. The tableland portion of the site provides opportunities for the development of mixed density residential units.

- With the exception of three specimens of the provincially endangered Butternut, none of the plant or animal species known to occur within the study area is considered rare. The Butternuts will be retained within the floodplain of Black Creek and adequately buffered from the adjacent development.
- All SWM ponds will be constructed on tableland above top-of-bank or situated greater than 30 m from the main branch of Black Creek or outside the floodplain, whichever is greater.
- The form and function of two ephemeral drainage features associated with Black Creek identified as EPA I and EPA II have been examined in detail and it has been concluded that neither warrant an EPA designation.
- Drainage Features A and B downstream of the Ontario Hydro easement will be retained in Open Space “corridors”, while flow from the upstream portions will be captured in the storm sewer system.
- The greater of a 6 m setback from the top-of-bank (which could be wider depending on the results of a future slope stability analysis) or a 5 m buffer from tree dripline, is an appropriate separation distance between the wooded valley features and the proposed adjacent development. This buffer is to be planted with native edge species and fencing erected adjacent to the Open Space blocks (EPA I and II features) to inhibit intrusion.
- Given the foregoing, it is concluded that the proposed residential development of the tableland portions of Neighbourhood 1, with the provision of appropriate buffers and other mitigative measures (fencing) can occur without adversely affecting the Black Creek corridor or adjacent EPA I and II features (woodlands/valleylands).

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Appendix 1

Breeding Birds Recorded in Midhurst CRDI Lands, 2008

Appendix 1

Breeding Birds Recorded in Midhurst CRDI Lands, 2008

		Status			Area-sensitive sources	Locations						
Common Name	Scientific Name	COSEWIC (national) ^a	COSSARO (provincial) ^a	Provincial breeding season SRANK ^b	Area-sensitive (OMNR ¹)	1	2	3	4	5	6	7
Wild Turkey	<i>Meleagris gallopavo</i>											1
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>					1						1
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>									1		
Downy Woodpecker	<i>Picoides pubescens</i>								1	1		
Hairy Woodpecker	<i>Picoides villosus</i>				A			1		1		
Northern Flicker	<i>Colaptes auratus</i>					1		1				1
Eastern Wood-Pewee	<i>Contopus virens</i>					6	2	1	3			
Great Crested Flycatcher	<i>Myiarchus crinitus</i>					1						
Eastern Kingbird	<i>Tyrannus tyrannus</i>									1	1	2
Tree Swallow	<i>Tachycineta bicolor</i>									1		1
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>									2		
Barn Swallow	<i>Hirundo rustica</i>											5
Blue Jay	<i>Cyanocitta cristata</i>					1		1		1		
American Crow	<i>Corvus brachyrhynchos</i>						1		1	1		1
Black-capped Chickadee	<i>Poecile atricapillus</i>					1		1	2	1		
Red-breasted Nuthatch	<i>Sitta canadensis</i>				A		1					
House Wren	<i>Troglodytes aedon</i>							2	1	1		
Veery	<i>Catharus fuscescens</i>				A	4						
Wood Thrush	<i>Hylocichla mustelina</i>								2			
American Robin	<i>Turdus migratorius</i>					1	2	1	4			
Gray Catbird	<i>Dumetella carolinensis</i>									2		
Brown Thrasher	<i>Toxostoma rufum</i>										1	
Cedar Waxwing	<i>Bombycilla cedrorum</i>					1			1	1	3	

		Status			Area-sensitive sources	Locations						
Common Name	Scientific Name	COSEWIC (national) ^a	COSSARO (provincial) ^a	Provincial breeding season SRANK ^b	Area-sensitive (OMNR ¹)	1	2	3	4	5	6	7
European Starling	<i>Sturnus vulgaris</i>			SE								1
Red-eyed Vireo	<i>Vireo olivaceus</i>					13	1	3	3		1	2
Yellow Warbler	<i>Dendroica petechia</i>										2	1
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>					5					1	
Black-throated Blue Warbler	<i>Dendroica caerulescens</i>				A	4						
Black-throated Green Warbler	<i>Dendroica virens</i>				A	2						
Pine Warbler	<i>Dendroica pinus</i>				A	3	1					
American Redstart	<i>Setophaga ruticilla</i>				A	1			1			
Ovenbird	<i>Seiurus aurocapillus</i>				A	3	1		1			
Mourning Warbler	<i>Oporornis philadelphia</i>								1		1	
Common Yellowthroat	<i>Geothlypis trichas</i>									2	2	
Scarlet Tanager	<i>Piranga olivacea</i>				A	2						
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>								1			
Indigo Bunting	<i>Passerina cyanea</i>					4	1	1	2	3	3	4
Chipping Sparrow	<i>Spizella passerina</i>					3	2		1			2
Vesper Sparrow	<i>Pooecetes gramineus</i>											5
Savannah Sparrow	<i>Passerculus sandwichensis</i>				A					1		13
Grasshopper Sparrow	<i>Ammodramus savannarum</i>				A							1
Song Sparrow	<i>Melospiza melodia</i>					2			1	4	5	5
Bobolink	<i>Dolichonyx oryzivorus</i>				A					3	1	5
Red-winged Blackbird	<i>Agelaius phoeniceus</i>					1				5	5	4
Common Grackle	<i>Quiscalus quiscula</i>						2				1	
Brown-headed Cowbird	<i>Molothrus ater</i>									1		
Baltimore Oriole	<i>Icterus galbula</i>										3	
American Goldfinch	<i>Carduelis tristis</i>									1	1	4
Field Work Conducted On: June 18 and June 30, 2008												
Location 1 - Forest block at north end of property												
Location 2 - Forest edge zone along east side of unopened road allowance (Anne St.)												

		Status			Area-sensitive sources	Locations						
Common Name	Scientific Name	COSEWIC (national) ^a	COSSARO (provincial) ^a	Provincial breeding season SRANK ^b	Area-sensitive (OMNR ¹)	1	2	3	4	5	6	7
Location 3 - Small woodlot on east side												
Location 4 - Forest edge zone along west boundary												
Location 5 - Riparian / wetland area												
Location 6 - Creek slope area along west edge												
Location 7 - Fields & hedgerows												
Number of Species:		48										
Number of (provincial and national) Species at Risk:		0										
Number of S1 to S3 (provincially rare) Species:		0										
Number of Regionally Rare Species:		0										
Number of Area-sensitive Species:		12										

KEY

^a COSEWIC = Committee on the Status of Endangered Wildlife in Canada

COSSARO = Committee on the Status of Species at Risk in Ontario

END = Endangered, THR = Threatened, SC = Special Concern (formerly Vulnerable), NAR = Not at Risk

^b SRANK (from Natural Heritage Information Centre) shown for breeding status if: S1 (extremely rare), S2 (very rare), S3 (rare to uncommon), and SE (exotic, i.e. introduced)

Tracked species that are S4 or S5 are also noted. Occurrence data are actively gathered for tracked species by the NHIC. Species actively tracked generally have fewer than 100 recent occurrences in Ontario, or are highly ranked globally.

SRANK not shown if: S4 (common), S5 (very common), SZB (breeding migrants or vagrants) and SR (reported as breeding, but no persuasive documentation)

Area-sensitive sources:

1 = Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide (Appendix G). 151 p plus appendices.

Appendix 2

Vascular Plants Recorded in Midhurst CDRI Lands, 2008

Appendix 2

Vascular Plants Recorded in Midhurst CRDI Lands, 2008

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Equisetum arvense</i>	Field Horsetail	G5	S5			N	EQUISETACEAE
<i>Pteridium aquilinum</i>	Bracken Fern	G5	S5			N	DENNSTAEDTIACEAE
<i>Athyrium filix-femina</i> var. <i>angustum</i>	Lady Fern	G5T5	S5			N	DRYOPTERIDACEAE
<i>Dryopteris carthusiana</i>	Spinulose Shield Fern	G5	S5			N	DRYOPTERIDACEAE
<i>Dryopteris intermedia</i>	Evergreen Woodfern	G5	S5			N	DRYOPTERIDACEAE
<i>Matteuccia struthiopteris</i>	Ostrich Fern	G5	S5			N	DRYOPTERIDACEAE
<i>Onoclea sensibilis</i>	Sensitive Fern	G5	S5			N	DRYOPTERIDACEAE
<i>Pinus resinosa</i>	Red Pine	G5	S5			N	PINACEAE
<i>Pinus strobus</i>	Eastern White Pine	G5	S5			N	PINACEAE
<i>Pinus sylvestris</i>	Scotch Pine	G?	SE5			N	PINACEAE
<i>Tsuga canadensis</i>	Eastern Hemlock	G5	S5			N	PINACEAE
<i>Thuja occidentalis</i>	Eastern White Cedar	G5	S5			N	CUPRESSACEAE
<i>Typha angustifolia</i>	Narrow-leaved Cattail	G5	S5			N	TYPHACEAE
<i>Typha latifolia</i>	Broad-leaf Cattail	G5	S5			N	TYPHACEAE
<i>Agrostis gigantea</i>	Black Bentgrass	G4G5	SE5			N	POACEAE
<i>Bromus inermis</i> ssp. <i>inermis</i>		G5T?	SE5			N	POACEAE
<i>Dactylis glomerata</i>	Orchard Grass	G?	SE5			N	POACEAE
<i>Elymus repens</i>	Quack Grass	G5	SE5			N	POACEAE
<i>Festuca rubra</i>	Red Fescue	G5	S5			N	POACEAE
<i>Phalaris arundinacea</i>	Reed Canary Grass	G5	S5			N	POACEAE
<i>Phleum pratense</i>	Meadow Timothy	G?	SE5			N	POACEAE
<i>Carex arctata</i>	Black Sedge	G5?	S5			N	CYPERACEAE
<i>Carex rosea</i>	Rosy Sedge	G5	S5			N	CYPERACEAE
<i>Carex spicata</i>	A Sedge	G?	SE5			N	CYPERACEAE
<i>Maianthemum canadense</i>	Wild-lily-of-the-valley	G5	S5			N	LILIACEAE
<i>Maianthemum racemosum</i>	False Solomon's-Seal	G5	S5			N	LILIACEAE
<i>Polygonatum pubescens</i>	Downy Solomon's-seal	G5	S5			N	LILIACEAE
<i>Streptopus roseus</i>	Rose Twisted-stalk	G5	S5			N	LILIACEAE
<i>Trillium grandiflorum</i>	White Trillium	G5	S5			N	LILIACEAE
<i>Smilax herbacea</i>	Smooth Herbaceous Greenbrier	G5	S4			N	SMILACACEAE
<i>Epipactis helleborine</i>	Eastern Helleborine	G?	SE5			N	ORCHIDACEAE
<i>Populus grandidentata</i>	Large-tooth Aspen	G5	S5			N	SALICACEAE
<i>Populus tremuloides</i>	Trembling Aspen	G5	S5			N	SALICACEAE
<i>Salix petiolaris</i>	Meadow Willow	G5	S5			N	SALICACEAE
<i>Juglans cinerea</i>	Butternut	G3G4	S3?			Y	JUGLANDACEAE
<i>Betula papyrifera</i>	Paper Birch	G5	S5			N	BETULACEAE
<i>Ostrya virginiana</i>	Ironwood	G5	S5			N	BETULACEAE
<i>Fagus grandifolia</i>	American Beech	G5	S5			N	FAGACEAE
<i>Quercus rubra</i>	Northern Red Oak	G5	S5			N	FAGACEAE
<i>Ulmus americana</i>	American Elm	G5?	S5			N	ULMACEAE
<i>Rumex crispus</i>	Curly Dock	G?	SE5			N	POLYGONACEAE
<i>Silene vulgaris</i>	Bladder Campion	G?	SE5			N	CARYOPHYLLACEAE
<i>Actaea pachypoda</i>	White Baneberry	G5	S5			N	RANUNCULACEAE

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Anemone virginiana</i>	Virginia Anemone	G5	S5			N	RANUNCULACEAE
<i>Caltha palustris</i>	Marsh Marigold	G5	S5			N	RANUNCULACEAE
<i>Ranunculus acris</i>	Tall Butter-cup	G5	SE5			N	RANUNCULACEAE
<i>Podophyllum peltatum</i>	May Apple	G5	S5			N	BERBERIDACEAE
<i>Alliaria petiolata</i>	Garlic Mustard	G?	SE5			N	BRASSICACEAE
<i>Capsella bursa-pastoris</i>	Common Shepherd's Purse	G?	SE5			N	BRASSICACEAE
<i>Lepidium campestre</i>	Field Pepper-grass	G?	SE5			N	BRASSICACEAE
<i>Ribes cynosbati</i>	Prickly Gooseberry	G5	S5			N	GROSSULARIACEAE
<i>Geum aleppicum</i>	Yellow Avens	G5	S5			N	ROSACEAE
<i>Malus pumila</i>	Common Apple	G5	SE5			N	ROSACEAE
<i>Potentilla recta</i>	Rough-fruited Cinquefoil	G?	SE5			N	ROSACEAE
<i>Prunus serotina</i>	Wild Black Cherry	G5	S5			N	ROSACEAE
<i>Rosa multiflora</i>	Rambler Rose	G?	SE4			N	ROSACEAE
<i>Rubus allegheniensis</i>	Common Blackberry	G5	S5			N	ROSACEAE
<i>Rubus occidentalis</i>	Black Raspberry	G5	S5			N	ROSACEAE
<i>Lotus corniculatus</i>	Birds-foot Trefoil	G?	SE5			N	FABACEAE
<i>Medicago lupulina</i>	Black Medic	G?	SE5			N	FABACEAE
<i>Medicago sativa</i> ssp. <i>sativa</i>		G?T?	SE5			N	FABACEAE
<i>Mellilotus alba</i>	White Sweet Clover	G5	SE5			N	FABACEAE
<i>Trifolium pratense</i>	Red Clover	G?	SE5			N	FABACEAE
<i>Rhus radicans</i> ssp. <i>negundo</i>	Poison Ivy	G5T5	S5			N	ANACARDIACEAE
<i>Rhus typhina</i>	Staghorn Sumac	G5	S5			N	ANACARDIACEAE
<i>Acer saccharum</i> ssp. <i>saccharum</i>	Sugar Maple	G5T5	S5			N	ACERACEAE
<i>Impatiens capensis</i>	Spotted Jewel-weed	G5	S5			N	BALSAMINACEAE
<i>Parthenocissus vitacea</i>	Virginia Creeper	G5	S5			N	VITACEAE
<i>Vitis riparia</i>	Riverbank Grape	G5	S5			N	VITACEAE
<i>Tilia americana</i>	American Basswood	G5	S5			N	TILIACEAE
<i>Hypericum perforatum</i>	Common St. John's-wort	G?	SE5			N	CLUSIACEAE
<i>Viola pubescens</i> var. <i>pubescens</i>		G5T5	S5			N	VIOLACEAE
<i>Circaea lutetiana</i>	Southern Broadleaf Enchanter's Nightshade	G5	S5			N	ONAGRACEAE
<i>Oenothera biennis</i>	Common Evening-primrose	G5	S5			N	ONAGRACEAE
<i>Aralia nudicaulis</i>	Wild Sarsaparilla	G5	S5			N	ARALIACEAE
<i>Daucus carota</i>	Queen Anne's Lace	G?	SE5			N	APIACEAE
<i>Cornus alternifolia</i>	Alternate-leaf Dogwood	G5	S5			N	CORNACEAE
<i>Monotropa uniflora</i>	Indian-pipe	G5	S5			N	MONOTROPACEAE
<i>Pyrola elliptica</i>	Shinleaf	G5	S5			N	PYROLACEAE
<i>Trientalis borealis</i>	Northern Starflower	G5	S5			N	PRIMULACEAE
<i>Fraxinus americana</i>	White Ash	G5	S5			N	OLEACEAE
<i>Asclepias syriaca</i>	Common Milkweed	G5	S5			N	ASCLEPIADACEAE
<i>Echium vulgare</i>	Common Viper's-bugloss	G?	SE5			N	BORAGINACEAE
<i>Leonurus cardiaca</i>	Common Mother-wort	G?	SE5			N	LAMIACEAE
<i>Prunella vulgaris</i> ssp. <i>lanceolata</i>	Self-heal	G5T?	S5			N	LAMIACEAE
<i>Solanum dulcamara</i>	Climbing Nightshade	G?	SE5			N	SOLANACEAE
<i>Verbascum thapsus</i>	Common Mullein	G?	SE5			N	SCROPHULARIACEAE
<i>Plantago lanceolata</i>	English Plantain	G5	SE5			N	PLANTAGINACEAE
<i>Plantago major</i>	Common Plantain	G5	SE5			N	PLANTAGINACEAE

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Galium circaezans</i>	Wild Licorice	G5	S5			N	RUBIACEAE
<i>Galium triflorum</i>	Sweet-scent Bedstraw	G5	S5			N	RUBIACEAE
<i>Mitchella repens</i>	Partridge-berry	G5	S5			N	RUBIACEAE
<i>Lonicera tatarica</i>	Tartarian Honeysuckle	G?	SE5			N	CAPRIFOLIACEAE
<i>Sambucus canadensis</i>	Common Elderberry	G5	S5			N	CAPRIFOLIACEAE
<i>Viburnum acerifolium</i>	Maple-leaf Viburnum	G5	S5			N	CAPRIFOLIACEAE
<i>Viburnum opulus</i>	Guelder-rose Viburnum	G5	SE4			N	CAPRIFOLIACEAE
<i>Ambrosia artemisiifolia</i>	Annual Ragweed	G5	S5			N	ASTERACEAE
<i>Arctium minus ssp. minus</i>	Common Burdock	G?T?	SE5			N	ASTERACEAE
<i>Chrysanthemum leucanthemum</i>	Oxeye Daisy	G?	SE5			N	ASTERACEAE
<i>Cirsium arvense</i>	Canada Thistle	G?	SE5			N	ASTERACEAE
<i>Cirsium vulgare</i>	Bull Thistle	G5	SE5			N	ASTERACEAE
<i>Erigeron hyssopifolius</i>	Daisy Fleabane	G5	S5			N	ASTERACEAE
<i>Eupatorium maculatum ssp. maculatum</i>	Spotted Joe-pye Weed	G5T?	S5			N	ASTERACEAE
<i>Prenanthes alba</i>	White Rattlesnake-root	G5	S5			N	ASTERACEAE
<i>Rudbeckia laciniata</i>	Cut-leaved Coneflower	G5	S5			N	ASTERACEAE
<i>Solidago altissima</i>	Tall Goldenrod	G5T5	S5			N	ASTERACEAE
<i>Solidago canadensis var. canadensis</i>	Canada Goldenrod	G5T?	S5			N	ASTERACEAE
<i>Taraxacum officinale</i>	Brown-seed Dandelion	G5	SE5			N	ASTERACEAE
<i>Tussilago farfara</i>	Colt's Foot	G?	SE5			N	ASTERACEAE

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COSSARO = Committee on the Status of Species at Risk in Ontario

END = Endangered, THR = Threatened, SC = Special Concern (formerly Vulnerable), NAR = Not at Risk

SRANK (from Natural Heritage Information Centre) shown for breeding status: S1 (extremely rare), S2 (very rare), S3 (rare to uncommon), S4 (common), S5 (very common), and SE (exotic, i.e. introduced)

Tracked species that are S4 or S5 are also noted. Occurrence data are actively gathered for tracked species by the NHIC. Species actively tracked generally have fewer than 100 recent occurrences in Ontario, or are highly ranked globally.



GUIDING SOLUTIONS IN THE
NATURAL ENVIRONMENT

Doran Road - Neighbourhoods 2 and 3 Environmental Impact Study

Prepared For:

Midhurst Development Doran Road Inc.

Prepared By:

Beacon Environmental

Date: Project:

September 2009 207056

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1. Introduction

1.1 Background

This report is submitted in connection with three draft plans of subdivision filed by Midhurst Development Doran Road Inc. (MDDRI) in December 2008 for a total of 195.4 ha (482.7 acres) of land in the Midhurst Settlement Area, in the Township of Springwater, Simcoe County.

In January 2008 MDDRI filed an Official Plan Amendment (OPA) Application for these lands, which are located in what is referred to as Neighbourhoods 2 and 3 as per the Midhurst Secondary Plan, OPA 38, Schedule "B", a potential total future development area of approximately 502.7 ha (1242.2 acres) located in the eastern half of the Midhurst Settlement Area.

The MDDRI lands are generally bounded by Doran Road and Walt Road to the north, the Midhurst Settlement Area boundary to the east, environmental lands to the south, and the existing residential development, environmental lands and Russell Road to the west.

The Township of Springwater began a Secondary Planning process for the entire Midhurst community in the summer of 2007 in order to plan for the growth and future land use designations and policies for the community over the next 20 years. The Township is also undertaking the appropriate Environmental Assessment (EA) processes in tandem with its Secondary Planning process. The Midhurst Secondary Plan was adopted by the Township of Springwater in November 2008, but not yet approved by the County. The EA process, which deals with future servicing and transportation improvements of Neighbourhoods 2 and 3, was filed on July 9, 2009.

1.2 Study Scope and Objectives

Beacon Environmental has been retained by MDDRI to conduct a review of natural heritage features associated with six separate properties (totalling 204.3 ha) that lie within the MDDRI lands and to assess the impact of development of these properties on the natural environment. These six properties are known as the Bell, Rusdor, R. Coutts, J. & G. Coutts, Jones and Wright properties. The respective locations of each of these properties within the study area are shown in **Figure 1**.

This report, therefore, represents an Environmental Impact Study (EIS) submitted in respect of the three draft plans of subdivision for these properties, which have been prepared by Gatzios Planning (June 2009). The three draft plans cover the following properties (hereafter collectively referred to as the "study area"):

1. Bell, Rusdor and R. Coutts (98.48 ha) - north of Poole's Road and west of Russell Road (Gatzios Dwg. DP2-1);
2. J. & G. Coutts and Jones (78.67 ha) - south of Poole's Road and west of Old 2nd Road South (Gatzios Dwg. DP2-2); and
3. Wright (18.20 ha) – south of Walt Road and west of Old 2nd Road South (Gatzios Dwg. DP2-3).

The overall objective of this EIS is to identify the presence of natural features on and adjacent to the six properties that may pose constraints to their future development, as well as to identify those areas that, due to an absence of environmental constraints, would appear to present opportunities for development. An assessment of the potential impacts of development on natural heritage features is also presented, based on the three draft plans of subdivision prepared by Gatzios Planning (June, 2009).

The specific objectives of this EIS are to:

- Confirm the boundaries of the natural features to be protected;
- Carry out detailed inventories of the study area (flora and fauna, physical setting, ecological attributes and functions; species and communities of conservation concern; degree of connectivity);
- Assess the sensitivity of natural heritage features and their ecological functions to the proposed development;
- Assess the potential impacts of the proposed development on the features and functions of the natural area; and
- Identify appropriate mitigating measures to protect the feature from impacts associated with the proposed development of the MDDRI lands.

2. Methodology

2.1 Background Review

Prior to undertaking any site specific field investigations, Beacon Environmental reviewed the applicable natural heritage policies of the Provincial Policy Statement (PPS 2005), the Township of Springwater Official Plan (2001), the County of Simcoe Official Plan (2007), as well as the Nottawasaga Valley Conservation Authority's regulations (NVCA 2006) respecting watercourses, wetlands and valleylands. It should be noted that although this application was initiated prior to the adoption of the County Official Plan (OP) by County Council on November 25, 2008, the relevant policy direction provided in this latest (2008) version of the County's OP has been considered even though the COP is not approved, as the policies reflect the most recent view of the County.

The applicable policies contained within the Midhurst Secondary Plan (OPA 38) were also reviewed and considered.

A number of sources were consulted for information relating to the Neighbourhoods 2 and 3 study area and the Midhurst area in general, including the following:

- County of Simcoe Official Plan (Office Consolidation 2007);
- Proposed County of Simcoe Official Plan (November 2008)
- Township of Springwater Official Plan (2001);
- *Master Environmental Report for the Midhurst Secondary Plan Area* (Azimuth Environmental 2003);



Legend

- Doran Neighbourhood Boundary
- Springwater-Midhurst Settlement Area
- Unopened Willow Creek Tributary
- Properties
- Lands Not Part of this Application



Site Location

Figure 1

Environmental Impact Study
Midhurst Doran Neighbourhoods 2 & 3

UTM Zone 17 N, NAD 83

Ortho Photo Base 2002

0 125 250 500 Meters



1:12,500



Project 207056
June 2009

- Midhurst Secondary Plan – Official Plan Amendment No. 38 (The Planning Partnership 2008);
- Growth Management Memo – Midhurst Secondary Plan Study (The Planning Partnership 2008);
- Draft Environmental Mapping – Midhurst Secondary Plan Study (Bird & Hale 2008);
- Nottawasaga Valley Conservation Authority (NVCA) natural heritage resource information (regulated area mapping, *2007 Willow Creek Subwatershed Report Card*); and
- Ministry of Natural Resources' Natural Heritage Information Centre (NHIC) rare species database.

Other sources of information, such as aerial photography and topographic maps, were also consulted prior to commencing on-site field investigations.

2.2 Field Investigations

Field investigations of the six properties were undertaken by a Beacon Environmental ecologist on the following 10 dates:

- September 5, 2007 – preliminary reconnaissance survey of properties north of Pooles Road with NVCA;
- October 29, 2007 – preliminary reconnaissance survey of properties south of Pooles Road;
- November 21, 2007 – preliminary staking of top-of-bank (Willow Creek tributary – SE corner);
- November 29, 2007 – confirm top-of-bank staking with NVCA; winter birds;
- April 17, 2008 – breeding amphibian survey (visit 1);
- May 13, 2008 – breeding amphibian survey (visit 2);
- June 10, 2008 – breeding bird survey (visit 1, part 1);
- June 13, 2008 – breeding bird survey (visit 1, part 2);
- June 26, 2008 – breeding bird survey (visit 2, both parts); and
- July 18, 2008 – ELC vegetation mapping, flora.

During these field visits, the existing conditions with respect to natural habitats and drainage features within various portions of the study area, as described above, were examined and some feature limits (particularly on the Jones, Bell, J & G. Coutts and R. Coutts properties) were staked and surveyed. Two of the above dates (September 5 and November 29, 2007) involved site visits with ecology and planning staff of the NVCA to review and determine valley top-of-bank lines and other feature limits.

2.2.1 Breeding Amphibians

Two nocturnal surveys for breeding amphibians were carried out within the study area: on April 17 and May 13, 2008. On the first survey the air temperature was 12°C and clear with no wind. Conditions were calm on the second survey, with an air temperature of 18°C. During each of the two surveys the same locations were sampled:

- in and around the two man-made ponds associated with an unnamed headwater tributary of Willow Creek (situated in the southeast corner of the study area); and

- in the dry valley at the northwest corner of the intersection of Pooles Road and Russell Road (see Figure 1).

The amphibian survey followed the standard sampling protocol for southern Ontario, adapted from the Wisconsin Index (Mossman *et al.* 1998), whereby calling anurans (frogs and toads) were identified to species and chorus activity was assigned one of the following codes:

- 0..... no calls
- 1..... individuals of one species can be counted, calls not simultaneous
- 2..... some calls of one species simultaneous, numbers can be reliably estimated
- 3.....full chorus, calls continuous and overlapping

Amphibian surveys on the tablelands within the MDDRI lands were not required due to the absence of any suitable amphibian habitat conditions (i.e., no breeding ponds are present).

2.2.2 Breeding Birds

Three visits to the subject property were made in the early mornings of June 10th, June 13th and June 26th, 2008 to survey the breeding bird community. All representative habitats in the study area were surveyed on foot (see Figure 1). Only the six properties owned by participating landowners were surveyed. For non-participating landowners within Neighbourhoods 2 and 3 or for properties adjacent to the study area, observations were made from property lines or roadsides/public rights-of-way. All birds seen or heard in suitable habitat and showing some evidence of breeding (e.g., territorial behaviour) were assumed to be breeding (see Section 4.2.2 for additional information).

2.2.3 Vegetation Communities and Flora

Vegetation communities within the study area were described and mapped (see **Figure 2**) on July 18th following the Ecological Land Classification System for southern Ontario (Lee *et al.* 1998). Vegetation community descriptions are contained in Section 4.1. For non-participating or adjacent properties ELC was either determined from roadside/property edge observations or follows the earlier work of Azimuth Environmental (2003), who mapped ELC communities at a very broad scale throughout the Midhurst Secondary Plan Area as part of the *Master Environmental Report for the Midhurst Secondary Plan Area*.

Detailed inventories of the flora found within the six participating properties were also carried out in July 2008. The inventory was conducted by random sampling within the various vegetation communities that occur within the study area. This survey effort allowed for a detailed assessment of the floristic community.

2.2.4 Incidental Wildlife Observations

Any other wildlife species identified within the MDDRI lands during field investigations were recorded as an incidental observation for the purposes of the EIS.



Existing Conditions

Figure 2

Environmental Impact Study
Midhurst Doran Neighbourhoods 2 & 3

Legend

- Amphibian Survey Locations
- Breeding Bird Locations (see Appendix 1)
- Butternut (*Juglans cinerea*)
- Western Chorus Frog (*Pseudacris triseriata*)
- OPA Application Area
- Doran Neighbourhood Boundary
- ELC Communities
- Springwater-Midhurst Settlement Area
- Willow Creek Tributary
- Significant Hedgerow (Azimuth 2003)
- Additional Lands Not Part of this Application

Ortho Photo Base 2002

UTM Zone 17 N, NAD 83

0 120 240 480 Meters



1:11,000



Project 207056
June 2009

2.2.5 Aquatic Habitat

There is one surface water drainage feature within the study area, an unnamed headwater tributary of Willow Creek that flows through the southeast corner of the study area (see Figure 1). There is an on-line pond on a section of this watercourse, located just downstream of Old 2nd Road South on the Jones property. A general description of the aquatic habitat conditions associated with the Willow Creek tributary is found below in Section 4.3. However, it should be noted that a more detailed discussion of the aquatic habitat conditions of the Willow Creek tributary, from both a fisheries and water quality perspective, are contained in the companion *Surface Receiving Water Assessment* report which has been prepared in connection with the MDDRI draft plan of subdivision applications by AECOM Limited (2009a).

2.2.6 Landscape Connectivity

An assessment of landscape connectivity was made using information gathered on the subject property, aerial photography and topographic mapping. The results of this assessment are discussed in Section 4.7.

3. Policy Context

The following sections provide the provincial, regional and local policy context for this assessment.

3.1 Provincial Policy

Policy 2.1 of the *Provincial Policy Statement* (PPS) (2005) provides direction to municipalities regarding planning policies for the protection and management of natural heritage features and resources. The PPS defines seven natural heritage features, providing planning policies for each. The *Natural Heritage Reference Manual* (OMNR 1999) is a technical document used to guide in the assessment of the seven PPS natural heritage features listed below:

- significant wetlands;
- significant habitat of endangered and threatened species;
- significant woodlands;
- significant valleylands;
- significant Areas of Natural and Scientific Interest (ANSIs)
- significant wildlife habitat; and
- fish habitat.

Each of these features is afforded varying levels of protection subject to guidelines, and in some cases, regulations. Significant wetlands and ANSIs are to be identified by the Ministry of Natural Resources. Significant habitat of threatened and endangered species is also to be determined by the Ministry of Natural Resources, if a threatened or endangered species is known to occur/have occurred on a given property, or has been identified through site specific investigations. Fish habitat is governed by the federal *Fisheries Act* and variously applied by Fisheries and Oceans Canada (DFO)

with Conservation Authorities often acting on their behalf. The identification of the other three PPS natural heritage features (i.e., significant woodlands, significant valleylands and significant wildlife habitat) is the responsibility of the municipality (i.e., planning authority).

3.2 County of Simcoe Official Plan (2008)

In November 2008, the County of Simcoe adopted the *Proposed Official Plan County of Simcoe* (County of Simcoe 2008), which proposes to replace its earlier OP (County of Simcoe 2007). Although the OPA application was initiated prior to the adoption of the 2008 County Official Plan, which has yet to be approved by the Ontario Ministry of Municipal Affairs and Housing (OMMAH), it provides policy direction to the current draft plan of subdivision applications.

The 2008 County Official Plan identifies a Natural Heritage System comprised of natural heritage features that are collectively referred to as “Greenlands”. The Greenlands designation generally encompasses the following natural heritage features: significant habitat of endangered and threatened species; wetlands greater than 0.5 ha; significant woodlands, valleylands, significant wildlife habitat, and Areas of Natural and Scientific Interest (ANSIs).

Under the new Official Plan (County of Simcoe 2008), no development of any kind is permitted in wetlands greater than 2 hectares or the significant habitat of endangered or threatened species. Also, no residential development of the type proposed by the three draft plans of subdivision for the study area is permitted in the Greenlands designation. However, with respect to lands within Settlement Areas Greenlands boundaries can be refined through an EIS.

Within designated Settlement Areas such as Midhurst, development shall be directed away from Greenland areas and development proposed within specific distances of Greenlands features (i.e., within 120 m of a wetland or 60 m from a significant woodland and/or valleyland) must be supported by an EIS. The EIS must demonstrate that the proposed development will not have any negative impacts on the nearby features and their functions.

3.3 Township of Springwater Official Plan (2001)

The Township of Springwater Official Plan (2001) presently identifies a Natural Heritage System comprised of Category 1 and Category 2 Environmental Protection Lands. Category 1 Lands are composed of the following natural heritage features/areas:

- provincially and locally significant wetlands;
- ANSIs;
- significant habitat of threatened and endangered species; and
- significant watercourses and ravines.

These Environmental Protection 1 lands are depicted on the Land Use Plan (Schedule A of the Springwater OP) and are areas where development is not permitted.

Category 2 EP Lands include the following:

- lands adjacent to Category 1 Lands;
- unique and significant wildlife habitat;
- forests and woodlots;
- natural connections through valley corridors or other linkages
- between core areas;
- groundwater recharge and discharge areas; and
- natural fish habitat.

These areas are shown on the Schedule B - Natural Heritage (Environmental Protection) as Category 2 Lands and are areas where development may be permitted, subject to the findings of an Environmental Impact Assessment (which is synonymous with an EIS).

However, within the Midhurst Settlement Areas, the land use designations in the 2001 Official Plan, including EP 1 and 2 are proposed to be amended by the Midhurst Secondary Plan (The Planning Partnership 2008), also known as Official Plan Amendment (OPA) No. 38. The relevant environmental policies of OPA 38 are discussed in detail in the following section.

3.4 Midhurst Secondary Plan - OPA Number 38 (2008)

In 2007 the Township of Springwater initiated a Secondary Planning process for the Midhurst community. The Midhurst Secondary Plan (The Planning Partnership 2008), also known as OPA 38, was adopted by Township of Springwater council in early November 2008. It has not received approval from the County but represents the most current views of the Township and, as such, is being considered in this analysis. In conjunction with this Secondary Plan process, the Township is also undertaking Class Environmental Assessments to determine the most appropriate servicing plan and arterial road network for the Midhurst Settlement Area.

The natural heritage component of the Secondary Plan has involved mapping the significant features and assigning either an Environmental Protection Area I designation or an Environmental Protection Area II designation to each. The definitions of EPA I and EPA II as they apply to the Midhurst Secondary Plan are not the same as EP Category 1 and EP Category 2 lands, as defined in the Township's Official Plan (2001).

For the purposes of the Midhurst Secondary Plan, lands within the Environmental Protection Area designation "include features that are Provincially mandated or regulated for protection, features that warrant protection based on the mandate of the Conservation Authority and typical buffers generally required to maintain those features" (p. 19). This is interpreted to refer to natural heritage features identified by the Provincial Policy Statement (e.g., significant wetlands, significant woodlands, significant wildlife habitat, etc.), as well as those features (i.e., watercourses, wetlands, and valleylands) that are regulated by NVCA. From a land use planning perspective EPA I lands are fully protected (i.e., no development is permitted within them), even though some development may have been permitted in these areas (subject to an EIS) under the policies of the PPS (MMAH 2005).

Any development proposed within 30 m of an EPA 1 is subject to the preparation of an EIS, which is to be carried out in accordance with the technical requirements of the Township and the NVCA and ultimately requires the Township's approval. Very detailed guidelines as to the required scope and

content of an EIS are contained in Section 9.7.2 of OPA 38. One of the primary objectives of the EIS is to determine the actual width of a buffer between the EPA 1 land and the edge of development.

The Environmental Protection Area II designation “includes areas that may [emphasis added] be considered significant with respect to natural heritage features and functions” (p.19). Based on the mapping of natural heritage features in Schedule B of the Midhurst Secondary Plan, it appears that EPA II areas are generally comprised of the following: valleylands, smaller woodlands and plantations.

EPA II lands are areas where some development or land use change may be permitted, subject to the findings of an EIS that has examined the significance and function of these areas in greater detail and determined “the nature and extent of the feature and the determination of any buffer that may be required between the feature and the limit of urban development” (p.19).

3.5 NVCA Watershed Policies and Regulations (2006)

The NVCA regulates hazard lands, including creeks, valleylands, shorelines, and wetlands. It is also responsible for administering many aspects of the federal *Fisheries Act* on behalf of the federal Department of Fisheries and Oceans (DFO).

Under NVCA's (2006) *Ontario Regulation 172/06 (Development, Interference with Wetlands and Alterations to Shorelines and Watercourses)*, a permit is required from the Authority before any development proposals that are located within: 1) 15 m of a watercourse; 2) 120 m of a Provincially Significant Wetland or a wetland area greater than 2 ha; or 3) 30 m of a wetland less than 2 ha in area can proceed.

The 15 m, 30 m or 120 m area around the feature defines the area that is subject to the regulations (i.e., the “regulated area”). For development applications that encroach within the regulated area, the NVCA typically requires that an EIS be prepared to its satisfaction.

Generally, development within the flood limit of a watercourse is not allowed. However, subject to conformity with the Township's Official Plan and the completion of appropriate studies, some development *may* be permitted within the regulated area outside of the floodplain. The NVCA generally requires that watercourses remain in their natural state with respect to development proposals.

The NVCA also generally requires that all watercourses be protected from adjacent development by a vegetative buffer that will be measured from the annual high water mark. In the case of warmwater systems, the minimum buffer is 15 m on each side of the watercourse, while in the case of coolwater or coldwater systems the buffer requirements are 30 m on each side of the watercourse. In situations where thermal regimes and fish populations have not yet been studied and determined, the NVCA may also request 30 m buffer zones.

The presence of any watercourses or wetlands on or in close proximity (i.e., “adjacent lands”) to areas proposed for development would trigger the need for an EIS. The EIS may recommend that wetlands be maintained in their existing location and/or for protective buffers to be placed on wetlands and watercourses within the study area.

It should be noted that with respect to “adjacent lands” from a natural heritage feature, the NVCA’s definition of the “regulated area” (e.g., 30 m or 120 m from a wetland) is greater than the Township’s definition of a proximity distance before the requirement for an EIS is triggered (e.g., 30 m from an EPA I area). Notwithstanding this difference, however, it is our expectation that in cases where a development application adjacent to a feature triggers the need for an EIS, the scope of the study will be established such that the requirements of both the Town and the NVCA are satisfied in a single document.

The NVCA also has a Level 2 agreement with DFO, meaning that it has responsibility for identifying if a “*Harmful Alteration, Disruption or Destruction*” (HADD) of fish habitat is likely to occur as a result of a development proposal. If the HADD cannot be mitigated, then a Fisheries Act authorization is required and the file is referred to DFO by NVCA.

4. Existing Conditions

4.1 Soils and Topography

From a topographic perspective, the village of Midhurst is located in the Simcoe Upland and Lowland physiographic regions as defined by Chapman and Putnam (1984). The area generally lies at an elevation below approximately 230 metres above sea level (masl) and is occupied by Little Lake, Willow Creek and Matheson Creek, all of which form part of the Willow Creek watershed (Nottawasaga Valley Conservation Authority), and all of which flow north and west to Minesing Swamp.

The surficial soils within Neighbourhood 2 and 3 are characterized by sands and sandy till (Golder Associates Ltd. (2008)). There are relatively few streams present in Neighbourhoods 2 and 3, due to the presence of permeable sandy soils in the upland areas that promote recharge. The lowland areas to the south of the Neighbourhoods 2 and 3 contain a number of poorly-drained wetland areas associated with Little Lake and along the reach of Willow Creek the flows between Midhurst and the Minesing Swamp to the northwest.

4.2 Hydrogeological Conditions

The following description of hydrogeological conditions within Neighbourhoods 2 and 3 is summarized from the information contained in a companion hydrogeology report prepared by Golder Associates Ltd. (2008).

Golder Associates Ltd. used the Ministry of the Environment (MOE) digital water well database and digital topographic maps to determine the relative locations of four major (regional) aquifers that underlie the study area. These aquifers have been classified into four regional aquifers: Aquifers A1 through A4. The upper A1 Aquifer is unconfined or partly confined and is generally present at elevations above 250 masl. It appears to merge with Aquifer A2 under some of the upland areas and west of Russell Road. The private wells providing water supply to residences along Russell Road and Old 2nd Road South tap into both Aquifer A1 and A2. The few private wells drawing from Aquifer A1

wells are typically around 55 m deep, while Aquifer A2 wells are generally 53 to 84 m below ground. This aquifer appears to be under confined artesian (upward flowing) water table, although in places this thin (approximately 5 to 6 m) confining layer between Aquifer A1 and A2 appears to be absent.

Aquifer A2 is likely the source of baseflow to the upper reaches of Willow Creek and its tributaries, including the unnamed tributary that originates near the intersection of Pooles Road and Old 2nd Road South. The Oro, and Hillsdale/Anten Mills uplands, situated to the north and upgradient of (i.e., at higher elevations than) Midhurst, are predominantly underlain by loose textured granular deposits. These uplands are thought to provide significant recharge to Aquifer A2 and deeper aquifers.

The village of Midhurst obtains its water from wells drilled down into Aquifer A3, a confined artesian aquifer. This aquifer is thought to be continuous throughout the Willow Creek Valley and to the north in the Matheson Creek Valley, including the Anten Mills area (Golder Associates Ltd. 2008). The aquifer is under confined artesian conditions and is overlain by a lacustrine silt and clay confining layer approximately 35 to 40 m thick. Aquifer A3 is also the primary water supply for local central Simcoe communities such as Angus, Barrie, CFB Borden, Hillsdale, Anten Mills and Wasaga Beach.

Aquifer A4 is the deepest of the four regional aquifers and generally present at elevations below 140 masl. Very few wells in the area receive their water from this deep aquifer.

4.3 Vegetation Communities

Vegetation communities on the subject property were described and mapped on July 18 2008 following the ELC classification system for southern Ontario (Figure 2).

Dry – Fresh White Pine – Oak Mixed Forest Type (FOM2-2)

This second growth community occurs on a slope that extends north of Pooles Road (see Figure 2). It is comprised of a mix of coniferous and deciduous tree species. The dominant canopy cover is provided by White Pine (*Pinus strobus*) and Red Oak (*Quercus rubra*) and also includes lesser amounts of Sugar Maple (*Acer saccharum*), Paper Birch (*Betula papyrifera*), White Ash (*Fraxinus americana*) and American Beech (*Fagus grandifolia*). The sub-canopy is mostly Sugar Maple, Ironwood (*Ostrya virginiana*), Black Cherry (*Prunus serotina*) and American Beech. A young, seemingly healthy Butternut (*Juglans cinerea*) approximately 5 m tall also occurs in this community (see Figure 2). The provincial status of Butternut is discussed in greater detail in Section 4.5 below.

Shrubs in this community mainly consist of Choke Cherry (*Prunus virginiana*), Alternate-leaved Dogwood (*Cornus alternifolia*), Prickly Gooseberry (*Ribes cynosbati*) and two species of blackberry (*Rubus allegheniensis*, *Rubus occidentalis*). There is a considerable amount of Poison Ivy (*Rhus radicans*) and the highly invasive Garlic Mustard (*Alliaria petiolata*) growing at the edges of the community; elsewhere the groundcover consists of forbs such as Wild-Lily-of-the-Valley (*Maianthemum canadensis*), Starry False Solomon's Seal (*Smilacina stellata*), and Herb Robert (*Geranium robertianum*), ferns such as Lady Fern (*Athyrium filix-femina*) and Intermediate Wood Fern (*Dryopteris intermedia*), sedges including Black Sedge (*Carex arctata*) and Rosy Sedge (*C. rosea*) and grasses such as False Melic (*Schizachne purpurascens*).

Dry – Fresh Oak – Hardwood Deciduous Forest (FOD2-4)

This community also occurs along the slope north of Pooles Road (see Figure 2), where the forest transitions to predominantly deciduous west of the mixed forest community FOM2-2 described above. The dominant canopy species is Red Oak; other tree species include Sugar Maple, White Ash and Paper Birch. Balsam Poplar (*Populus balsamifera*) and Large-tooth Aspen (*P. grandidentata*) occur along the edge where the forest abuts the agricultural field. The sub-canopy is mostly comprised of Sugar Maple and White Ash and the shrub layer is dominated by Choke Cherry and young sapling trees. The understorey and groundcover is dense due to the relatively open nature of the canopy. False Solomon's Seal (*Maianthemum racemosum*) is dominant in the groundcover, with other common ground species including Poison Ivy, Downy Solomon's Seal (*Polygonatum pubescens*) and Enchanter's Nightshade (*Circaea lutetiana*).

Dry – Fresh Sugar Maple Deciduous Forest (FOD5-1)

This is a small community which occurs adjacent to a cedar forest and agricultural field (Figure 2). The canopy is dominated by Sugar Maple, with American Elm (*Ulmus americana*) and Black Cherry.

Dry – Fresh Sugar Maple – White Ash Deciduous Forest (FOD5-8)

This is the largest forest unit in the study area, occupying the area south of Pooles Road and west of the unopened road allowance for Russell Road (Figure 2). Sugar Maple is the dominant species in the canopy. Other canopy species are White Ash, American Beech and Red Oak. The sub-canopy consists of Paper Birch, Bitternut Hickory (*Carya cordiformis*), American Elm, Basswood (*Tilia americana*), Ironwood and Eastern Hemlock (*Tsuga canadensis*). The shrub layer is dominated by Red Elder (*Sambucus racemosa* ssp. *pubescens*), Alternate-leaved Dogwood, blackberries and young Sugar Maple and White Ash saplings. The groundcover is mostly Spinulose Wood Fern (*Dryopteris spinulosa*), Trillium (*Trillium grandiflorum*), Enchanter's Nightshade, Herb Robert and sedges. There is evidence of past logging in this community.

Fresh – Moist White Cedar Coniferous Forest (FOC4-1)

This is a small coniferous unit located along Old 2nd Road South (Figure 2). It occurs on two slopes which become cedar swamp at their lowest point. The canopy is almost exclusively Eastern White Cedar (*Thuja occidentalis*) with some scattered Eastern Hemlock. The understorey is lacking and the groundcover is sparse but does include Indian Pipe (*Monotropa uniflora*) and Jack-in-the Pulpit (*Arisaema triphyllum*).

Mineral Cultural Woodland (CUW1)

This community represents an area of regrowth, where the original forest has been cleared and may include some planted specimens. It occurs on fill and consists of a variety of tree species of varying heights and an open canopy. The dominant trees in this community are White Pine, White Ash, Red Oak, and Scot's Pine (*Pinus sylvestris*). Shrubs include Common Apple (*Malus pumila*), Pin Cherry

(*Prunus pensylvanica*) and Highbush Cranberry (*Viburnum trilobum*). The dominant groundcover is Bracken (*Pteridium aquilinum*) and various terrestrial forbs.

Red Pine Coniferous Plantation (CUP3-1)

These are communities in which the canopy is dominated by planted Red Pine (*Pinus resinosa*). They are generally limited in diversity of plant species.

Mineral Cultural Thicket (CUT1) and Sumac Cultural Thicket (CUT1-1)

These communities are dominated by shrubs such as Common Apple, hawthorn (*Crataegus* sp.), young elms and Staghorn Sumac (*Rhus typhina*). The groundcover is terrestrial forbs and grasses.

Dry – Moist Old Field Meadow (CUM1-1)

These are open cultural meadows with few trees and shrubs, consisting of a mixture of grasses such as Quack Grass (*Elymus repens*), Awnless Brome (*Bromus inermis*), Black Bentgrass (*Agrostis gigantea*), Canada Bluegrass (*Poa compressa*), Orchard Grass (*Dactylis glomerata*), Meadow Timothy (*Phleum pratense*) and Perennial Ryegrass (*Lolium perenne*) and forbs including Wild Bergamot (*Monarda fistulosa*), Black-eyed Susan (*Rudbeckia hirta*), Common Milkweed (*Asclepias syriaca*), goldenrods (*Solidago* spp.) and asters (*Symphyotrichum* spp.).

White Cedar Mineral Coniferous Swamp (SWC1-1)

Cedar swamp occurs between the two cedar forest slopes (FOC4-1) and is similar in that the canopy is almost exclusively cedar. The groundcover, however, features a variety of ferns: Sensitive Fern (*Onoclea sensibilis*), Oak Fern (*Gymnocarpium dryopteris*) and Clinton's Wood Fern (*Dryopteris clintoniana*).

Reed-canary Grass Mineral Meadow Marsh (MAM2-2) and Cattail Mineral Shallow Marsh (MAS2-1)

These communities occur along the unnamed tributary of Willow Creek that crosses the Jones property west of Old 2nd Road South (Figure 2). In some areas Reed-canary Grass (*Phalaris arundinacea*) is the dominant species and in others cattails (*Typha angustifolia*, *T. latifolia*) dominate. Other species present in this community include: Wild Mint (*Mentha arvensis*), Purple-stemmed Aster (*Symphyotrichum puniceum*), Sensitive Fern, Boneset (*Eupatorium perfoliatum*), Northern Bugleweed (*Lycopus uniflorus*), sedges (*Carex flava*, *C. hystericina*, *C. vulpinoidea*, *C. lupulinus*), Soft Stem Rush (*Schoenoplectus tabernaemontani*) and Joe-Pye Weed (*Eupatorium maculatum*).

The following sections describe the general vegetation conditions on each of the six subject properties within the draft plan area.

4.3.1 Bell Property

The Bell property is 17.1 ha in size. It is almost entirely an agricultural field, planted with corn. Based on the colour aerial photography examined and site investigations, this area is relatively devoid of trees, with the exception of a small Red Pine plantation (CUP3-1) situated along the western edge of the property. This tableland plantation is contiguous with a large well-defined and steep-sided wooded valley feature which extends south and east onto the adjacent Coutts Property to the south. This is a dry valley that does not contain a defined watercourse. Woodland cover in the valley is comprised of two of the dry-fresh mixed and deciduous forest communities described above (FOM2-2 and FOD2-4; see Figure 2).

The Bell Property also has narrow (i.e., single tree) deciduous hedgerows along its western, southern and eastern boundaries (Figure 2). These hedgerows have been identified as “significant” hedgerows by Azimuth Environmental (2003). However, these features are not considered to be important from an ecological perspective, but rather provide aesthetic benefits to the rural character of the area.

4.3.2 Rusdor Property

The Rusdor property is comprised of 42.4 ha of agricultural land, entirely planted in corn. There is a small treed area (too small to classify under ELC) associated with an existing residence that fronts on Doran Road, as well as hedgerows surrounding the south and east sides of the lot (Figure 2). These hedgerows are not of ecological significance and were not identified as such by Azimuth Environmental (2003).

4.3.3 R. Coutts Property

The R. Coutts property lies due south of the Bell and Rusdor properties and extends south to Pooles Road. It is 39.0 ha in size, of which approximately 27.2 ha is presently utilized for agricultural purposes (corn). Approximately one-quarter of the Coutts property at its south end (10.6ha) is occupied by the woodland/valleyland described above in Section 4.3.1. In the southeast corner of the property, where the open, paved section of Russell Road terminates at Pooles Road, the valley is more open, with scattered trees and shrubs. In this location it takes on the character of a cultural meadow (CUM1-1; see Figure 2).

4.3.4 J. & G. Coutts Property

The J. & G. Coutts property lies south of Pooles Road and extends from the unopened road allowance for Russell Road to the west to Old 2nd Road South to the east. It is 44.5 ha in size, most of which is used for agricultural cultivation. The only portions of the J. & G. Coutts property that contain a natural heritage feature are two very small wooded areas at its west end that are contiguous with the extensive tract of deciduous forest (FOD5-8) that lies south of Pooles Road and west of the unopened Russell Road allowance (Figure 2).

4.3.5 Jones Property

The Jones property is situated immediately south of J. & G. Coutts, that also extends between the unopened Russell Road allowance and Old 2nd Road South. The west side of the Jones property is crossed by a wooded slope containing a Cultural Woodland (CUW1), below which there is an agricultural field (which was not cultivated in 2008). The eastern side of the property (which does not form part of this application) is occupied by a well-defined valley that contains an unnamed headwater tributary of Willow Creek. This watercourse has its source just north of the site, arising as a spring at the intersection of Pooles Road and Old 2nd Road South. From its origin the creek flows south, passing through an Eastern White Cedar swamp (SWC1-1) flanked by dense fresh-moist white cedar forest units (FOC4-1) as it enters the Jones property. The creek then enters an on-line dug pond before continuing southward through a semi-open valley characterized by a meadow marsh (MAM2-2) floodplain and a grassed meadow with scattered trees and shrubs (CUM1-1), until it reaches the Walton property at the extreme southerly end of the MDDRI lands (Figure 2). The Walton property does not form part of the OPA and draft plan applications initiated by MDDRI, but is presently the subject of a separate draft plan application to the Township.

4.3.6 Wright Property

The Wright property is an 18.2 ha parcel located in the northeast corner of the MDDRI lands, at the southwest corner of the junction of Walt Road and Old 2nd Road South. It is entirely used for agricultural purposes and surrounds the Jacques property on three sides. The Jacques property is not part of the OPA application initiated by MDDRI and is identified as "Potential Future Development" on the draft plan of subdivision (Gatzios Planning Dwg. DP2-3). The southerly and westerly limits of the property are marked by narrow deciduous hedgerows of no particular ecological significance; otherwise the Wright property is entirely devoid of vegetation (Figure 2).

4.4 Wildlife Function

4.4.1 Amphibians

The breeding amphibian surveys revealed the presence of three species of frogs breeding in the floodplain of the valley containing the Willow Creek tributary on the Jones property (see Figure 2). These are: Spring Peeper (*Hyla crucifer*), Wood Frog (*Rana sylvatica*) and Western Chorus Frog (*Pseudacris triseriata*). All three were recorded at chorus levels of 2-3 on the first sampling night (April 17, 2008) downstream of the on-line pond. Only peepers were recorded in this location on the second visit (May 13, 2008).

The bottom of the dry valley at the northeast corner of Pooles Road and Russell Road (Figure 2) was also checked on both sample nights; however, no breeding amphibians were encountered in this location.

In April 2008, Western Chorus Frog (Great Lakes/St. Lawrence – Canadian Shield population) was designated as a federally Threatened Species-at-Risk (COSEWIC 2008). At present this species is ranked S4 ("Apparently Secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors") in Ontario (Natural Heritage Information Centre 2009). The status of Western Chorus Frog is discussed in greater detail in Section 4.5.

4.4.2 Breeding Birds

A total of 56 species of birds exhibiting some evidence of breeding were recorded in the study area. These are listed in Appendix 2, along with estimated numbers of breeding pairs. It should be noted that the Wild Turkey (*Meleagris gallopavo*), Barn Swallow (*Hirundo rustica*) and Tree Swallow (*Tachycineta bicolor*) numbers refer to birds seen only, not breeding pairs.

The breeding bird community associated with the MDDRI properties and the adjacent forest/valleylands is quite rich but is also relatively typical of old field, forest interior/forest edge and riparian habitats in rural areas. The breeding bird community is also characterized by many species that are relatively urban-tolerant.

Given the size and relatively mature condition of the large woodland tract adjacent to the study area to the south and west, it is not surprising that a relatively rich breeding bird community occupies this area, including a number of area-sensitive forest birds (i.e., birds that require relatively large areas of specialized habitat in which to breed) (OMNR 2000; see Appendix 2). Area-sensitive species for which more than a single breeding pair was recorded include: Yellow-bellied Sapsucker (*Sphyrapicus varius*), Veery (*Catharus fuscescens*), Pine Warbler (*Dendroica pinus*), American Redstart (*Setophaga ruticilla*), Ovenbird (*Seiurus aurocapillus*), and Scarlet Tanager (*Piranga olivacea*).

The margins of the agricultural fields and the outer edges of the woodlands support several grassland breeding birds, including some area-sensitive species (e.g., Savannah Sparrow *Passerculus sandwichensis* and Eastern Meadowlark *Sturnella magna*). However, all the area-sensitive species recorded are ranked S4 or S5.

Across the entire study area the most numerous breeding bird species present are:

- Red-eyed Vireo (*Vireo olivaceus*), forest edge/interior – 26 pairs;
- Song Sparrow (*Melospiza melodia*), grasslands, forest edge – 21 pairs;
- Black-capped Chickadee (*Poecile atricapillus*), forest edge -15 pairs;
- Indigo Bunting (*Passerina cyanea*), forest edge – 15 pairs;
- American Goldfinch (*Carduelis tristis*), open fields – 15 pairs;
- Red-winged Blackbird (*Agelaius phoeniceus*), grasslands/wetlands – 11 pairs; and
- Field Sparrow (*Spizella pallida*), grasslands – 10 pairs.

The majority of species recorded, including many of the forest interior specialists, are represented by only one or two pairs.

None of the breeding birds recorded within the MDDRI lands or within the adjacent forests/valleylands is endangered, threatened or nationally or provincially rare. All of the breeding bird species are ranked S4 (common) or S5 (very common) by the Ontario Ministry of Natural Resources (NHIC 2009).

4.4.3 Other Wildlife

Due to the predominance of open field habitat on the six properties and the proximity of the study area to several busy adjacent roadways and estate residential development, the mammal species associated within the MDDRI lands are those generally adapted to suburban and rural environments. Some common wildlife species use the subject property, mostly visiting the tablelands from the valley.

For example, White-tailed Deer (*Odocoileus virginianus*) tracks were noted at various locations on the site. Striped Skunk (*Mephitis mephitis*), Raccoon (*Procyon lotor*) and Coyote (*Canis latrans*) tracks were also noted in places. The first two of these species are very common in natural areas close to human habitation.

Based on the habitat available in the Cultural Meadow (CUM1-1) communities and along the forest/field interface it is likely that common mammal species such as the Meadow Vole (*Microtus pennsylvanicus*), Gray Squirrel (*Sciurus carolinensis*), Eastern Cottontail (*Sylvilagus floridanus*), and Red Fox (*Vulpes vulpes*) are also present within the study area.

Based on the existing habitat, amphibian and reptile species that use old field habitat in summer, such as the Eastern Garter Snake (*Thamnophis sirtalis*) and Northern Leopard Frog (*Rana pipiens*), may be present given that suitable breeding habitat occurs elsewhere in the valley system. These species are both very common in southern Ontario.

4.5 Species of Conservation Concern

4.5.1 Butternut

As noted in Section 4.1 under the discussion of ELC vegetation community FOM2-2, a single Butternut tree was encountered within this unit during 2008 field investigations. The location of this Butternut is shown on Figure 2.

Although this species is still fairly widespread in Southern Ontario, the provincial Butternut population is experiencing a rapid and noticeable decline due to infestation by a fungal pathogen known as Butternut Canker (*Sirococcus clavigignenti-juglandacearum*). The fungus is spread aggressively by rain and insects. It may infect any part of the tree where there is a wound, but the most common point of entry is leaf scars, especially at the tops of trees. The disease then spreads down the tree every time it rains. The ultimate cause of death is cankers that eventually girdle the tree. There is no known cure for Butternut Canker or any measures that can be applied to prevent the spread of the disease.

As a result, Butternut is now considered Endangered in Ontario (COSEWIC 2003; Province of Ontario 2008), and is therefore subject to the *Endangered Species Act* (2007) and the Provincial Policy Statement (2005) policy 2.1.3 regarding significant portions of the habitat of threatened or endangered species. This policy states that:

“Development and site alteration shall not be permitted in:

- a. significant habitat of endangered species and threatened species”

In regard to the habitat of endangered species and threatened species, the PPS (2005) defines “significant habitat” as “the habitat, as approved by the Ontario Ministry of Natural Resources, that is necessary for the maintenance, survival, and/or the recovery of naturally occurring or reintroduced populations of endangered species or threatened species, and where those areas of occurrence are occupied or habitually occupied by the species during all or any part(s) of its life cycle”.

Ontario’s new *Endangered Species Act* (2007) came into effect on June 30, 2008. The Act generally prohibits the killing or harming of a threatened or endangered species, as well as the destruction of its

habitat. However, there is an exception to the *Endangered Species Act*, (2007) that specifically pertains to Butternuts that are affected by the Butternut Canker. In a recent (May 15, 2008) *Ontario Regulation* made under the *Endangered Species Act* (2007), the Act does not apply to a Butternut tree that has been adjudged to be affected and therefore “not likely to make a significant contribution to the protection or recovery of the butternut species in Ontario”.

The habitat protection provisions under Section 10 of the *Endangered Species Act* (2007) currently do not apply to Butternut, as the species is listed on Schedule 3 of the Act and therefore currently has no habitat regulations. General habitat protection under the ESA will not come into force until June 30, 2013, unless species specific habitat regulation is developed prior to this date. Protection of significant habitat for Butternut is therefore currently provided only through the PPS (2005).

While Butternuts are typically found on rich, well-drained forest sites, they can also occur in a range of different habitat types. Unlike many other species of rare plants and wildlife, which are under threat and in decline due to loss of habitat (and often the loss of very specific habitat types), suitable habitat for Butternut is widespread and common throughout southern Ontario. The identification of significant habitat for Butternut can therefore be challenging, given the species' habitat variability and shade intolerance. Therefore, Beacon Environmental proposes that in the case of the Butternut encountered on the R. Coutts property (Figure 2), the significant habitat requirements should be defined as the immediate site where the tree is growing (i.e., the 5 m radius contained within the tree dripline) plus an additional 5 m radius surrounding the tree, resulting in a combined 10 m radius habitat protection zone, as measured from the crown of the tree.

This approach to identifying habitat protection zones for Butternuts has recently been adopted on a development project in the Town of Georgina (Region of York) where the habitat protection zone was identified as a radius of approximately 10 m around healthy butternut specimens. This approach was reviewed and accepted by the OMNR.

Notwithstanding the above, the Butternut found within the FOM2-2 community at the south end of the R. Coutts property will be retained *in situ*. The tree is located well within the forest community, at least 40 m downslope from the edge of the nearest proposed development (low density residential), which will occur on the tableland portion of the property (see Figure 2 and Gatzios Planning Dwg. DP2-1). No disturbance to this Butternut or its 10 m radius habitat protection zone will occur as a result of the proposed development of the tableland portion of the R. Coutts property (see also Section 7.1).

4.5.2 Western Chorus Frog

As noted above, the Great Lakes population of Western Chorus Frogs has recently been designated as Threatened in Canada (COSEWIC 2008). However, this frog presently has no status as a provincial species of concern in Ontario, where it is ranked S4 (NHIC 2009). Western Chorus Frogs are typically found in forest openings around woodland ponds and breed in almost any fishless pond with at least 10 cm of water (including ditches, gravel pits, flooded fields, beaver ponds, marshes, swamps and shallow lakes). Over the winter they hibernate under logs and rocks, or underground, and in the summer they tend to remain relatively close to wetlands, especially in urban environments where surrounding habitats may be limited. This species appears to be quite tolerant of human activities, and occurs in agricultural and suburban areas, but requires some “buffers” around its habitat. According to the latest status report on the species (COSEWIC 2008), Western Chorus Frog individuals' home ranges include their breeding pond and the surrounding terrestrial habitat.

However, they appear not to disperse too widely and studies have found that they tend to remain within 100 m to 200 m of their breeding pool.

Western Chorus Frogs were recorded from the floodplain of the Willow Creek on the Jones property, within an area that is designated Environmental Protection Area II in the Midhurst Secondary Plan (The Planning Partnership 2008) and within which no development is proposed as part of this application. Since no additional intrusion into the valley will occur as part of this application, and given the fact that Western Chorus Frogs, as noted, are relatively tolerant of nearby human activity, no impacts on this species and its breeding habitat are expected as a result of residential development on tablelands to the west of this area.

4.6 Aquatic Features

The discussion of watercourses as an aquatic feature is made separately from a discussion of fish habitat, as there is a set of discrete policies and regulations that apply to a watercourse as a feature, and another policy regime that relates to the presence or absence of fish or fish habitat.

Following the definition of the *Conservation Authority Act*, a “watercourse” means an identifiable depression in the ground in which a flow of water regularly or continuously occurs. Based on this definition, a watercourse may be: 1) ephemeral, supporting flow for a short period during the spring freshet or during major rain events; 2) intermittent, maintaining flows from the spring freshet for a number of months, typically to mid-summer; or 3) a permanently flowing brook, creek or river.

4.6.1 Willow Creek Tributary

There is one surface water drainage feature within the study area, an unnamed headwater tributary of Willow Creek that flows through the Jones property in the southeast corner of the study area (see Figure 1). It flows off-site to the south where it meets the main branch of Willow Creek at Little Lake, which ultimately flows west through the built-up section of Midhurst to Minesing Swamp.

This watercourse is a coolwater stream and supports excellent water quality; however it is subject to intermittent flows within that portion of the creek that occurs within the study area. Despite a considerable amount of rainfall experienced in the summer of 2008, the channel in this watercourse was observed to be dry in late August (AECOM Limited 2009a).

The composition of the benthic invertebrate community suggests that the water quality in this tributary of Willow Creek in the vicinity of the proposed development “has been minimally impacted by current land uses” (AECOM Limited 2009a).

According to the *Willow Creek 2007 Subwatershed Report Card* (NVCA 2007), stream health in the section of Willow Creek downstream of Little Lake improves (from a rating of only “fair” in its upstream reaches), primarily due to groundwater inputs from seeps within the densely wooded valley that extends south and west of the Jones property. The bottomlands of the Willow Creek valley downstream of Little Lake also form part of the Provincially Significant Willow Creek/Little Lake Wetland Complex. This natural heritage feature is situated more than 1 km downstream of the MDDRI study area.

4.6.2 Fish Habitat

Fish sampling in this headwater tributary of Willow Creek was carried out by AECOM Limited (2009a) in the summer of 2008. One fish species, northern redbelly dace (*Chrosomus eos*), was captured near the southern limit of Neighbourhoods 2 and 3, approximately 200 m south of the Jones property. Both adult and young-of-the-year dace were found, suggesting that spawning occurs in this location. No trout or other sensitive coldwater indicator fish species were encountered.

The findings of AECOM Limited (2009a), as reported in its *Surface Receiving Water Assessment* report generally confirms the NVCA's (2001) characterization of the main branch of Willow Creek (south of and west of Neighbourhoods 2 and 3) as providing coolwater to coldwater habitat, although the portion within the study area is intermittent coolwater. Although this watercourse provides fish habitat, AECOM Limited (2009a) concluded that in an overall sense it was "not considered highly sensitive".

Additional discussion of the water quality, fisheries and aquatic habitat conditions of the Willow Creek tributary, and the potential impacts of development on its features and functions, is contained in the companion *Surface Receiving Water Assessment* report prepared in respect of these draft plan of subdivision applications by AECOM Limited (2009a).

4.7 Landscape Connectivity

Landscape connectivity, including the concept of wildlife corridors, has become recognized as an important part of natural heritage planning. Although there is not universal agreement on the net benefits of corridors, a wide range of benefits can be attributed to maintaining connectivity within the natural landscape. In the fragmented landscape of southern Ontario, connectivity functions range from low, where major development features (e.g., highways, railways) fragment a pathway, to high, where natural features dominate the landscape and are more or less contiguous.

The subject property occurs in an area where the local landscape is dominated by a mix of agricultural fields and an extensive tract of unbroken forest that extends south for several kilometres where it connects to a series of provincially significant wetlands associated with Willow Creek and Little Lake.

At a local level the three frog species (Spring Peeper, Western Chorus Frog and Wood Frog) that breed on the Jones property during the spring disperse from the ponds in the valley into the larger forested blocks to the south during the summer and fall months.

At a larger regional level, north - south connectivity functions are also supported by the vegetated creek valley of the unnamed Willow Creek tributary. The forest block and this valley feature are likely locally important corridors that provide for the movement of urban-tolerant wildlife species at all seasons, and many migrant bird species in the spring and fall. There is limited habitat connectivity from Neighbourhoods 2 and 3 in other directions; the land use is presently agricultural (although proposed to be designated future residential in the Midhurst Secondary Plan) to the north and east (i.e., outside the Midhurst Secondary Plan area) and to the west is existing residential within the built-up part of Midhurst.

5. Policy Implications

The following sections describe those significant natural heritage features and functions associated with the MDDRI lands in the context of applicable policy documents, and briefly discuss the implications of each on future development of the six properties that presently form the basis of the draft plan of subdivision applications.

5.1 Provincial Policy Statement (2005)

Three of the seven natural heritage features addressed by the PPS (2005) occur on or adjacent to the subject property:

1. significant habitat of an endangered species (Butternut);
2. significant woodlands; and
3. fish habitat.

The occurrence of Butternut on the west side of the study area is discussed in detail in Section 4.5 above.

The well-wooded feature extending down the entire length of the west side of the study area is identified on Schedule B of the Township of Springwater Official Plan as a “Woodlot over 30 ha”, which is considered by Beacon Environmental to be synonymous with the PPS definition of “significant woodlands”. Therefore, for the purposes of the OPA and draft plan applications, Beacon has treated this feature as significant woodlands as defined by the PPS (2005).

The significance and function of the headwater tributary of Willow Creek as fish habitat has been addressed as part of the companion *Final Surface Receiving Water Assessment for Doran Neighbourhood Development, Midhurst, Ontario* prepared by AECOM Limited (2009a). AECOM’s study documented that portions of this watercourse within the study area provide direct, cool to coldwater fish habitat, in spite of its intermittent flow.

5.2 County of Simcoe Official Plan (2008)

The Simcoe County Official Plan states that development shall be directed away from Greenland areas and development proposed within specific distances of Greenlands features (i.e., within 120 m of a wetland or 60 m from a significant woodland and/or valleyland) must be supported by an EIS.

Given that the proposed development of the study area will fall within 60 m of significant woodland and valleyland, this EIS has been prepared to address potential impacts of future development on the features and functions of the Greenland unit.

5.3 Township of Springwater Official Plan (2001)

As noted above, a “Woodlot greater than 30 ha”, as described in the Township of Springwater Official Plan, has been treated as meeting the definition of a “Significant Woodland” under the PPS (2005). The OP states that any development proposed on lands “situated adjacent to and within 15 m of Significant Woodlots may be permitted by the Township subject to the completion of an Environmental Impact Assessment (E.I.A.)”.

In Schedule A (Land Use) of the Midhurst Secondary Plan, the entire wooded valley extending down the west side of the study area has an Environmental Protection Area I designation (i.e., no development permitted) in all but two places: 1 the non-forested portion of the dry valley in the southeast corner of the R. Coutts property, and 2) the wooded slope in the southwest corner of the Jones property, both of which are designated Environmental Protection Area II (see **Figure 3**)

Development may be permitted in EPA II areas, subject to the findings of an EIS. The intent of the EIS is to determine whether, on the basis of their features and functions, these EPA II lands warrant full or partial protection or whether some or all of these areas could be developed.

5.4 NVCA Watershed Policies and Regulations

As summarized above in Section 3.5, the NVCA regulates wetlands, watercourses and floodplains. Within the MDDRI lands the NVCA’s regulation mapping applies to only one area: the valley, floodplain, watercourse and wetland associated with the unnamed Willow Creek tributary that occupies the southeast corner of the study area.

5.5 Summary of Functions and Attributes

On Schedule A, the land use plan for the Midhurst Secondary Plan (The Planning Partnership 2008), the entire woodland block that extends along the west side of the study area is given an Environmental Protection I designation (i.e., no development permitted), except in two locations (see Figure 3). The non-forested portion of the dry valley in the southeast corner of the R. Coutts property, as well as the wooded slope in the southwest corner of the Jones property, are designated Environmental Protection II; (see Figure 3). Environmental Protection Area II areas are to be flagged for further assessment in order to determine whether, on the basis of their features and functions, they warrant some form of protection or whether some or all of these areas could be developed.

The majority of the study area is represented by active agricultural fields, with adjacent lands (especially to the west and south) characterized by wooded valleylands and extensive blocks of woodland/wetland. For the purpose of this assessment, the woodlands that lie adjacent to several of the subject properties are treated as “significant” as defined by the PPS (2005). Although the valleyland associated with the Willow Creek tributary is not identified by the Township as a “significant valleyland” as defined by the PPS (2005), it is both a regulated feature and identified as an EPA II feature on Schedule A (Land Use) of the Midhurst Secondary Plan.

The unnamed tributary of Willow Creek, which is an NVCA-regulated feature by virtue of being a watercourse and is designated EPA I on Schedule A of the Midhurst Secondary Plan, also provides fish habitat as defined by the PPS (2005).

No Provincially Significant Wetlands or ANSIs (as identified by the OMNR) have been identified on or within 120 m of the study area. One plant species listed in regulation under the province's *Endangered Species Act, 2007* (Butternut) has been identified. None of the other plant or animal species recorded within the MDDRI lands has been designated as Endangered, Threatened or a provincial Species at Risk, nor are any species considered rare in the County of Simcoe known to occur within the study area. No provincially rare vegetation communities (NHIC 2006) were found..

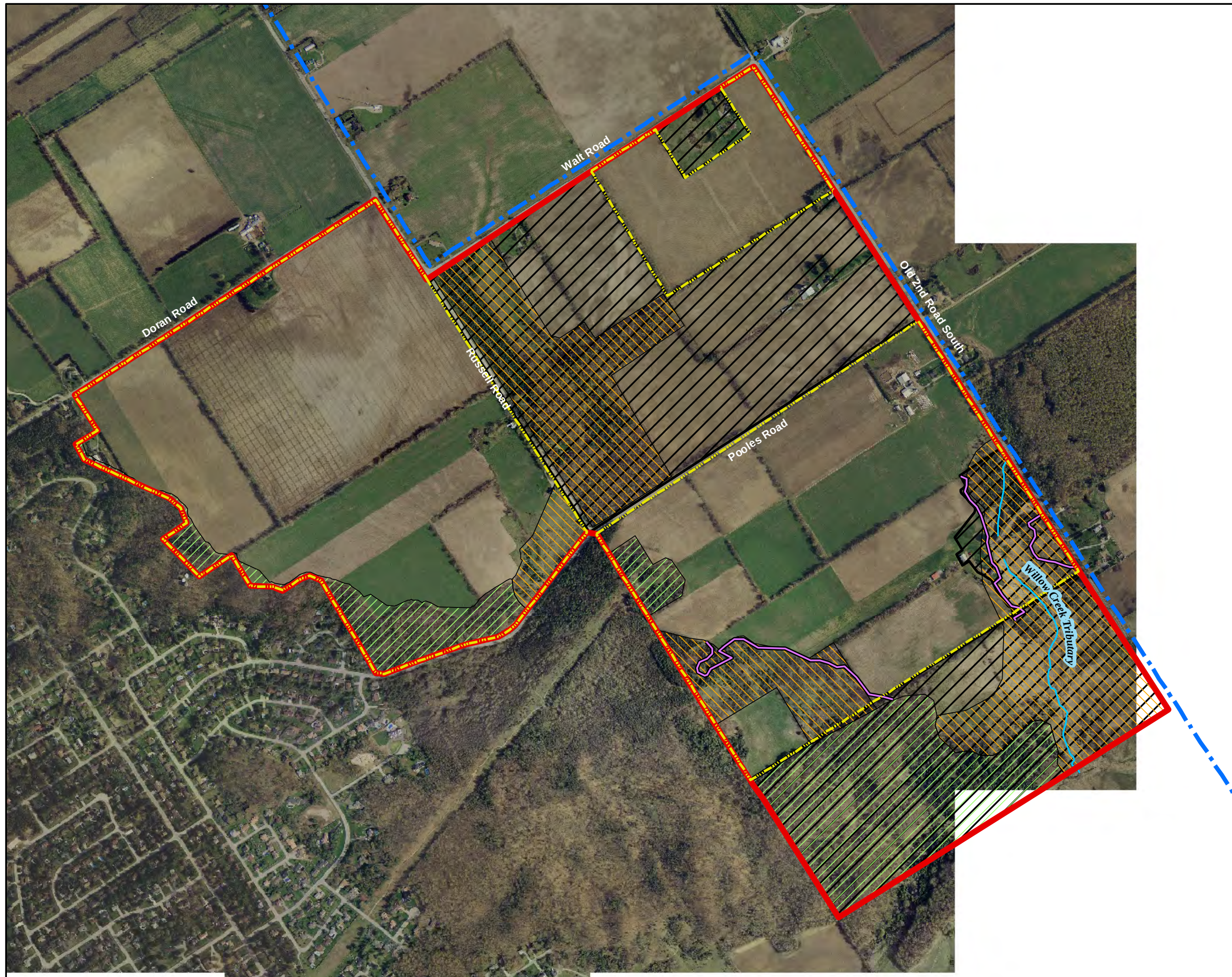
Table 1 provides a summary of the key natural heritage features and functions, their sensitivities and general location within the study area. It should be noted that in this case the “sensitivity” of the feature is being considered in the context of its sensitivity to development in general, as opposed to its sensitivity to the development of Neighbourhoods 2 and 3 as proposed by MDDRI, which is addressed in Section 7.0.

Table 1. Key Natural Heritage Features and Functions, Midhurst Study Area

Feature or Function	Sensitivity Level	Reason for Sensitivity	Location(s)
Butternut (provincially Endangered)	Low	Location of single tree is approximately 40 m from edge of proposed residential development (at closest point)	ELC vegetation community FOM2-2 at south end of R. Coutts property
Coolwater Fish Habitat	Moderate	Some sensitivity to changes in water quality	Tributary of Willow Creek
“Significant Woodlots”/EPA I (Township of Springwater)	Low	Existing forest edge adapted to open conditions (agricultural fields)	Located within areas to be retained and fully protected situated adjacent to development areas
NVCA Regulated Areas (valleylands, wetlands, watercourses)	Moderate	Sensitive to removal or alteration of habitat, impingement on valley system	Willow Creek tributary and associated wetland (on-line ponds) and riparian vegetation

6. Development Proposal

The proposed development of the MDDRI lands is depicted on three separate draft plans of subdivision (Gatzios Planning Dwgs. DP2-1, DP2-2 & DP2-3, May 29, 2009) for the six properties described in Section 1.2. Although the plans have been generated separately, they are fully integrated with each other in terms of land use, densities and municipal servicing. Collectively, the three plans are consistent with the Midhurst Secondary Plan, as illustrated on Schedule A – Land Use, with high and medium density residential and mixed use development concentrated along Doran Road, Russell Road and Pooles Road east of Russell Road, and low density residential occupying the bulk of the



Environmental Features

Figure 3

Environmental Impact Study
Midhurst Doran Neighbourhoods 2 & 3

Legend

- Doran Neighbourhood Boundary
- OPA Application Area
- Additional Lands Not Part of this Application
- Willow Creek Tributary
- Springwater-Midhurst Settlement Area
- Surveyed Top of Bank
- Environmental Protection Area II
- Environmental Protection Area I
(Township of Springwater Significant Woodland)

Ortho Photo Base 2002

UTM Zone 17 N, NAD 83

0 125 250 500 Meters



1:11,000



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remaining developable lands (i.e., those unconstrained by environmental features. A total of 2,459 units are proposed among the three draft plans.

Beacon Environmental provided input to the project planning consultants (Gatzios Planning) and engineering consultants (SCS Consulting) throughout the preparation of the three draft plans of subdivision with respect to significant features to be avoided, and the appropriate locations of various infrastructure facilities (e.g., stormwater management ponds [SWMPs]) from a natural heritage perspective.

All existing farms and homes in the study area are presently serviced by private septic systems. A municipal servicing system is proposed for the proposed development of the subject property, which can be expanded in the future to accommodate the entire community.

6.1 Water Supply

The following information is taken from the Functional Servicing Report prepared in respect of this application by SCS Consulting Group Ltd. (2009), which should be consulted for further details.

A new water supply will be required to accommodate the projected growth in Neighbourhoods 2 and 3. Based on a number of previous hydrogeological studies it appears that there is a significant amount of groundwater available in the regional A3 aquifer to the east and northeast of Midhurst, as well as in the Anten Mills area, situated to the northwest of Midhurst. The location of a well or wells will be confirmed as part of a Class Environmental Assessment that is presently being undertaken by the Township of Springwater. This will entail a municipally-owned well site and water treatment plant, with a storage facility and a distribution system which conveys the water to individual units via a local watermain system utilizing the existing and future road network.

6.2 Wastewater Treatment

A Class Environmental Assessment is currently being undertaken by the Township of Springwater for the overall Midhurst Secondary Plan to confirm the final wastewater treatment scheme, plant type, location and sizing. The wastewater treatment plant for Neighbourhoods 2 and 3 is proposed to be a municipally-owned facility that will provide service for all residential and commercial/employment/administrative land uses included within the Secondary Plan area.

Wastewater flows from Neighbourhoods 2 and 3 are proposed to be collected via a series of gravity sewers and pumping stations. These flows would be pumped into the gravity sewer system within the MDDRI lands and then flow by gravity to a small (0.11 ha) pumping station located at the northwest corner of Pooles Road and Russell Road (Block 809). The wastewater flows from the study area would then be pumped west along Pooles Road/Findlay Mill Road and Snow Valley Road to the Midhurst Waste Water Treatment Plant (MWWTP) proposed in the northwest quadrant of Neighbourhood 1.

Treated effluent discharge to surface waters has been identified as the most feasible wastewater disposal option for Neighbourhoods 2 and 3. Willow Creek at Highway 26 was identified as the preferred alternative for effluent discharge due to increased stream flows and resultant greater

assimilative capacity (AECOM 2009b). The presence of the Minesing Swamp, immediately downstream of this location, will also buffer increased flow from the MWWTP discharge and would polish nutrients in the effluent during the summer growth season.

6.3 Stormwater Management

Stormwater runoff from the proposed development will be managed in each of the three subdivision plan areas. In the Bell-Rusdor-Coutts Block there will be a single SWM pond (Block 808) located northwest of the intersection of Pooles Road and Russell Road (see Gatzios Planning Dwg. DP2-1).

The Wright development area will have two smaller SWM ponds, one (Block 228) located in the northwest corner of the development and the other (Block 227) in the southeast (see Gatzios Planning Dwg. DP2-3).

The Coutts-Jones development area will have three SWM ponds; two located east of the development adjacent to environmental protection lands (Blocks 540 and 541) and one to the west of the development also adjacent to EP lands (Block 539; see Gatzios Dwg. DP2-2). The ponds will not only be designed to achieve the highest level of quality control (Level 1), but enhanced treatment in the form of subsurface gravel “soak away” pits to provide thermal mitigation (cooling to groundwater temperatures) prior to discharge to Willow Creek may also be implemented (see SCS Consulting Ltd. 2009 and AECOM Limited 2009a, 2009b).

For additional details regarding the proposed servicing and surface and groundwater management of Neighbourhoods 2 and 3 development the reader is referred to the companion *Functional Servicing Report* prepared by SCS Consulting Ltd. (2009), the surface water/aquatic resources report by AECOM Limited (2009a, 2009b) and the hydrogeological evaluation report prepared by Golder Associates Limited (2008).

7. Impact Assessment & Mitigation

7.1 Significant Portions of the Habitat of Endangered Butternut

A single Butternut tree was encountered within the MDDRI lands. The Butternut is found within the FOM2-2 community at the south end of the R. Coutts property and will be retained *in situ*. The tree is located well within the forest; at least 40 m from the edge of any proposed residential development (see Figure 2). The proposed development will not have an impact on the habitat of an endangered species and accordingly, no mitigation is required for this Butternut tree.

7.2 Significant Woodlands/Valleylands

Environmental Protection Areas I and II are located within the Neighbourhood 2 and 3 lands. The Environmental Protection areas include significant woodland and valleyland in the southeast quadrant (Coutts and Jones; see Gatzios Planning Dwg. DP2-2) and significant woodland along the western

and southern edges of the Bell and Coutts properties (see Gatzios Planning Dwg. DP2-1). These EP areas are shown as Open Space blocks on the draft plans or, in the case of the Willow Creek tributary/valley on the Jones Property, will be held in separate ownership and do not form part of the application. Where feasible, stormwater management ponds have been located adjacent to these environmental features in order to provide additional buffer to the lands.

The locations of these SWM ponds will provide substantial additional buffering to the valley system. All the SWM pond facilities should also be naturalized with the planting of native trees and shrubs. This will add to the overall availability of habitat within the SWM pond blocks Identified on the draft plans. The stormwater facilities are located such that they will reduce pedestrian access to the valley and will further separate the development from the EPA I woodland and EPA II valleyland systems, in turn creating wider buffers between the feature and adjacent residential development.

The mature deciduous forest that extends along the west side of the Bell and R. Coutts property, as well as that adjacent to the west side of the J. & G. Coutts property and south end of the Jones property are designated EPA I woodland in the Midhurst Secondary Plan and in the MDDRI OPA application, and shown as Open Space on Gatzios Planning Dwg. DP2-2). No intrusion by development into EPA I will occur and it will be fully retained and protected as Open Space within the plan of subdivision.

The greater of a 5 m buffer from the dripline of trees marking the edge of an EPA I or II area or 6 m from the top-of-bank will be established adjacent to low density residential units proposed in the study area. It is recommended that this buffer be planted with appropriate native edge species to provide additional protection.

The edges of the woodland/valleylands should be fenced (including adjacent to SWMP pond blocks, community parks and residential lots) to discourage people from accessing the EPA I and EPA II areas. This will also reduce, but not eliminate entirely, access for household pets (especially cats) that are known predators on ground-nesting birds. Fencing will also reduce the amount of yard waste that is disposed in the valley.

7.3 Tributary of Willow Creek

An unnamed headwater tributary to Willow Creek and its associated valley is located in the south-eastern portion of Neighbourhoods 2 and 3. This feature is regulated by NVCA, contains a meadow marsh wetland in its floodplain and provides fish habitat. The tributary and its floodplain will be contained within a separate property that is not part of this application and development will occur beyond a 6 m buffer measured from the staked top-of-bank of the valley. This surveyed top-of-bank line, as determined in the field with NVCA, is illustrated on Figure 3.

7.4 Loss of Habitat for Area-sensitive Grassland Birds

The proposed development will occur on existing agricultural areas. As a result of the rapid future urbanization of the Village of Midhurst, there is expected to be an overall reduction in the population of some grassland breeding birds that are associated with agricultural landscapes. Within the study area

two such species are Savannah Sparrow and Eastern Meadowlark, both of which are considered area-sensitive (see **Appendix 1**) but also common in southern Ontario.

Habitat for grassland nesting species such as these is difficult to preserve in areas experiencing urban growth. Several pairs of Savannah Sparrows are expected to persist as nesters within the Ontario Hydro easement, which will be placed in an Open Space designation and will continue to be maintained as an open, grassed (i.e., treeless) habitat.

The federal *Migratory Bird Treaty Act* protects the nests, eggs and young of most bird species from harm or destruction. As the breeding bird season in southern Ontario generally extends from mid-April through mid-July, the clearing of grassland field vegetation to accommodate the development should be completed outside of these dates. For any proposed clearing of vegetation within these dates, or where birds may be suspected of nesting outside of typical dates, an ecologist should undertake detailed nest searches immediately prior to site alteration to ensure that no active nests are present.

7.5 Summary

Natural heritage features to be retained and protected within the six properties that comprise the MDDRI lands are shown on the draft plans of subdivision (Figure 4) as Environmental Protection Blocks and coloured dark green. The outside limits of the features include a buffer, as described above and summarized in **Table 2** below:

Table 2. Buffers Proposed from Natural Heritage Features

Feature	Location on MDDRI Lands	Buffer and Additional Comments
Butternut	Located within the FOM 2-2	- Tree will be retained in situ and buffered by existing vegetation on slope adjacent to tableland - Situated 40 m from nearest proposed residential development
Significant Woodland and Valleyland (EPA I and EPA II)	- West portions of the Jones property - West side of J. & G. Coutts property - South portion of R. Coutts Property	- no new edges to be created - the greater of 6m from the top-of-bank or 5 m from the staked dripline - planted with native edge species - fenced adjacent to Environmental Protection Areas
Tributary to Willow Creek and Associated Valley	East side of Jones Property (to be retained by present owner and not part of this application; see Figure 3)	Entirely contained within an Environmental Protection Area II block (not part of this application)
Unevaluated wetland – (regulated) feature	MAM2-2/MAS2-1 in floodplain Willow Creek tributary	Feature plus 30 m is contained within EPA II

8. Conclusions

Based on the findings of this EIS and the other technical studies prepared as part of the draft plan applications, specifically the surface water study, hydrogeological assessment and stormwater management report, the following conclusions have been reached:

- The results of this site-specific EIS confirm the findings of the previous Natural Environment Evaluation completed by Beacon Environmental (2008) in support of the Official Plan Amendment application for the study area.
- All the significant natural heritage features and functions associated with the subject properties are identified as either EPA I or EPA II features in the Midhurst Secondary Plan.
- No development will occur within the EPA I and II woodlands and valleylands and these features will be buffered from adjacent development. The tableland portion of the site provides opportunities for the development of residential units with a range of uses.
- With the exception of one specimen of the nationally and provincially endangered Butternut, none of the plant or animal species known to occur within the study area is considered endangered, threatened or rare in Ontario. The Butternut will be retained *in situ* and is adequately buffered from the adjacent development by surrounding woodland habitat. Breeding habitat for the nationally threatened Western Chorus Frogs and two other frog species will be maintained in the floodplain of the Willow Creek tributary valley.
- The Willow Creek tributary and its associated floodplain will be retained in an Environmental Protection II designation and buffered from adjacent development with a 6 m setback from the top-of-bank.
- A 5 m buffer from tree dripline will be provided between EPA I or EPA II woodland features and the proposed adjacent development. This buffer is to be planted with native edge species and fencing will be erected adjacent to these EPA areas to inhibit intrusion.
- Given the foregoing, it is concluded that, with the provision of appropriate buffers and other mitigative measures, the proposed development of the MDDR lands within Neighbourhoods 2 and 3, can occur without adversely affecting the Willow Creek tributary corridor or adjacent EPA I and II features (woodlands/valleylands).

9. References

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Appendix 1

Breeding Birds Recorded in Midhurst MDDRI Lands, 2008

Appendix 1

Breeding Birds Recorded in Midhurst MDDRI Lands, 2008

		Status			Area-sensitive sources	Locations								
Common Name	Scientific Name	COSEWIC (national) ^a	COSSARO (provincial) ^a	Provincial breeding season SRANK ^b	Area-sensitive (OMNR) ^c	1	2	3	4	5	6	7	8	9
Wild Turkey*	<i>Meleagris gallopavo</i>					4*					1*			
Mourning Dove	<i>Zenaida macroura</i>					1								
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>						2							
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>							1			1			
Ruby-throated Hummingbird	<i>Archilochus colubris</i>						1				1			
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>				A			2						
Downy Woodpecker	<i>Picoides pubescens</i>							2	1				1	
Hairy Woodpecker	<i>Picoides villosus</i>				A								1	
Northern Flicker	<i>Colaptes auratus</i>							2						
Pileated Woodpecker	<i>Dryocopus pileatus</i>				A			1						
Eastern Wood-Pewee	<i>Contopus virens</i>							2					1	
Willow Flycatcher	<i>Empidonax traillii</i>						3							
Eastern Phoebe	<i>Sayornis phoebe</i>						1							
Great Crested Flycatcher	<i>Myiarchus crinitus</i>						1	1						
Eastern Kingbird	<i>Tyrannus tyrannus</i>					2	2			1	1			
Horned Lark	<i>Eremophila alpestris</i>					1								
Tree Swallow	<i>Tachycineta bicolor</i>						3				1			
Barn Swallow	<i>Hirundo rustica</i>					7*	3*							
Blue Jay	<i>Cyanocitta cristata</i>							1			1		1	
American Crow	<i>Corvus brachyrhynchos</i>							1	1		1	1	1	
Black-capped Chickadee	<i>Poecile atricapillus</i>						3	3	3		3	2	1	
Red-breasted Nuthatch	<i>Sitta canadensis</i>				A								1	
White-breasted Nuthatch	<i>Sitta carolinensis</i>				A			1					1	
House Wren	<i>Troglodytes aedon</i>						1	1						
Veery	<i>Catharus fuscescens</i>				A			5						

		Status			Area-sensitive sources	Locations								
Common Name	Scientific Name	COSEWIC (national) ^a	COSSARO (provincial) ^a	Provincial breeding season SRANK ^b	Area-sensitive (OMNR) ^c	1	2	3	4	5	6	7	8	9
Wood Thrush	<i>Hylocichla mustelina</i>							1						
American Robin	<i>Turdus migratorius</i>					2	3	2					1	1
Gray Catbird	<i>Dumetella carolinensis</i>						3							
Brown Thrasher	<i>Toxostoma rufum</i>						1							
Cedar Waxwing	<i>Bombycilla cedrorum</i>						3		1					
Red-eyed Vireo	<i>Vireo olivaceus</i>					1	2	10	1	1	1	6	4	
Nashville Warbler	<i>Vermivora ruficapilla</i>									2				1
Yellow Warbler	<i>Dendroica petechia</i>					1	4							
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>										2			
Black-throated Green Warbler	<i>Dendroica virens</i>				A			1						
Pine Warbler	<i>Dendroica pinus</i>				A			1				1		
Black-and-white Warbler	<i>Mniotilta varia</i>				A									1
American Redstart	<i>Setophaga ruticilla</i>				A			2				1		
Ovenbird	<i>Seiurus aurocapillus</i>				A			3					1	
Common Yellowthroat	<i>Geothlypis trichas</i>						2							
Scarlet Tanager	<i>Piranga olivacea</i>				A			2						
Northern Cardinal	<i>Cardinalis cardinalis</i>							2			1			
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>							1						
Indigo Bunting	<i>Passerina cyanea</i>					7		1	1	1	2	1	1	1
Chipping Sparrow	<i>Spizella passerina</i>						4	2			1		1	
Field Sparrow	<i>Spizella pusilla</i>						5		1		4			
Vesper Sparrow	<i>Pooecetes gramineus</i>					8								
Savannah Sparrow	<i>Passerculus sandwichensis</i>				A	4	2							
Song Sparrow	<i>Melospiza melodia</i>					8	4	1	2		3	1	1	1
Bobolink	<i>Dolichonyx oryzivorus</i>				A		1							
Red-winged Blackbird	<i>Agelaius phoeniceus</i>						11							
Eastern Meadowlark	<i>Sturnella magna</i>				A	1	2							
Common Grackle	<i>Quiscalus quiscula</i>						2							
Brown-headed Cowbird	<i>Molothrus ater</i>						3	1	1					
Baltimore Oriole	<i>Icterus galbula</i>					1	2							
American Goldfinch	<i>Carduelis tristis</i>					6	4	1		2	1		1	

		Status			Area-sensitive sources	Locations								
Common Name	Scientific Name	COSEWIC (national) ^a	COSSARO (provincial) ^a	Provincial breeding season SRANK ^b	Area-sensitive (OMNR ¹)	1	2	3	4	5	6	7	8	9
* Denotes number of individuals, not breeding pairs														
Field Work Conducted On: 10 June, 13 June and 26 June, 2008														
Location 1 - Agricultural fields and hedgerows														
Location 2 - Old fields and valley, SE corner														
Location 3 - Deciduous forest														
Location 4 - Open forest/thicket														
Location 5 - Hydro corridor														
Location 6 - Old fields along Pooles Rd														
Location 7 - Mixed forest on slope, inside study area														
Location 8 - Outside study area (adjacent)														
Location 9 - Small woodlot in SE corner														
Total Number of Species:		56												
Number of (provincial and national) Species at Risk:		0												
Number of S1 to S3 (provincially rare) Species:		0												
Number of Regionally Rare Species:		0												
Number of Area-sensitive Species:		15												

KEY

^a COSEWIC = Committee on the Status of Endangered Wildlife in Canada

COSSARO = Committee on the Status of Species at Risk in Ontario

END = Endangered, THR = Threatened, SC = Special Concern (formerly Vulnerable), NAR = Not at Risk

^b SRANK (from Natural Heritage Information Centre) shown for breeding status if: S1 (extremely rare), S2 (very rare), S3 (rare to uncommon), and SE (exotic, i.e. introduced)

T (tracked species) that are S4 or S5 are also noted. Occurrence data is actively gathered for tracked species by the NHIC. Species actively tracked generally have fewer than 100 recent occurrences in Ontario, or are highly ranked globally

SRANK not shown if: S4 (common), S5 (very common), SZB (breeding migrants or vagrants) and SR (reported as breeding, but no persuasive documentation)

^c Area-sensitive sources:

1 = Ontario Ministry of Natural Resources (OMNR). 2000. Significant Wildlife Habitat Technical Guide (Appendix G). 151 p plus appendices.

Appendix 2

Vascular Plants Recorded in Midhurst MDDRI Lands, 2008

Appendix 2

Vascular Plants Recorded in Midhurst MDDRI Lands, 2008

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Equisetum arvense</i>	Field Horsetail	G5	S5			N	EQUISETACEAE
<i>Equisetum hyemale</i>	Rough Horsetail	G5	S5			N	EQUISETACEAE
<i>Equisetum scirpoides</i>	Dwarf Scouring Rush	G5	S5			N	EQUISETACEAE
<i>Diphasiastrum digitatum</i>	Fan Club-moss	G5	S5			N	LYCOPODIACEAE
<i>Pteridium aquilinum</i>	Bracken Fern	G5	S5			N	DENNSTAEDTIACEAE
<i>Athyrium filix-femina</i> var. <i>angustum</i>	Lady Fern	G5T5	S5			N	DRYOPTERIDACEAE
<i>Cystopteris protrusa</i>	Southern Bladder Fern	G5	S2			Y	DRYOPTERIDACEAE
<i>Dryopteris carthusiana</i>	Spinulose Shield Fern	G5	S5			N	DRYOPTERIDACEAE
<i>Dryopteris clintoniana</i>	Clinton Woodfern	G5	S4			N	DRYOPTERIDACEAE
<i>Dryopteris intermedia</i>	Evergreen Woodfern	G5	S5			N	DRYOPTERIDACEAE
<i>Gymnocarpium dryopteris</i>	Oak Fern	G5	S5			N	DRYOPTERIDACEAE
<i>Onoclea sensibilis</i>	Sensitive Fern	G5	S5			N	DRYOPTERIDACEAE
<i>Picea glauca</i>	White Spruce	G5	S5			N	PINACEAE
<i>Picea pungens</i>	Blue Spruce	G5	SE1			N	PINACEAE
<i>Pinus resinosa</i>	Red Pine	G5	S5			N	PINACEAE
<i>Pinus strobus</i>	Eastern White Pine	G5	S5			N	PINACEAE
<i>Pinus sylvestris</i>	Scotch Pine	G?	SE5			N	PINACEAE
<i>Tsuga canadensis</i>	Eastern Hemlock	G5	S5			N	PINACEAE
<i>Typha angustifolia</i>	Narrow-leaved Cattail	G5	S5			N	TYPHACEAE
<i>Typha latifolia</i>	Broad-leaf Cattail	G5	S5			N	TYPHACEAE
<i>Agrostis gigantea</i>	Black Bentgrass	G4G5	SE5			N	POACEAE
<i>Bromus inermis</i> ssp. <i>inermis</i>		G5T?	SE5			N	POACEAE
<i>Dactylis glomerata</i>	Orchard Grass	G?	SE5			N	POACEAE
<i>Elymus repens</i>	Quack Grass	G5	SE5			N	POACEAE
<i>Lolium perenne</i> var. <i>perenne</i>	Perennial Ryegrass	G?T?	SE4			N	POACEAE
<i>Phalaris arundinacea</i>	Reed Canary Grass	G5	S5			N	POACEAE
<i>Phleum pratense</i>	Meadow Timothy	G?	SE5			N	POACEAE
<i>Poa compressa</i>	Canada Bluegrass	G?	S5			N	POACEAE
<i>Schizachne purpurascens</i>	Purple Oat	G5	S5			N	POACEAE
<i>Carex arctata</i>	Black Sedge	G5?	S5			N	CYPERACEAE
<i>Carex flava</i>	Yellow Sedge	G5	S5			N	CYPERACEAE
<i>Carex hystericina</i>	Porcupine Sedge	G5	S5			N	CYPERACEAE
<i>Carex rosea</i>	Rosy Sedge	G5	S5			N	CYPERACEAE
<i>Carex spicata</i>	A Sedge	G?	SE5			N	CYPERACEAE

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Carex vulpinoidea</i>	Fox Sedge	G5	S5			N	CYPERACEAE
<i>Schoenoplectus tabernaemontani</i>	Soft-stem Club-rush	G?	S5			N	CYPERACEAE
<i>Scirpus atrovirens</i>	Dark-green Bulrush	G5?	S5			N	CYPERACEAE
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	G5	S5			N	ARACEAE
<i>Juncus tenuis</i>	Path Rush	G5	S5			N	JUNCACEAE
<i>Allium tricoccum</i>	Small White Leek	G5	S5			N	LILIACEAE
<i>Maianthemum canadense</i>	Wild-lily-of-the-valley	G5	S5			N	LILIACEAE
<i>Maianthemum racemosum</i>	False Solomon's-Seal	G5	S5			N	LILIACEAE
<i>Maianthemum stellatum</i>	Starflower False Solomon's-seal	G5	S5			N	LILIACEAE
<i>Polygonatum pubescens</i>	Downy Solomon's-seal	G5	S5			N	LILIACEAE
<i>Streptopus roseus</i>	Rose Twisted-stalk	G5	S5			N	LILIACEAE
<i>Trillium grandiflorum</i>	White Trillium	G5	S5			N	LILIACEAE
<i>Smilax herbacea</i>	Smooth Herbaceous Greenbrier	G5	S4			N	SMILACACEAE
<i>Populus balsamifera</i>	Balsam Poplar	G5	S5			N	SALICACEAE
<i>Populus grandidentata</i>	Large-tooth Aspen	G5	S5			N	SALICACEAE
<i>Populus tremuloides</i>	Trembling Aspen	G5	S5			N	SALICACEAE
<i>Carya cordiformis</i>	Bitter-nut Hickory	G5	S5			N	JUGLANDACEAE
<i>Juglans cinerea</i>	Butternut	G3G4	S3?			Y	JUGLANDACEAE
<i>Betula papyrifera</i>	Paper Birch	G5	S5			N	BETULACEAE
<i>Ostrya virginiana</i>	Ironwood	G5	S5			N	BETULACEAE
<i>Fagus grandifolia</i>	American Beech	G5	S5			N	FAGACEAE
<i>Quercus rubra</i>	Northern Red Oak	G5	S5			N	FAGACEAE
<i>Ulmus americana</i>	American Elm	G5?	S5			N	ULMACEAE
<i>Boehmeria cylindrica</i>	False Nettle	G5	S5			N	URTICACEAE
<i>Rumex obtusifolius</i>	Bitter Dock	G?	SE5			N	POLYGONACEAE
<i>Chenopodium album</i> var. <i>album</i>		G5T?	SE5			N	CHENOPODIACEAE
<i>Silene vulgaris</i>	Bladder Campion	G?	SE5			N	CARYOPHYLLACEAE
<i>Actaea pachypoda</i>	White Baneberry	G5	S5			N	RANUNCULACEAE
<i>Anemone virginiana</i>	Virginia Anemone	G5	S5			N	RANUNCULACEAE
<i>Aquilegia canadensis</i>	Wild Columbine	G5	S5			N	RANUNCULACEAE
<i>Caltha palustris</i>	Marsh Marigold	G5	S5			N	RANUNCULACEAE
<i>Ranunculus acris</i>	Tall Butter-cup	G5	SE5			N	RANUNCULACEAE
<i>Caulophyllum thalictroides</i>	Blue Cohosh	G4G5	S5			N	BERBERIDACEAE
<i>Podophyllum peltatum</i>	May Apple	G5	S5			N	BERBERIDACEAE
<i>Alliaria petiolata</i>	Garlic Mustard	G?	SE5			N	BRASSICACEAE
<i>Lepidium campestre</i>	Field Pepper-grass	G?	SE5			N	BRASSICACEAE
<i>Ribes cynosbati</i>	Prickly Gooseberry	G5	S5			N	GROSSULARIACEAE
<i>Fragaria vesca</i>	Woodland Strawberry	G5	S5			N	ROSACEAE

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Fragaria virginiana</i>	Virginia Strawberry	G5	S5			N	ROSACEAE
<i>Geum aleppicum</i>	Yellow Avens	G5	S5			N	ROSACEAE
<i>Malus pumila</i>	Common Apple	G5	SE5			N	ROSACEAE
<i>Potentilla recta</i>	Rough-fruited Cinquefoil	G?	SE5			N	ROSACEAE
<i>Prunus pensylvanica</i>	Pin Cherry	G5	S5			N	ROSACEAE
<i>Prunus serotina</i>	Wild Black Cherry	G5	S5			N	ROSACEAE
<i>Prunus virginiana</i>	Choke Cherry	G5	S5			N	ROSACEAE
<i>Rubus allegheniensis</i>	Common Blackberry	G5	S5			N	ROSACEAE
<i>Rubus idaeus ssp. idaeus</i>	Common Red Raspberry	G5T5	SE1			N	ROSACEAE
<i>Rubus occidentalis</i>	Black Raspberry	G5	S5			N	ROSACEAE
<i>Rubus odoratus</i>	Purple Flowering Raspberry	G5	S5			N	ROSACEAE
<i>Amphicarpaea bracteata</i>	American Hog-peanut	G5	S5			N	FABACEAE
<i>Coronilla varia</i>	Common Crown-vetch	G?	SE5			N	FABACEAE
<i>Desmodium canadense</i>	Showy Tick-trefoil	G5	S4			N	FABACEAE
<i>Desmodium glutinosum</i>	Large Tick-trefoil	G5	S4			N	FABACEAE
<i>Lotus corniculatus</i>	Birds-foot Trefoil	G?	SE5			N	FABACEAE
<i>Medicago lupulina</i>	Black Medic	G?	SE5			N	FABACEAE
<i>Medicago sativa ssp. sativa</i>		G?T?	SE5			N	FABACEAE
<i>Melilotus alba</i>	White Sweet Clover	G5	SE5			N	FABACEAE
<i>Robinia pseudo-acacia</i>	Black Locust	G5	SE5			N	FABACEAE
<i>Trifolium pratense</i>	Red Clover	G?	SE5			N	FABACEAE
<i>Trifolium repens</i>	White Clover	G?	SE5			N	FABACEAE
<i>Vicia cracca</i>	Tufted Vetch	G?	SE5			N	FABACEAE
<i>Oxalis corniculata</i>	Creeping Woodsorrel	G?	SE1			N	OXALIDACEAE
<i>Geranium robertianum</i>	Herb-robert	G5	SE5			N	GERANIACEAE
<i>Rhus radicans ssp. negundo</i>	Poison Ivy	G5T5	S5			N	ANACARDIACEAE
<i>Rhus typhina</i>	Staghorn Sumac	G5	S5			N	ANACARDIACEAE
<i>Acer rubrum</i>	Red Maple	G5	S5			N	ACERACEAE
<i>Acer saccharum ssp. saccharum</i>	Sugar Maple	G5T5	S5			N	ACERACEAE
<i>Parthenocissus vitacea</i>	Virginia Creeper	G5	S5			N	VITACEAE
<i>Vitis riparia</i>	Riverbank Grape	G5	S5			N	VITACEAE
<i>Tilia americana</i>	American Basswood	G5	S5			N	TILIACEAE
<i>Malva neglecta</i>	Dwarf Cheeseweed	G?	SE5			N	MALVACEAE
<i>Hypericum perforatum</i>	Common St. John's-wort	G?	SE5			N	CLUSIACEAE
<i>Viola pubescens var. pubescens</i>		G5T5	S5			N	VIOLACEAE
<i>Circaea lutetiana</i>	Southern Broadleaf Enchanter's Nightshade	G5	S5			N	ONAGRACEAE
<i>Aralia nudicaulis</i>	Wild Sarsaparilla	G5	S5			N	ARALIACEAE

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Daucus carota</i>	Queen Anne's Lace	G?	SE5			N	APIACEAE
<i>Cornus alternifolia</i>	Alternate-leaf Dogwood	G5	S5			N	CORNACEAE
<i>Monotropa uniflora</i>	Indian-pipe	G5	S5			N	MONOTROPACEAE
<i>Trientalis borealis</i>	Northern Starflower	G5	S5			N	PRIMULACEAE
<i>Fraxinus americana</i>	White Ash	G5	S5			N	OLEACEAE
<i>Apocynum androsaemifolium</i>	Spreading Dogbane	G5	S5			N	APOCYNACEAE
<i>Asclepias syriaca</i>	Common Milkweed	G5	S5			N	ASCLEPIADACEAE
<i>Convolvulus arvensis</i>	Field Bindweed	G?	SE5			N	CONVOLVULACEAE
<i>Echium vulgare</i>	Common Viper's-bugloss	G?	SE5			N	BORAGINACEAE
<i>Clinopodium vulgare</i>	Field Basil	G5	S5			N	LAMIACEAE
<i>Leonurus cardiaca</i>	Common Mother-wort	G?	SE5			N	LAMIACEAE
<i>Lycopus uniflorus</i>	Northern Bugleweed	G5	S5			N	LAMIACEAE
<i>Mentha arvensis</i>	Corn Mint	G5	S5			N	LAMIACEAE
<i>Monarda fistulosa</i>	Wild Bergamot	G5	S5			N	LAMIACEAE
<i>Verbascum thapsus</i>	Common Mullein	G?	SE5			N	SCROPHULARIACEAE
<i>Veronica officinalis</i>	Gypsy-weed	G5	SE5			N	SCROPHULARIACEAE
<i>Veronica serpyllifolia</i> ssp. <i>serpyllifolia</i>	Thyme-leaved Speedwell	G5T?	SE5			N	SCROPHULARIACEAE
<i>Epifagus virginiana</i>	Beechdrops	G5	S5			N	OROBANCHACEAE
<i>Plantago lanceolata</i>	English Plantain	G5	SE5			N	PLANTAGINACEAE
<i>Plantago major</i>	Common Plantain	G5	SE5			N	PLANTAGINACEAE
<i>Galium odoratum</i>	Sweet Bedstraw	G?	SE1			N	RUBIACEAE
<i>Lonicera tatarica</i>	Tartarian Honeysuckle	G?	SE5			N	CAPRIFOLIACEAE
<i>Viburnum acerifolium</i>	Maple-leaf Viburnum	G5	S5			N	CAPRIFOLIACEAE
<i>Viburnum trilobum</i>	Highbush Cranberry	G5T5	S5			N	CAPRIFOLIACEAE
<i>Achillea millefolium</i> ssp. <i>millefolium</i>	Common Yarrow	G5T?	SE			N	ASTERACEAE
<i>Ambrosia artemisiifolia</i>	Annual Ragweed	G5	S5			N	ASTERACEAE
<i>Arctium minus</i> ssp. <i>minus</i>	Common Burdock	G?T?	SE5			N	ASTERACEAE
<i>Chrysanthemum leucanthemum</i>	Oxeye Daisy	G?	SE5			N	ASTERACEAE
<i>Cichorium intybus</i>	Chicory	G?	SE5			N	ASTERACEAE
<i>Erigeron hyssopifolius</i>	Daisy Fleabane	G5	S5			N	ASTERACEAE
<i>Erigeron philadelphicus</i>	Philadelphia Fleabane	G5	S5			N	ASTERACEAE
<i>Eupatorium maculatum</i> ssp. <i>maculatum</i>	Spotted Joe-pye Weed	G5T?	S5			N	ASTERACEAE
<i>Eupatorium perfoliatum</i>	Common Boneset	G5	S5			N	ASTERACEAE
<i>Hieracium pilosella</i>	Mouseear	G?	SE5			N	ASTERACEAE
<i>Hieracium praealtum</i>	King Devil	G?	SE1			N	ASTERACEAE
<i>Prenanthes altissima</i>	Tall Rattlesnake-root	G5?	S5			N	ASTERACEAE
<i>Rudbeckia hirta</i>	Black-eyed Susan	G5	S5			N	ASTERACEAE

Scientific Name	English Name	Grank	Srank	COSEWIC	COSSARO	Track	Family
<i>Solidago altissima</i>	Tall Goldenrod	G5T5	S5			N	ASTERACEAE
<i>Solidago flexicaulis</i>	Zig Zag Goldenrod	G5	S5			N	ASTERACEAE
<i>Symphyotrichum cordifolium</i>	Heart-leaf Aster	G5	S5			N	ASTERACEAE
<i>Symphyotrichum lanceolatum</i> ssp. <i>lanceolatum</i>	Panicled Aster	G5T?	S5			N	ASTERACEAE
<i>Symphyotrichum novae-angliae</i>	New England Aster	G5	S5			N	ASTERACEAE
<i>Symphyotrichum puniceum</i>	Swamp Aster	G5	S5			N	ASTERACEAE
<i>Taraxacum officinale</i>	Brown-seed Dandelion	G5	SE5			N	ASTERACEAE
<i>Tragopogon dubius</i>	Meadow Goat's-beard	G?	SE5			N	ASTERACEAE
<i>Tussilago farfara</i>	Colt's Foot	G?	SE5			N	ASTERACEAE
<i>Sambucus racemosa</i> ssp. <i>pubens</i>	Red Elderberry						

KEY

COSEWIC = Committee on the Status of Endangered Wildlife in Canada

COSSARO = Committee on the Status of Species at Risk in Ontario

END = Endangered, THR = Threatened, SC = Special Concern (formerly Vulnerable), NAR = Not at Risk

SRANK (from Natural Heritage Information Centre) shown for breeding status: S1 (extremely rare), S2 (very rare), S3 (rare to uncommon), S4 (common), S5 (very common), and SE (exotic, i.e. introduced)

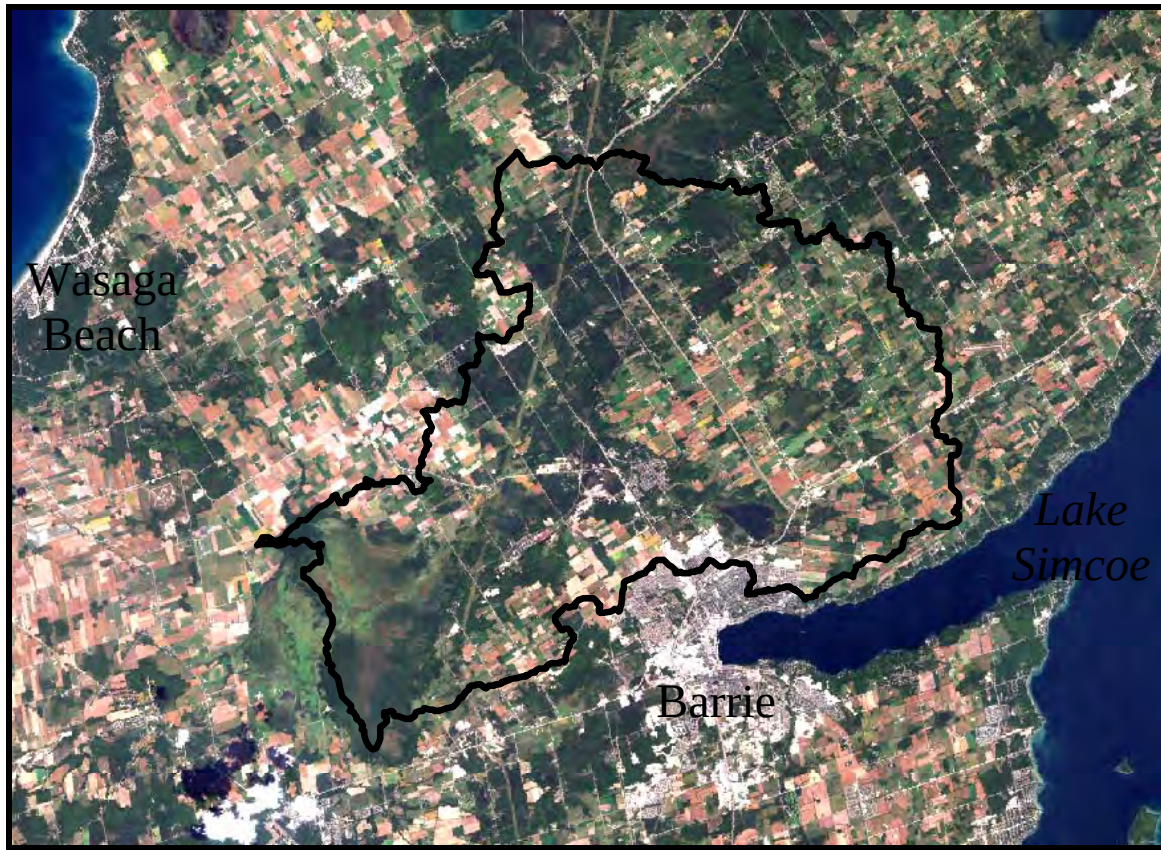
Tracked species that are S4 or S5 are also noted. Occurrence data are actively gathered for tracked species by the NHIC.

Species actively tracked generally have fewer than 100 recent occurrences in Ontario, or are highly ranked globally

Appendix C

- **Willow Creek Subwatershed Plan**
- **Soil Studies for the three neighborhoods**

WILLOW CREEK SUBWATERSHED PLAN



December 2001



Nottawasaga Valley
Conservation Authority

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APPENDICES

The updated appendices are posted on NVCA's website at www.nvca.on.ca along with the Subwatershed Plan.

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Appendix B	Stream Health Report
Appendix C	Official Plan Land Use Designations
Appendix D	Hydrology
Appendix E	Water Balance Calculations (Existing and Future Conditions)

Updates: Please note that updates to both the appendices and the subwatershed plan itself will be posted on our website.

Willow Creek Subwatershed Plan

**December 2001
(2001-2020)**

**Prepared by the Nottawasaga Valley Conservation Authority
for the
City of Barrie
Oro-Medonte Township
Springwater Township**

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STEERING COMMITTEE

Rick Newlove, Bill Gilbert – City of Barrie
Andria Leigh, Keith Mathieson – Oro-Medonte Township
Julian Tofts, Todd Stocks, Mary M. Rose – Springwater Township
Gail White – Simcoe County
Marilyn Bidgood, Dan Parle – OMAFRA
Karen Jones, Bill Armstrong – MOE

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1.0 INTRODUCTION

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This section of the plan outlines the specific water related issues associated with Willow Creek, the goal and objectives that were developed to address these issues, the study approach and background information on the subwatershed.

1.1 Subwatershed Planning, an Ecosystems Approach

Ontario residents are very aware of the significance of our water resources and the importance of providing them with adequate protection. Public concerns have been well documented across the province relating to the cumulative impacts of land uses and development on the quality and quantity of both our surface and ground waters.

Some of these impacts include significant reductions in base flow (particularly during recent summer droughts), and contamination of both surface and ground water. It must be emphasized that these impacts are usually not limited to the municipality in which they occur, but also affect adjacent and downstream municipalities. For example, disturbing a stream's headwater wetlands and discharge areas has the potential for significant impacts on downstream municipalities through reduced the streams base flow, water quality impairment, increased flooding, and erosion.

One of the most effective ways of dealing with these cross-boundary issues is to study the entire area that may be affected by the land use or development impacts. In most cases the water management issues can be addressed within a subwatershed. This approach assures the assessment of all impacts on the entire ecological unit (the subwatershed) and it's functions, rather than simply focusing on the isolated impacts on a specific feature within a municipal boundary.

Support for a coordinated watershed planning and ecosystems approach comes from the Provincial Policy Statement which indicates that *"a coordinated approach should be achieved when dealing with issues which cross municipal boundaries including, ... ecosystems and watershed related issues; and shoreline and riverine hazards"*¹

In response, a growing number of municipalities and regulatory agencies have implemented watershed and subwatershed management plans as a means of addressing these cross-boundary issues. In order to provide the broad watershed context, the Nottawasaga Valley Conservation Authority (NVCA) developed the Nottawasaga Valley Watershed Management Plan dealing with water management issues across the entire Nottawasaga River Valley.

The goal of the Watershed Plan is the *"conservation of natural resources within our watershed in a co-operative, integrated manner in which human needs are met in*

¹ "Provincial Policy Statement". Government of Ontario, Queen's Printer 1997, Section 1.1.1.e, Page 2

*balance with the need to sustain the natural environment”.*²

One of the recommendations from the Watershed Plan was the preparation of subwatershed studies for the “high priority subwatersheds”. Criteria such as the significance of the ecological features, impacts from flooding, and stresses due to land use practices, determined the priority.

Black Ash Creek, which passes through the Town of Collingwood was the first subwatershed study undertaken and addressed significant flooding issues and natural heritage identification.

The municipalities within the Willow Creek Subwatershed (City of Barrie, Oro-Medonte and Springwater Townships) recognized that working together through a subwatershed study would address many of the land use and water management issues associated with the Willow Creek. They formed a partnership with NVCA (the coordinating agency) and the Ontario Government to carry out this study. This study will act as valuable technical input to municipal planning documents such as official plans, secondary plans and subdivision applications.

The plan provides water management recommendations to municipalities, NVCA, and other stakeholders to assist in their decision-making responsibilities. It provides a tool to assist in striking the balance between the demands for growth and the need to ensure, over the long term, a safe, clean, and self-sustaining ecosystem

The plan will provide water management direction in the following areas:

- The integration and co-ordination of water resource management (e.g. surface and ground water quality)
- The identification and protection, of the natural heritage system, groundwater recharge/discharge areas, as well as the identification of restoration opportunities
- The protection of human life and property from water-related hazards, such as flooding, erosion and sedimentation

Water quality of investigations within Willow and Matheson Creek as well Little Lake are significant components of the plan.

The development of a water balance provides a context for understanding ground and surface water quality and quantity issues. It guides the development of the water management standards and criteria necessary to sustain the aquatic ecosystem. If required in the future, it also provides the scientific basis for the development of a water budget and allocation framework to ensure sustainability of water usage by all sectors of the community.

In the past, stormwater management (SWM) facilities have been constructed to limit adverse environmental impacts of urban runoff through the land development process on a

² Nottawasaga Valley Watershed Management Plan 1996-2015, page 19

“case-by-case” basis. This isolated approach is not the most effective or efficient way of managing stormwater. The plan promotes the effective integration of storm water management practices on a subwatershed basis (including facilities within new development areas and those already in operation).

The identification, protection, and restoration of Willow Creek’s Natural Heritage System are also very important issues addressed in this plan. The natural heritage system integrates the existing “green lands” systems of the municipalities and the County and adds a more detailed inventory of the significant natural features and areas using criteria developed by the Province of Ontario.

1.2 Subwatershed Issues

The issues associated with Willow Creek are those of a rural subwatershed with the additional pressures of a rapidly growing population in the City of Barrie and Simcoe County.

A list of subwatershed management issues was derived from previous studies, staff experiences, and consultation with the municipalities.

- There is a need to better understand and protect surface and groundwater
- There is a need to better understand the subwatersheds hydrologic cycle as a basis for managing water and help ensure the sustainability of water usage
- Natural heritage features and functions must be identified, protected, and where possible restored
- Best management practices for land use and stormwater needs to be apply across the subwatershed
- Flood and erosion damage must prevent

The subwatershed plan focuses on resolving these issues in a clear, concise and easily understood manner.

1.3 Goal and Objectives

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Subwatershed Plan Goal:

The goal is: *“To conserve Willow Creek’s natural resources in a cooperative, integrated manner in which human needs are met in balance with the need to sustain and where possible restore the health of the natural environment.”*

Subwatershed Plan Objectives:

These objectives are required to implement our goal and address the Willow Creek issues listed above:

Aquatic:

- ❖ The identification and assessment of aquatic resources in the subwatershed such that protection of water quality and quantity can be afforded through an informed planning process and restoration efforts can be targeted at impaired areas.
- ❖ The co-ordination of water resource management within the subwatershed including the development of water and nutrient budgets, stormwater management, erosion and flood control
- ❖ The enhancement of water conservation practices

Terrestrial:

- ❖ The identification and protection of the natural heritage system
- ❖ The identification of opportunities for rehabilitation and restoration of natural heritage features (including stream corridors, wetlands and forest habitats)

1.4 Study Approach

The approach that was taken to develop this plan was to focus on identifying and resolving the specific water related issues associated with the Willow Creek Subwatershed. The goal and objectives were established to address these issues. The plan and implementation strategy was then developed to achieve these objectives and address the issues.

The phased approach used to create the plan is described below.

Phase I Background Review and Mapping: This phase developed the Terms of Reference, identified the subwatershed issues, goal and objectives. It gathered information on the significant natural heritage features that characterize the area. This included developing the technical water resources background information, initial data collection and model development.

Phase II Evaluation: The study refined the phase 1 models providing the basis for a water balance, water quality and quantity assessments. It identified management measures to mitigate the potential impacts. NVCA staff field checked and confirmed the Natural Heritage System mapping.

Phase III Plan Preparation: This phase developed the subwatershed plan including the implementation strategy, and suggested monitoring requirements.

Compatibility with the Environmental Assessment (EA) Process:

The process through which this plan was developed, is compatible with the “environmental assessment process” set out in the document, *Municipal Class Environmental Assessment* (Municipal Engineers Association, June 2000). This Class Environmental Assessment

process represents an approved planning procedure for municipal projects. It ensures that social, economic and environmental factors are considered in the planning and design of new infrastructure (including stormwater management facilities).

Planning horizon:

The studies planning horizon or context is twenty years (2001-2020), however due to the rapidly changing planning and development landscape, it is recommended that the plan be reviewed after five years to determine its effectiveness.

1.5 Public Consultation

The planning process for the subwatershed plan provided a variety of opportunities for public and municipal input, including:

- A review of issues and concerns raised in earlier processes including the Nottawasaga Valley Watershed Management Plan, municipal planning documents and special event forums such as those on the Oro Moraine etc.
- Establishment of a Steering Committee, which was made up of representatives from the City of Barrie, Oro-Medonte and Springwater Townships, MOE, OMAFRA, Simcoe County and NVCA. MNR was also involved through circulation of minutes and documents. The committee acted as a very important conduit for public and staff comments and input. Interest groups and concerned citizens provided input and comments through steering committee members, staff and at related information sessions such as those for the Oro Moraine
- Consultation with the municipal councils
- A public open house was held November 22, 2001 at the Simcoe County Administration Building attracting between 25-30 people. Valuable comments and input was obtained from this meeting and incorporated into this final plan.

1.6 Background Information

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1.6.1 Drainage

Willow Creek subwatershed is approximately 339 sq. km located in the northeast corner of the Nottawasaga River Watershed (**Map 1**). The total length of Willow Creek is 45 km. Along this length, the stream channel drops in elevation some 152 m from the headwaters to its confluence with the Nottawasaga River. Matheson Creek is the largest tributary in terms of catchment area and baseflow contribution.

This subwatershed is important to the Nottawasaga River's aquatic ecosystem because of its size, the amount of discharge, and the coldwater habitats (primarily Matheson Creek). Much of the headwaters of Willow and Matheson Creeks are located on the Oro Moraine, a very important recharge area and headwater of several other streams. A portion of the southern shoreline of Little Lake is within the City of Barrie. The lake is very important to both the City of Barrie and Springwater Township for recreation and aesthetics.

Willow Creek drains in a southwesterly direction into Little Lake, through the village of Midhurst and eventually into Minesing Swamp (a 6000 ha, internationally significant wetland), where it joins the Nottawasaga River. The study area also includes the Swaley, Downey and Giffen drains shown on Map 1. Although they are not directly connected to the Willow Creek, they were included for historical reasons. These drains may have been connected to Willow Creek at one time, and the waters flow from Willow Creek into these drains to the Nottawasaga River during significant storm events.

1.6.2 Physiography

The identification of landforms within the Willow Creek Subwatershed (**Map 2**) helps us understand how the various soil types were formed and how drainage characteristics vary over the area. Knowing the location of course, un-compacted soils identifies potential groundwater recharge or discharge areas.

The Willow Creek subwatershed is divided into two landform types: the Simcoe Uplands, which covers approximately two-thirds of the area and the Simcoe Lowlands covering the rest. Both were formed during the late stages of continental glaciation and the postglacial lacustrine activities of Lake Algonquin.

The uplands are made up of Drumlinized Till Plains and the Oro Moraine (sometimes known as the Bass Lake Kame Moraine), both have glacial and glaciofluvial origins. These uplands and ridges stand from 60 m to 120 m above the valley floor. They were islands within glacial Lake Algonquin after the last ice age retreat. The old Algonquin shoreline cliffs and beaches are found along the sides of these uplands. The sands and gravel were likely laid down in the Oro Moraine, with most of the fine sand and silt being carried away by a continuous flow of water. The Oro Moraine is a very important physiographic and natural feature. It is a major groundwater recharge area and the headwaters for Matheson Creek and to a lesser extent, the Willow Creek Branch.

The Lowlands are made up of sand and clay plains with the sand along the creeks and the clay in the flats north and west of Minesing. Depressions on the lowlands are filled with organic soils such as those found in Minesing Swamp.

1.6.3 Soils

The soils that were derived from the weathering process of the various materials deposited after glaciation are quite varied (**Map 3**). They include well-drained sands and sandy loams of the Simcoe Uplands (Sargent, Bondhead, Tioga, Vasey, Dundonald, and Bookton series). Making up almost three quarters of the study area, these course soils permit infiltration and recharge local aquifers, which in turn provide important baseflow to the many streams in the area.

The imperfectly and poorly drained loams, sandy loams, silty and marly clay, clay loams and muck soils of the Simcoe Lowlands (Guerin, Lyons, Granby, Simcoe-Berrien, Schomberg, Smithfield, and Minesing series) make up the other twenty-five percent.

Some of these soils such as Schomberg and Smithfield Silty Clays are very productive agricultural soils.

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1.6.4 Land Use Summary

Land use within the Willow Creek Subwatershed is primarily agricultural and rural in nature (approximately 90%). Agricultural operations are generally mixed farming, dairy, beef and cash crops. Hay, grain, corn, soybeans and some potatoes are typical crops with pasture and grazing being less common.

The largest built-up areas of the subwatershed are within the City of Barrie, the settlement area of Midhurst as well as along the Highway 11 corridor. Most new development will be through secondary plans, within the City of Barrie, Snow Valley, Midhurst, Centre Vespra, and Craighurst. The municipalities may establish some additional development through rural residential developments or adult lifestyle communities.

Aggregate extraction is also a significant existing land use within the study area because of the quality of aggregate resources found in the Simcoe Uplands. Aggregate extraction applications to expand and /or develop new operations are being processed for two locations adjacent to Highway 400.

1.6.5 Cultural Heritage

Simcoe County has a rich, well documented First Nations and European settlement history. Willow Creek Depot (now called Fort Willow), located at the west end of the subwatershed (**Map 1**), makes a significant contribution to that history. It was located on elevated ground overlooking Minesing Swamp. The site (also simply called “Nottawasaga” in early military records) is closely linked to the Nine Mile Portage from Kempenfelt Bay to Willow Creek, as it was the northwest terminus of the portage. The First Nations initially developed this portage as a travel and trade route. This route was an important link between Lake Ontario and the Upper Great Lakes. French explorers, missionaries and later fur traders used it.

During the war of 1812 the portage was of vital significance in moving large quantities of military supplies north to Sault Ste. Marie and Fort William (Thunder Bay). However, these supplies often accumulated at the Willow Creek landing because only small loads could be transported on the shallow waters of the Creek, especially during the summer season. As a result a depot was constructed to store the supplies about a mile south of the landing on the nearest high land and was called Willow Creek Depot. The Depot and Nine Mile Portage played an important role in Canadian history in the early 1800's as a transportation route, but their use declined in the mid-1800s with the construction of roads and the railway.

Currently, the Fort Willow Improvement Group (a volunteer organization) is dedicated to its restoration and preservation. Their historical displays and self-guided tours are important local attractions

2.0 ECOSYSTEM MANAGEMENT

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This section describes the subwatershed's ecosystems. It identifies the significant natural heritage features, examines aquatic ecosystem (water quality and fisheries resources) and makes recommendations to help ensure their protection.

The natural heritage system is made up of interconnected terrestrial (land based) and aquatic (water based) ecosystems. Although terrestrial and aquatic components are linked, discussion of the two ecosystems separately is useful because of the requirements for land use planning in the province as reflected in of the "Provincial Policy Statement" (PPS).

It has long been recognized that our natural heritage areas are a very important, shared, public and private trust. Landowners are stewards of their land and along with municipalities, manage the land use of these natural heritage areas independently and through plans, agreements and partnerships.

Our natural heritage areas are valued for their long-term contribution to the environmental quality of the provincial, regional and local ecosystems. They are also very important to the economic and social fabric, and in many instances help to define the character of an area. For example, the Oro Moraine and Minesing Swamp play a major role in defining the natural landscape of the Willow Creek subwatershed, as well as contributing to its social, cultural and economic fabric.

2.1 Natural Heritage Ecosystem

Natural Heritage Ecosystem is an integrated network of interconnected natural features and their functions including aquatic and terrestrial habitats such as woodlands, watercourses, wetlands etc. Also considered part of the system are the natural corridors and valley lands that link these features together, enabling exchange of biota, energy and other components of the ecosystem.

The natural heritage system was identified using the province's criteria, guidelines and policies as outlined in the *Provincial Policy Statement (PPS)* and the *Natural Heritage Reference Manual*. This approach provides the municipalities with the most useful information that can be directly inserted into their land use planning process and is supported by the PPS.

While the individual components that make up the natural heritage system have been documented, the entire interconnected system has been identified and mapped as a single entity (except for wetlands which have the most restrictive policies requirements). In many cases it is difficult to partition the natural heritage system into its individual components (such as wildlife habitats, woodlands and valley lands). From a planning perspective, there is no compelling reason to do so, as they are all interconnected and

require the same level of protection under section 2.3.1 b of the Provincial Policy Statement (PPS).³

This “systems” approach to natural heritage identification has been promoted for some time. For example, Riley and Mohr (1994), state in The Natural Heritage of Southern Ontario’s settled Landscapes: “Integrated networks of conservation lands and water are the appropriate and practical method to define the natural landscape we wish to conserve”.⁴

The Ministry of Natural Resource’s (MNR) Natural Heritage Reference Manual states that “The use of a natural heritage system approach facilitates the co-ordination of ecosystem-based and watershed based issues across planning authority boundaries as recognized in section 1.1.1(e) of the PPS, by recognizing important linkages (e.g. features such as valleylands and ecological functions such as hydrological connectivity) that extend beyond planning area boundaries”⁵

This is also the approach used by Simcoe County, Oro-Medonte and Springwater Townships in identifying their natural heritage systems for their Official Plans.

This approach for the Willow Creek Subwatershed Plan permits the identification, coordination and integration of the natural heritage system, across the three participating municipalities and in greater detail than does the County’s Greenland study.

2.1.1 Natural Heritage System Identification

The Willow Creek Subwatershed Plan illustrates the natural heritage system on **Map 4**.

While the PPS sets the minimum protection standards through its policies, there is nothing in the policy statement that is intended to prevent municipalities from going beyond those minimum standards. The municipalities within the Willow Creek Subwatershed have in some instances already gone beyond the PPS in identifying their Natural heritage system. Springwater Township for example, protects all wetlands from development not just “provincially significant” wetlands.

The Ministry of Natural Resources defines what is “significant” for wetlands and Areas of Natural and Scientific Interest using established evaluation procedures. For the rest of the natural heritage system, “significant” is defined by the PPS as “ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of and identifiable geographic area or natural heritage system”.⁶

3 “Provincial Policy Statement”. Government of Ontario, Queen’s Printer 1997, Page 8

4 “The Natural Heritage of Southern Ontario’s Settled Landscapes”, Riley and Mohr, OMNR 1994, page 32

5 “Natural Heritage Reference Manual,” OMNR. June 1999, section 3.1, page 35

6 “Provincial Policy Statement”. Government of Ontario, Queen’s Printer 1997, Page 18

We started the process of mapping significant features of the Willow Creek Subwatershed by integrating all existing natural heritage information such as the “Greenlands” studies from Simcoe County, Oro-Medonte and Springwater Townships and the City of Barrie’s planning documents (**Map 4**).

Supplemental information such as the forest information from OBM mapping, and digital colour infrared air photos (1998) interpretation was used along with field investigations in the spring and summer of 2001, to identify our “proposed additions to the natural heritage system”.

In order to clearly identify the most sensitive areas, we identified the “no development or site alteration” areas. They are the wetlands and flood plain lands that are subject to the most restrictive designations within municipal official plans. We added the “class 4-7” wetlands in Oro-Medonte Township. The other municipalities already placed these wetlands in their most restrictive designation.

The criteria for identifying our “proposed additions to the natural heritage system” are those suggested by the province in MNR’s Natural Heritage Reference Manual and are outlined in **Appendix A**.

The Willow Creek Natural Heritage System includes the following “significant” natural features and areas:

- Areas of Natural and Scientific Interest (ANSIs) – These are areas of land and water containing natural landscapes or features that have been identified as having life science or earth science values related to protection, scientific study or education. The provincially significant life sciences ANSI of Minesing Swamp as well as part of the regionally significant Copeland Forest Resource Management Area and a small portion of Martin Farm South are included within the natural heritage system.
- Fish Habitats – These areas are the spawning grounds, nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes. The Willow Creek and Little Lake have been identified as primarily a warmwater fishery, with some cool water habitat west of Midhurst supporting brown trout. Matheson Creek provides cold and cool water habitats. To protect this fishery, a **minimum of 30 metres** on either side of the stream and its tributaries has been identified as part of the natural heritage system. This area of self-sustaining natural vegetation is particularly important in landscapes where the stream is not already part of a wetland, forest, or larger forested valley lands.
- Groundwater Recharge/Discharge Areas – Known sensitive ground water recharge and discharge areas were included in the natural heritage system since they maintain surface and groundwater quality and quantity. Many of these areas

are associated with headwater wetlands and stream corridors. As additional groundwater studies are undertaken, any new information concerning sensitive groundwater areas will be incorporated into this plan.

- Significant Portions of the Habitat of Endangered and Threatened Species – Endangered species “means any native species, as listed in the regulations under the, that is at risk of extinction throughout all or a significant portion of its Ontario range if the limiting factors are not reversed”.⁷ It is our understanding that American Ginseng (listed as an endangered species by the National Committee on the Status of Endangered Wildlife in Canada) occurs in the Midhurst /Snow Valley area.

“Threatened species means any native species that is at risk of becoming endangered throughout all or a significant portion of its Ontario range if the limiting factors are not reversed”⁸ The Eastern Massasauga Rattlesnake, sited in Minesing Swamp, is the only threatened species we are aware of in the subwatershed.

“Vulnerable” species are indigenous species of fauna and flora that are particularly at risk because of low or declining numbers and need to be closely monitored. Three vulnerable species (Cerulean Warbler and Spotted Turtle found in the Minesing swamp and a Red-Shouldered Hawk spotted in the vicinity of Little Lake) have been documented within the subwatershed.

Six rare plant species have been identified (all but one in Minesing Swamp) including, Ram’s-head Lady’s-slippers; Beaked Spike-rush; Eastern Prairie White-fringed Orchid; Hackberry Emperor; Marsh Valerian; Houghton’s Umbrella-sedge; and one bird species, the Tufted Titmouse seen within the subwatershed in Oro-Medonte Township.

Protection of the species found within Minesing Swamp, has been ensured by securement of a large portion of the swamp as public lands, municipal planning policy, and a keen public awareness of the significance of this internationally recognized wetland. The plan encourages the protection of all species at risk, as they are an important component of the Natural heritage system.

- Wetlands – All wetlands are very important since they help to maintain and improve our water quality through trapping of sediments, retaining nutrients, contaminants and removing bacteria. Wetlands also moderate water temperature, maintain base flows, attenuate floods, store carbon, provide important groundwater recharge/discharge functions, control erosion and provide recreational and economic benefits.

7 “Provincial Policy Statement”. Government of Ontario, Queen’s Printer 1997, Page 14

8 Provincial Policy Statement”. Government of Ontario, Queen’s Printer 1997, Page 18

As a result of their importance to our ecosystem, all known wetlands are included in the natural heritage system.

In order to protect them it is necessary to have all wetlands identified. Therefore we are proposing that the Ministry of Natural Resources map all unevaluated wetlands. The next step would be to evaluate these wetlands. However, this may not be necessary for many municipalities as they are protecting all wetlands not just provincially significant wetlands

- Wildlife Habitats – These are areas where plants, animals, and other organisms live, and find adequate amounts of food, water, shelter, and space needed to sustain their populations.
- Woodlands – These are treed areas, woodlots or forested areas that provide environmental and economic benefits such as erosion prevention, water retention, wildlife habitats, recreation and the sustainable harvest of woodland products. Riley points out in Southern Ontario's Settled Landscapes that “*Across Southern Ontario, woodland losses have exceeded those of almost any other major ecosystem*”.⁹

Significant woodlands were identified that generally are larger than 40ha. (30ha. in Springwater Township from their Official Plan) and/or also provide additional important ecological functions such as protecting headwater areas and groundwater recharge areas. They contain diverse community types, ages, and composition providing important functions such as wildlife habitats. They are often connected to each other (e.g.; between Minesing Swamp and Copeland Forest and the Oro Moraine) via the linkage of Matheson Creek and the Willow Creek. They may also be contiguous to other significant natural heritage features such as wetlands.

- Valley lands – These are the natural areas that occur in the valley or other landform depressions that have water flowing through or standing for some period of the year. Valley lands associated with Matheson and Willow Creeks represent the skeleton or framework for the Willow Creek Natural Heritage System. They provide critical linkages and contain important fish and wildlife habitats. They act as both corridors and core areas for many different species. In some cases, the areas identified represent the actual defined valley, in other cases with no defined valley or wider riparian vegetation, a strip 30 m on either side of the stream has been identified.

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2.1.2 Restoration and Rehabilitation

Map 5 identifies priority natural areas where restoration such as tree planting and wetland rehabilitation would enhance and improve the natural heritage system. This

⁹ “The Natural Heritage of Southern Ontario’s Settled Landscapes”, Riley and Mohr, MNR, 1994 page 27.

includes linkage areas as well as priority riparian sites along the watercourses that need planting to establish the minimum of 30 m natural vegetation along both sides of the stream.

The un-vegetated headwater areas would represent the highest priority for restoration. In addition, since previous studies (Rush 1996) have identified significant erosion sites in Midhurst between St Vincent Street and Highway 27, this area should also be considered a priority for restoration and re-vegetation)¹⁰

Upland areas where plantings would eventually fill in open spaces making for larger interior forest blocks have been noted. This would improve the wild life habitats, for those species requiring larger interior forest patches.

In order to improve our surface and ground water quality, reduce flooding, and provide wildlife habitats, the study proposes not only to protect all existing wetlands, but also to encourage the restoration of wetlands that have been drained or impaired. Known potential wetland restoration areas have been identified on **Map 5**. However, it must be emphasized that because of the value of wetlands, the restoration of any wetland area would constitute a top priority regardless of whether or not it has not been identified on **Map 5**.

Naturally any rehabilitation or restoration work could only proceed with the landowner's permission and often through partnerships with interested groups such as youth groups (scouts and guides), and conservation organizations such as naturalist clubs Ducks Unlimited etc.

2.1.3 Natural Heritage System Recommendations

The Willow Creek Subwatershed Plan recommendations are outlined in the body of this report (numbered consecutively). They address the issues as they are reviewed and discussed in the body of this plan.

Please see **Table 4.1** in Section 4.0 for a summary of all recommendations and implementation requirements.

Recommendation #1

Municipalities should incorporate policies in their official plan indicating that “no development or site alteration” shall be permitted within all evaluated wetlands. All wetlands (as defined by the province) should be evaluated.

NVCA will implement a similar policy protecting all wetlands through its planning/permitting processes. The value and contribution of all wetlands to our natural heritage system has been well documented. This has been recognized by Springwater Township in their official plan as it protects all evaluated wetlands from development. The

¹⁰ Willow Creek Erosion Sites, Nadine Rush, NVCA, 1996.

Plan is recommending that the City of Barrie and Oro-Medonte Township similarly protect all evaluated wetlands in their official plan.

Recommendation #2:

The proposed additions to Willow Creek Natural Heritage System, as identified in Map 4 should be incorporated into municipal planning documents. Policies to protect the system and its functions from incompatible land use and development should also be included.

The subwatershed study has provided a more detailed examination of the significant natural heritage features. As a result there are numerous “proposed additions to the natural heritage system” that have been identified based on the criteria outlined by the province. It is very important that the municipalities, including the County, incorporate these additions to the natural heritage system into their planning documents with appropriate protection policies.

It must be emphasized that the “proposed additions to the Natural Heritage System” will not affect landowners existing uses, or resource management opportunities for their property.

If a landowner is within our proposed additions to the natural heritage system, they can continue to manage and enjoy these lands as they do now.

Landowners would only be affected if they applied to their municipality for a change in land use, such as for a subdivision development. If the proposed additions to the natural heritage system were incorporated into the municipality’s official plan, then the appropriate official plan policies would apply. This may include the requirement for an environmental impact study identifying the natural features and functions, the possible impacts from the proposal on these functions and how the impacts will be mitigated.

Eliminating the potential impacts from development on our natural heritage system is a common objective of landowners, developers, municipalities, approval authorities and review agencies.

The additions to the natural heritage system identified in this plan represents a reconnaissance level study that is for the most part, a “red flag” or an “early environmental warning system”. It locates the significant natural areas where additional environmental impact studies (EISs) should be undertaken to assist the municipalities in the planning and decision making process. The EIS provides councils with the appropriate environmental information upon which to make informed decisions.

Recommendation #3:

Landowners, environmental organizations and interested agencies should consider the restoration and rehabilitation areas identified in Map 5 when identifying projects. Rehabilitation of headwater streams and wetlands should be a priority along with re-vegetation of the Willow Creek riparian areas in Midhurst between St Vincent Street and Highway 27 to reduce the effects of erosion.

The landowners and partner organizations may choose their rehabilitation projects from a variety of the identified riparian, wetland or upland sites. Selecting projects from these priority areas will provide the greatest benefits to the aquatic or terrestrial ecosystems.

It must be emphasized that no restoration program can proceed without the permission and full cooperation of the landowners.

2.2 Aquatic Ecosystems

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The aquatic ecosystem is interconnected to, and an integral part of, the natural heritage system. Stream riparian areas have been identified on **Map 4** as a significant part of the natural heritage system. **Map 5** indicates those riparian areas that need rehabilitation, as they do not have adequate vegetation cover.

The Plan reviews the current status of the aquatic ecosystem, identifies the objectives, provides targets (where possible) and makes recommendations to help ensure they are achieved.

2.2.1 Water Quality and Stream Health

Commencing in October 2000, NVCA's Watershed Health Monitoring Department initiated a stream health or biological assessment of Willow Creek for the subwatershed study (see **Appendix B** for more details).

Stream health is a measure of how closely a stream's habitat, water quality and living community match its historical potential. We are able to evaluate a site's potential by comparing it to other streams (reference sites) that share similar physiographic and historic attributes such as soil types, substrate, gradient, temperature, and groundwaters flows, but are still in a "pristine" (unimpaired) condition.

Biological monitoring was borne out of the concept that the community of living things at a site tells a lot about habitat and water quality. In a biological sense, unimpaired streams are those in which living communities are largely shaped by natural features. Impaired streams communities are a manifestation of human influences. Benthic (bottom dwelling) invertebrates are particularly useful indicators and have been used in many studies.

- ♦ To establish baseline water quality conditions prior to development or other land use change. Various community indicators and analytical approaches can then be used to detect changes over time to habitat and water quality

- ♦ As surrogate indicators and to provide early warning of potential impacts to the fish community
- ♦ As diagnostic indicators to determine the magnitude, range of effect and cause of impairments to the aquatic system

Our approach to biological monitoring uses the BioMAP (Biological Monitoring and Assessment Program) protocol. BioMAP enables a stream health prognosis to be made based on an assessment of the aquatic invertebrate community present at a site.

To augment the biological surveys, water chemistry, temperature, hydrometric and bacteriological sampling was undertaken throughout the ice-free period of 2001.

MOE also carried out a water quality study of Little Lake during the summer of 2001.

A complete treatment of water chemistry information is provided in Appendix B (and linked spreadsheet files in the website version).

The priorities of the stream health monitoring aspect of the study were to:

- Classify the biological conditions of stream reaches as either “impaired”, “unimpaired”, or “below potential” (see Appendix B for definitions) to facilitate prioritization of stream reaches for rehabilitation and protection efforts
- Characterize water chemistry and pollutant load trends throughout the basin to guide restoration works, assist in the development of a nutrient budget, determine the frequency of pollutant exceedences of the “Provincial Water Quality Objectives” (Ontario Ministry of Environment, February, 1999) and compare Phosphorus loads against the assimilative capacity of the system
- Classify the thermal regime of Willow and Matheson Creeks at the reach level and generate an understanding of base flows at nodes in the system that are important from a modeling and management perspective

The recommendations to protect the aquatic ecosystem and stream health that come from the results of the stream health monitoring in **Appendix B** are outlined in section 2.2.3.

2.2.2 Fisheries Resources

The Willow Creek Subwatershed supports both warmwater and coldwater fish communities as described below.

Warmwater Fish Habitats

Little Lake and the adjacent reaches of Willow Creek (including Willow Creek between St. Vincent St. and Little Lake; plus between Little Lake and Simcoe Road 93, contain the following species:

- largemouth bass

- walleye (these fish spawn in the vicinity of Simcoe Road 93)
- northern pike
- black crappie

Willow Creek between the Nottawasaga River and Simcoe Road 28 holds:

- northern pike

Willow Creek Upstream from Simcoe Road 93 including tributaries contains:

- warmwater baitfish community
- northern pike

Please note that there has been some indication of the presence of coldwater habitat reaches upstream from Hwy. 11. There may still be the potential to provide coldwater habitat conditions in some locations.

Swaley Creek Drain (Muskrat Creek) between the Nottawasaga River and the Vespra Valley Rd. contains:

- northern pike (provides spawning and nursery habitat)

The Swaley Drain north of Highway 26 supports:

- warmwater baitfish

Warmwater Ecosystem Objectives and Targets

The ecosystem objective for the warmwater habitats is a diverse, stable and productive warmwater lake and stream ecosystem, linked to the cool/cold water habitats within the system.

The management standards and targets for the warmwater habitats should not compromise ecosystem targets identified for any of the more sensitive cool/cold water habitats of Willow Creek.

The following are the ecosystem targets for the above warmwater habitats of the Willow Creek system.

1. Summer stream temperatures should be lowered wherever possible (e.g. through planting of riparian vegetation).
2. Base flow should be maximized (i.e. limit evaporation and maximize adjacent infiltration).
3. Water quality should be enhanced and suspended solids reduced through nutrient management, sediment/erosion controls and rehabilitation of riparian vegetation.
4. Dissolved oxygen concentrations should be at saturation.
5. Water taking must ensure maintenance of the aquatic ecosystem and biotic communities on a sustainable basis.

In general, natural channel forms and functions should be maintained. Impaired and

degraded streams should be enhanced through the implementation of Best Management Practices (BMPs) for riparian vegetation and stream rehabilitation.

Coldwater Fish Habitats

Willow Creek between Simcoe Road 28 and St. Vincent Street holds resident brown trout and mottled sculpin.

Matheson Creek and the following tributaries contain native brook trout, resident brown trout and mottled sculpin:

1. Aunt Maggie's Creek
2. Tributary crossing Gill Road in Lot 3, Con. 3 former Vespra Twp.
3. Tributary entering Matheson Creek in Lot 2, Con. 3, former Vespra Twp.
4. Tributary entering Matheson Creek in Lot 41, Con. 2, former Flos Twp.
5. Tributary entering Matheson Creek in Lot 43, Con. 2, former Flos Twp.
6. Tributary entering Matheson Creek in Lot 44, Con. 2, former Flos Twp.
7. Various other tributaries

Black Creek extending upstream from Carson Road and the following tributaries contain native brook trout:

1. Mink Creek
2. Keast Creek
3. Tributary flowing in east ditch of main entrance road into Snow Valley Resort
4. Tributary crossing Snow Valley Road at Lot 13, Con. 7 former Vespra Twp.
(resident brook trout observed in on-line pond on south side of Snow Valley Road)
5. Tributary crossing ⁱⁿ Lot 11 Con. 7 former Vespra Twp. flowing out of Springwater Prov. Park.
6. Various other tributaries

Cool water Fish Habitats

Swaley Creek Municipal Drain extending upstream from the 9th Line former Vespra Twp. (includes the eastern branch of the Swaley Drain known as the Binnie Drain) contains:

- mottled sculpin

Cold/Cool water Ecosystem Objectives and targets

The Ecosystem objective for the cool/cold water habitats of the Willow and Matheson Creek is a diverse, stable and productive cold/cool water stream ecosystem linked to warmwater habitat in the system including Little Lake.

The following targets or standards, contribute to the cold/cool water stream ecosystem.

1. Four p.m. stream temperatures should be less than 22 °C on a standardized sample day where the maximum air temperature is 30 °C ¹¹
2. Base flow should be maximized through protection of existing recharge zones on the Oro Moraine and Snow Valley area (and elsewhere) and maximizing infiltration during the development process
3. Water quality should be enhanced, and suspended solids reduced through nutrient management, sediment/erosion controls and rehabilitation of riparian vegetation.
4. Dissolved oxygen concentrations should be at saturation.
5. Water taking must ensure maintenance of the aquatic ecosystem and biotic communities on a sustainable basis.

In general, natural channel forms and functions should be maintained. Impaired and degraded streams should be enhanced through the implementation of Best Management Practices (BMPs) for riparian vegetation and stream rehabilitation.

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2.2.3 Aquatic Ecosystem Recommendations

The following recommendations are needed to meet the aquatic ecosystem objective of protecting water quality, the fisheries resources as outlined above, and address the issues that resulted from the Stream Health monitoring report (**Appendix B.**)

Recommendation # 4

No development or site alteration should occur within a minimum of 30m on either side of a natural stream or watercourse, maintaining the natural vegetation. In the case of municipal drains, a minimum 30 m wide vegetated buffer should be established on the side of the drain not accessed for clean out.

Recommendation # 5

Phosphorus data from 2001 suggest that MOE would classify Willow Creek as a “Policy 2” receiver since phosphorus concentrations commonly exceed the provincial water quality objective (PWQO). MOE policy indicates that a remedial strategy for parameters exceeding the PWQO should be developed and that future discharges should not result in further PWQO exceedences (both magnitude and frequency). Matheson Creek appears to be a “Policy 1” receiver for phosphorus and future discharges should ensure that any phosphorus increases are not sufficient to result in PWQO exceedences for that (or any other) parameter.

Remedial strategies should adopt a philosophy of project design that addresses the widest possible range of stream health impairments at a site or over a reach. For example, agricultural projects that reduce manure-contaminated run-off to streams

¹¹ Stoneman and Jones, 1996 DFO/MNR Habitat Management Series.

should be augmented where possible with riparian works to improve shading and in-stream work to improve fish habitat and reduce erosion (where necessary). Projects on private lands may be best achieved through an incentive program such as the one offered through NVCA's "Healthy Waters" grant program (for which Willow/Matheson Creek landowners are eligible under current guidelines)

Recommendation # 6

Establish a long term monitoring program based on biological surveys at 5 sites in the subwatershed to track stream health impacts from land use change.

3.0 WATER MANAGEMENT

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This section provides the technical and engineering water management information for the subwatershed plan. It includes the models for existing and future hydrologic conditions, stormwater management criteria and water balance calculations. Please note that much of the technical data is located in **Appendix D and E**.

3.1 Existing Hydrologic Conditions

Various background information materials were reviewed to establish the existing conditions within the Willow Creek Subwatershed. A site visit was completed on 28 February 2001 and again on 12 June 2001.

3.1.1 **Surface Water Drainage**

Willow Creek consists of several tributaries and drains a total area of approximately 340 km². The most significant tributary of Willow Creek is Matheson Creek, which drains the northwest corner of the Willow Creek Subwatershed. The upper reach of Willow Creek passes through Little Lake prior to its confluence with the Matheson Creek tributary. Near the downstream end of the Subwatershed, Willow Creek empties into the Minesing Swamp prior to joining the Nottawasaga River. The general drainage pattern of the Willow Creek Subwatershed is from northeast to southwest. The Nottawasaga River flows in a northerly direction to Wasaga Beach where it empties into Georgian Bay.

3.1.1.1 **Municipal and Tile Drainage Systems**

Artificial land drainage comprising of municipal drains and tile drainage systems have been identified using Artificial Drainage System maps prepared by the Ontario Ministry of Agriculture and Food (OMAF). These drains have been included as part of the overall watercourse network and can be seen in **Map 1**.

3.1.1.2 **Subwatershed Discretization**

The Willow Creek Subwatershed was discretized (divided) into individual catchments and coded in the ISWMS model. Catchments were delineated using available background information as well as Ontario Base Maps (OBMs) and Digital Elevation Mapping (DEM). Approximately 20 catchments were delineated following the general level of discretization established in the 1988 MacLaren Plansearch report (see **Map 6**).

3.1.1.3 **Baseflows**

Baseflow is recognized as an important contributor to the biological habitat quality and to the structure of aquatic ecosystems identified in Willow Creek. Groundwater discharge is crucial to the maintenance of baseflow and to buffering thermal changes that could otherwise impact aquatic habitat. In addition, high baseflow conditions dilute pollutant concentrations and provide additional wetted area within the stream environment that biota can colonize. Subsequent to colonization, as animals conduct their regular life cycle processes, these additional areas contribute to assimilative capacity for both phosphorus

and nitrogenous compounds. Stream baseflow measurements were completed by the NVCA as part of the water quality analysis and are presented in **Appendix B**.

3.1.1.4 Streamflows

As part of a separate NVCA flow monitoring study, an ultrasonic flow monitoring device was installed on the bridge across Willow Creek at Simcoe Road 28. Continuous flow depths were logged for the monitoring period between May and October 2001. Due to the nature of the rainfall events encountered throughout the monitoring period, it was not possible to establish a rating curve over the full range of depths recorded and the range and frequency of events was limited. In addition to gathering general background flow information, it was intended that flows from this separate study could be used to provide data to calibrate and verify the hydrologic computer model. Unfortunately, this was not possible. Should the monitoring program be continued next year, it may be desirable to fully establish the rating curve and to obtain an adequate number of suitable rainfall/flow events to for calibration and verification.

Using HYDAT streamflow data available from the Water Survey of Canada, the monthly minimum, maximum and mean flows were calculated based on historical flow data from the flow monitoring station located near Midhurst. As shown in **Figures 3.1a and 3.1b**, the mean monthly streamflows for the period on record (1973 to 1998) range between 0.24 m³/s and 3.53 m³/s. Based on this analysis, the highest monthly mean flow occurs in April, while the lowest monthly mean flow occurs in August. The maximum and minimum monthly mean flows between 1973 and 1998 were 7.63 m³/s (April 1982) and 0.051 m³/s (August 1989).

3.1.2 Hydrologic Modelling

Streamflows reflect the time variation in discharges and are characterized by their frequency, duration and magnitude. Streamflows include peak flows generated from surface runoff caused by rainfall and snowmelt events, as well as groundwater discharges that appear as baseflow.

The combination of streamflow characteristics (i.e. frequency, magnitude and duration) controls many of the natural and ecological functions that occur in the creeks and streams present in the Willow Creek Subwatershed. Low streamflows (i.e. baseflows) sustain aquatic and terrestrial ecosystems in periods of no rain or runoff. Moderate streamflows with a return period of $\frac{1}{4}$ to $1\frac{1}{4}$ years contribute to the natural evolution of channel shape and form through erosion. Seasonal flooding such as that resulting from spring freshets provides nutrients and sediments to wetlands and floodplains and provides spawning opportunities for a number of fish species. High streamflows resulting from snowmelt events and extreme rainfall events such as the Timmins Storm can lead to natural hazards and a risk to human life and property.

Development within the Willow Creek Subwatershed will result in changes to peak flows, runoff frequency and duration, and response times to a given rainfall event. Development

will also result in changes to the existing water balance component quantities such as infiltration and runoff. In order to assess the extent of these changes, it is necessary to first establish the existing conditions of the subwatershed.

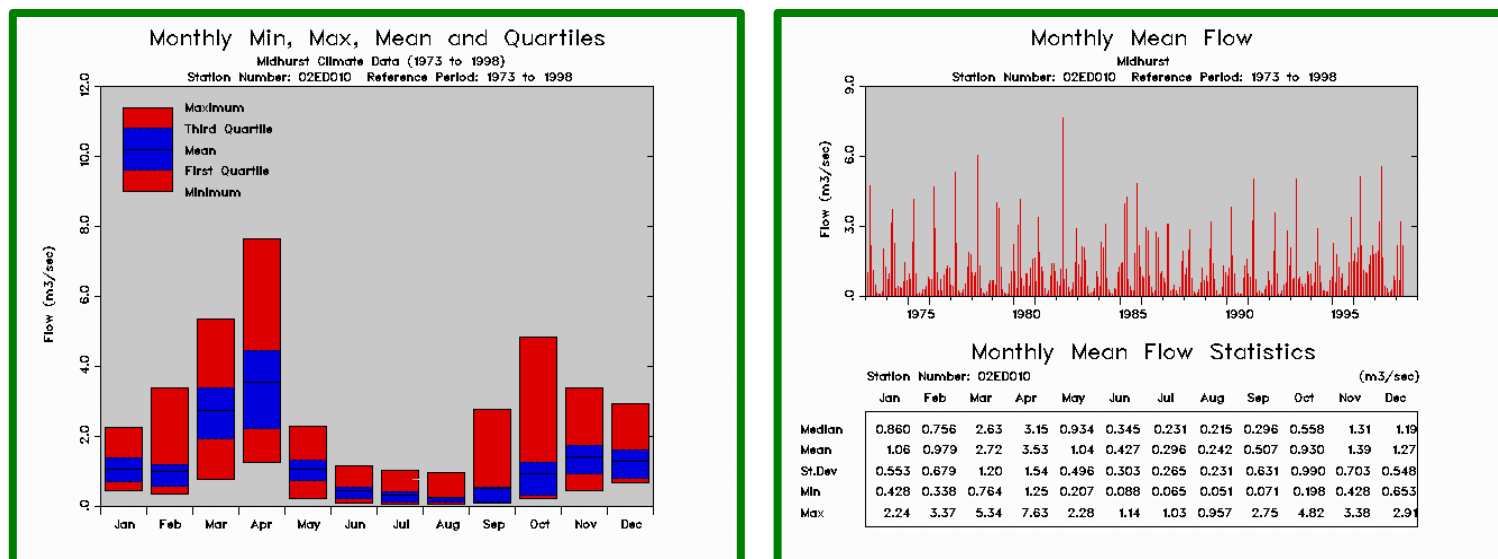


Figure 3.1a (left) and 3.1b (right): (a) monthly minimum, maximum and mean streamflows for Midhurst station from Water Survey of Canada (HYDAT) for period from 1973 to 1998, and (b) monthly mean flow statistics for Midhurst station.

3.1.2.1 Peak Flow Modelling

For the study area, the Integrated Stormwater and Watershed Management System (ISWMS®) by Greenland, was utilized to develop the hydrologic model reflective of existing conditions. The initial phase (i.e. flood forecasting) of the new software system was developed for the Nottawasaga Valley Conservation Authority, and combines the usefulness of both unit hydrograph runoff generation methods and US EPA's SWMM based models. This study will apply the unit hydrograph runoff generation methods, typically used in similar subwatershed planning studies across Ontario, to model the hydrology of the Willow Creek Subwatershed. Additional information regarding the hydrologic modelling methodology and technical details is provided in **Appendix D**.

Model Calibration

To improve the accuracy of our hydrologic model we initially intended to calibrate the model using precipitation and streamflow data collected during the study period. Unfortunately suitable data was not collected and the model was therefore not calibrated.

Hydrologic Model Results – Existing Conditions

The results of the single event hydrological modeling for a range of return period events and flow nodes are summarized in **Table 3.1**. In addition, **Figure 3.2** illustrates typical design storm event hydrographs at node 1019 located at the bottom of the Willow Creek Subwatershed just prior to the confluence with the Nottawasaga River. Flow node locations for the ISWMS model are identified in **Map 6**.

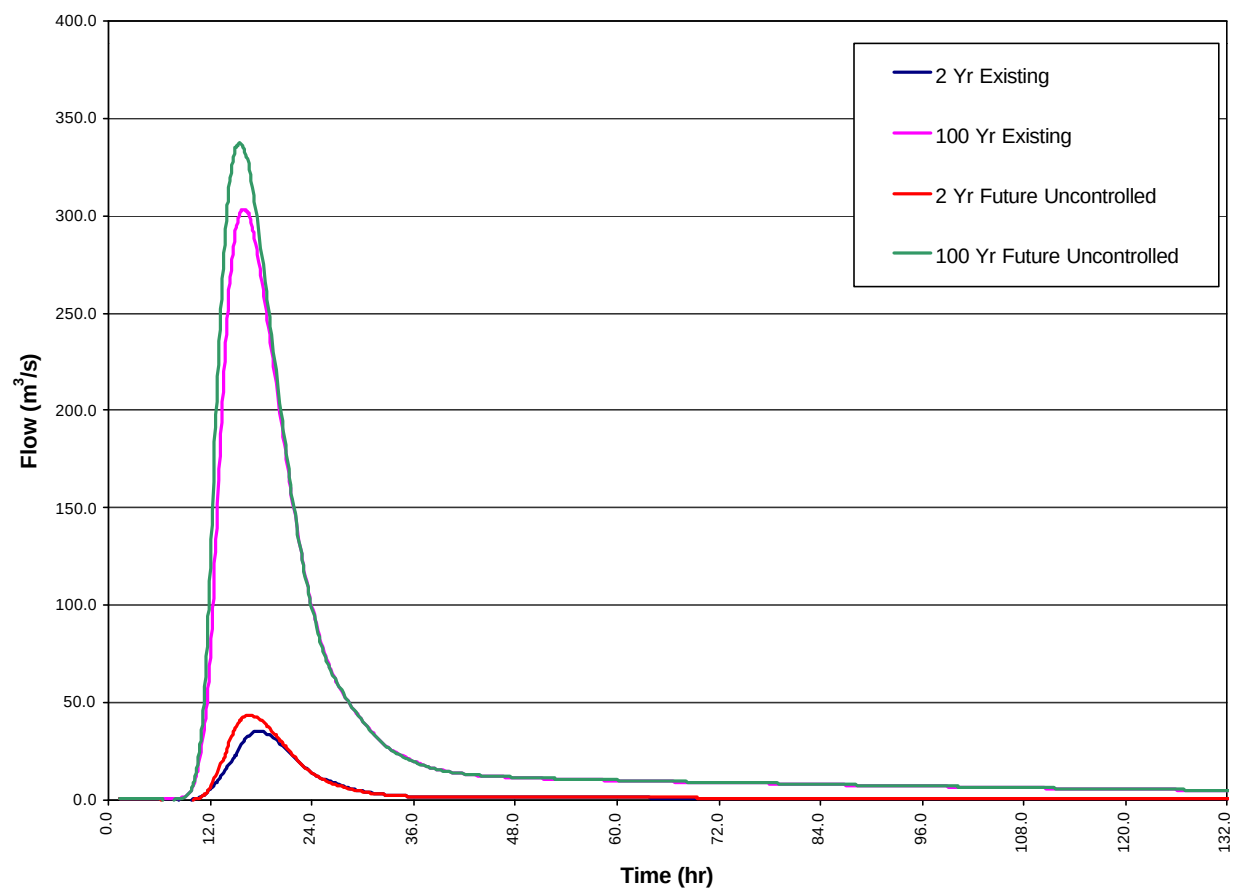
3.1.2.2 Water Balance Modelling

Water balance modelling was completed for both existing and future conditions within the Willow Creek Subwatershed. A Water balance is a form of hydrologic accounting whereby the distribution of water over a specified period is quantified for the various components of the hydrologic cycle. It is anticipated that the results of the water balance will be helpful in developing future water allocation strategies, however, this is not within the scope of this study. A sketch illustrating the different processes associated with the hydrologic cycle is provided in **Figure 3.3**. The primary components of the overall water balance presented in this plan include rain, snowmelt, evapotranspiration, runoff, baseflow, and deep groundwater storage. Additional information regarding the water balance methodology and technical details is provided in **Appendix E**.

Table 3.1
Summary of Peak Flows for Existing and Future Uncontrolled Conditions

Flow Node	Drainage Area km ²	Condition	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	Regional	Timmins Storm Reduction Factor
			(m ³ /s)	(m ³ /s)	(m ³ /s)	(m ³ /s)	(m ³ /s)	(m ³ /s)	(m ³ /s)	
1000	17.9	Existing	4.6	10.7	15.6	22.4	27.9	33.7	63.9	100
		Future	4.6	10.7	15.6	22.4	27.9	33.7	63.9	
1001	21.6	Existing	5.2	12.5	18.2	26.8	32.8	39.8	76.7	100
		Future	5.4	13.0	18.8	27.2	33.8	40.9	77.3	
1002	25.7	Existing	5.0	12.7	18.8	27.7	34.8	42.4	83.0	100
		Future	5.1	12.7	18.8	27.7	34.8	42.4	83.0	
1003	25.5	Existing	6.0	14.7	21.5	31.8	39.0	47.1	90.7	100
		Future	6.5	15.6	22.6	32.6	40.6	49.0	92.1	
1004	51.2	Existing	10.9	27.2	40.0	59.2	73.4	89.2	158.0	94
		Future	11.4	28.1	41.2	60.1	75.2	91.1	159.4	
1005	64.9	Existing	14.1	35.1	51.5	75.9	94.1	114.3	201.8	94
		Future	14.7	36.0	52.7	76.7	96.0	116.3	203.2	
1006	75.1	Existing	16.0	39.7	58.4	86.1	106.9	129.9	230.8	94
		Future	16.8	41.2	60.4	87.9	109.9	133.3	234.2	
1007	95.5	Existing	21.8	53.1	77.5	113.3	140.4	170.1	281.2	90
		Future	22.7	54.6	79.5	115.1	143.4	173.5	284.2	
1008	98.9	Existing	22.3	54.4	79.5	116.3	144.2	174.8	289.5	90
		Future	23.3	56.2	81.8	118.5	147.6	178.7	293.2	
1009	109.7	Existing	1.2	2.8	4.9	7.8	10.2	12.7	103.5	87
		Future	1.4	3.2	5.1	8.2	10.6	13.1	108.3	
1010	63.5	Existing	7.0	19.4	29.4	44.1	56.1	69.1	136.9	94
		Future	7.8	20.9	31.5	47.0	59.6	73.2	143.3	
1011	15.5	Existing	2.3	6.1	9.2	13.7	17.3	21.2	43.8	100
		Future	2.3	6.1	9.2	13.7	17.3	21.3	43.8	
1012	79.1	Existing	9.2	25.2	38.2	57.3	72.8	89.5	163.6	90
		Future	10.0	26.8	40.3	60.1	76.2	93.6	169.8	
1013	94.6	Existing	11.9	32.2	48.2	72.6	92.0	113.0	203.9	90
		Future	13.7	35.7	53.2	78.8	99.5	121.7	218.8	
1014	229.2	Existing	15.2	40.1	60.2	89.7	113.6	139.4	221.9	82
		Future	19.6	48.5	71.5	104.8	131.5	160.1	248.3	
1015	246.6	Existing	18.7	48.7	72.7	107.9	136.3	166.9	262.4	82
		Future	23.5	58.0	85.2	124.5	156.0	189.6	291.4	
1016	30.0	Existing	5.2	13.0	19.2	28.2	35.4	43.1	88.3	100
		Future	6.0	14.5	21.2	30.8	38.4	46.6	93.4	
1017	276.5	Existing	23.7	61.4	91.6	135.7	171.1	209.4	303.3	79
		Future	29.3	72.2	106.0	154.8	193.8	235.5	339.3	
1018	11.9	Existing	2.9	7.2	10.7	15.7	19.7	24.0	43.8	100
		Future	3.0	7.5	11.0	16.2	20.3	24.7	44.7	
1019	337.8	Existing	35.3	90.9	134.7	198.2	249.1	303.6	439.9	79
		Future	43.4	105.5	153.8	222.9	278.5	337.5	481.0	

Figure 3.2
Existing and Future Uncontrolled Flows
Node 1019



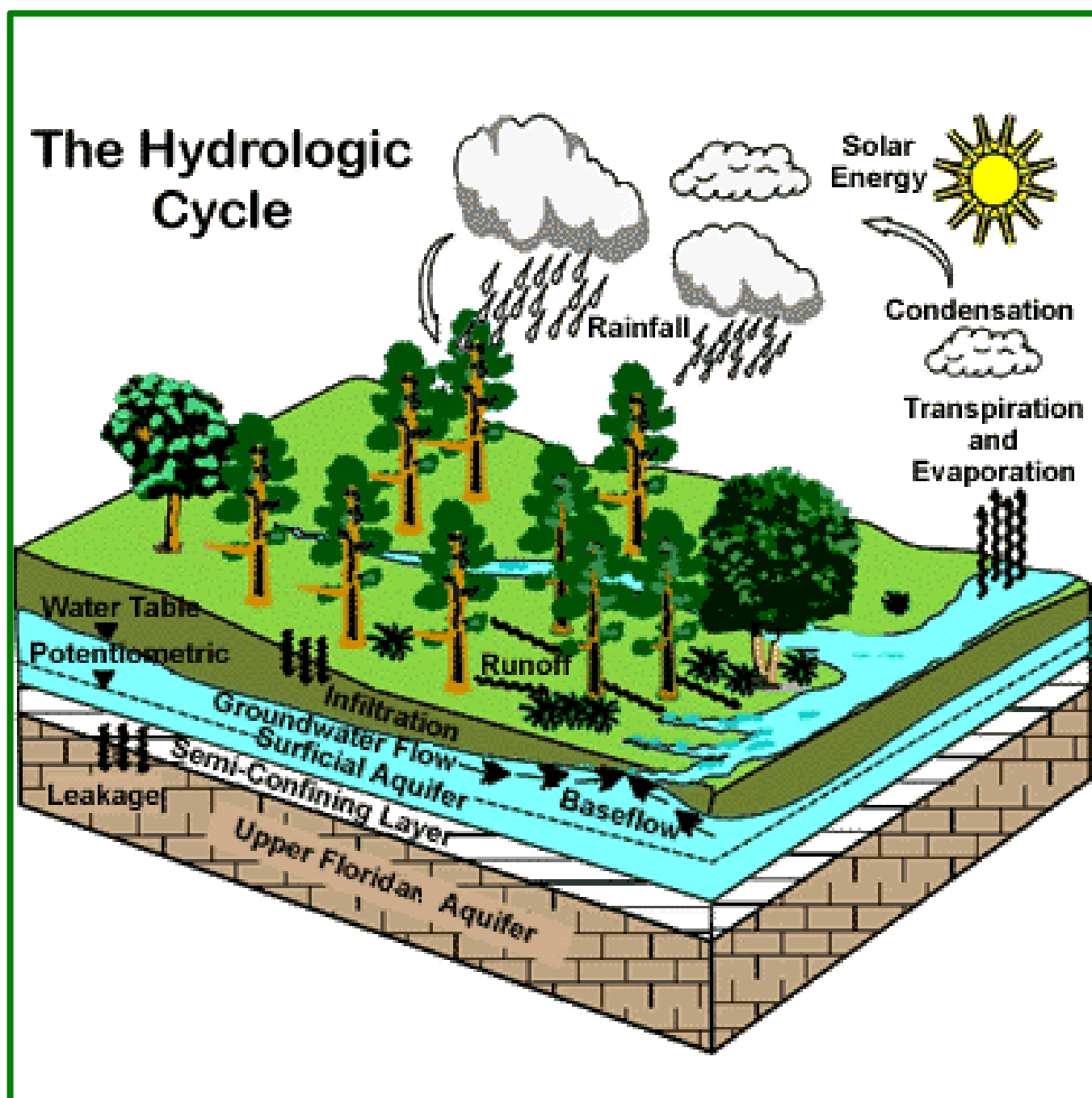


Figure 3.3: Processes associated with the hydrologic cycle.

Water Balance Results - Existing conditions

The results of the annual water balance analysis for existing conditions including pervious and impervious areas for the entire Willow Creek Subwatershed are presented in **Table 3.2** and **Figure 3.4**. Based on a total average annual precipitation of 926 mm, approximately 576.6 mm is lost to evapotranspiration. In addition, approximately 181.5 mm and 167.9 mm comprises of runoff and infiltration respectively. Approximately 114.7 mm of the infiltration component accounts for baseflow while approximately 53.2 mm of the infiltration component accounts for deep groundwater storage. Using the revised catchment areas based on the DEM, along with GIS techniques for obtaining area-weighted parameter values, the water balance was further discretized for all individual catchments within the Subwatershed. Annual water balance calculation sheets for all identified catchments within the Subwatershed are presented in **Appendix E**. Based on this analysis for existing conditions, **Map 8** depicts the relative infiltration quantities for the Willow Creek Subwatershed.

3.2 Modelling Future Hydrologic Conditions

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Future hydrologic conditions were estimated using the Official Plan land use documents obtained from the City of Barrie and the Townships of Oro-Medonte and Springwater (see **Appendix C**). Based on the revised land use, parameter values for the hydrologic model were revised from existing conditions and future peak flows were predicted. The future water balance model was also calculated based on revised land use to determine the potential impacts of future development on groundwater recharge, runoff and baseflow within the Willow Creek Subwatershed.

Peak Flows

As shown in **Table 3.1** and **Figure 3.2**, future development (based on the Official Plan) will increase peak flows in some areas of the Subwatershed. The net result, for example, of the proposed development on the peak flow for the 2-yr and 100-yr design storm at the bottom of the Subwatershed (i.e. Node 1019) is an increase of 23% and 9%, respectively.

Water Balance

The results of the annual water balance analysis for future conditions including pervious and impervious areas within the entire Subwatershed are presented in **Table 3.2** and **Figure 3.4**. Based on a total average annual precipitation of 926 mm, approximately 561.4 mm is lost to evapotranspiration. In addition, approximately 202.7 mm and 161.9 mm comprises of runoff and infiltration respectively. Approximately 110.6 mm of the infiltration component accounts for baseflow while approximately 51.3 mm of the infiltration component accounts for deep groundwater storage. Relative to existing conditions, the future proposed development will result in a reduction in actual evapotranspiration (-2.6%), an increase in runoff volume (+11.7%), a decrease in deep

Table 3.2
Existing and Future Water Balance Quantities for Willow Creek Subwatershed

Water Balance Component	Condition	Depth (mm)	Volume (m ³)	Percent (%)
Inputs				
Rainfall	Existing	717.0	242,274,000	77.4
	Future	717.0	242,274,000	77.4
Snowmelt	Existing	209.0	70,620,900	22.6
	Future	209.0	70,620,900	22.6
TOTAL	Existing	926.0	312,895,000	100.0
	Future	926.0	312,895,000	100.0
<u>Outputs</u>				
Actual ET	Existing	576.6	194,817,000	62.3
	Future	561.4	189,685,000	60.7
Runoff	Existing	181.5	61,329,900	19.6
	Future	202.7	68,529,400	21.9
DGWS	Existing	53.2	17,977,700	5.7
	Future	51.3	17,322,300	5.5
Baseflow	Existing	114.7	38,770,100	12.4
	Future	110.6	37,357,900	11.9
TOTAL	Existing	926.0	312,895,000	100.0
	Future	926.0	312,895,000	100.0

Figure 3.4: Existing and Future Water Balance Results

EXISTING CONDITIONS

Annual Water Balance
Willow Creek Subwatershed
Total Watershed

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.312	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
30163.6		192			0.663				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	579.5	346.5	185.9	287.6	127.0	160.6	58.9
Component Volume (m ³)									
216,272,846	63,041,876	178,870,011	174,783,831	104,530,890	56,080,093	86,753,501	38,302,704	48,450,797	17,777,390

Calculated Water Balance Components
Swamp/Fen/Marsh

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
30163.6		192			0.663				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	579.5	346.5	185.9	287.6	127.0	160.6	58.9
Component Volume (m ³)									
216,272,846	63,041,876	178,870,011	174,783,831	104,530,890	56,080,093	86,753,501	38,302,704	48,450,797	17,777,390

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
29096.2		193			0.663				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	579.7	346.3	185.6	287.5	126.8	160.7	58.8
Component Volume (m ³)									
208,619,992	60,811,127	172,540,663	168,663,470	100,767,649	54,012,487	83,645,690	36,890,529	46,755,162	17,121,958

Calculated Water Balance Components
Swamp/Fen/Marsh

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
3018.5		100.0			0.0				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m ³)									
21,642,977	6,308,762	17,899,980	17,899,980	10,051,759	0	10,051,759	0	10,051,759	0

Calculated Water Balance Components
Open Water

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
237.6		100.0			0.0				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m ³)									
1,703,384	496,523	1,408,796	1,408,796	791,111	0	791,111	0	791,111	0

Calculated Water Balance Components
Open Water

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
237.6		100.0			0.0				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m ³)									
1,703,384	496,523	1,408,796	1,408,796	791,111	0	791,111	0	791,111	0

Calculated Water Balance Components
Impervious Urban Area

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
164.2		10.0			0.0				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m ³)									
1,177,416	343,208	973,790	152,062	1,368,561	0	1,368,561	0	1,368,561	0

Calculated Water Balance Components
Impervious Urban Area

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
1231.5		10.0			0.0				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m ³)									
8,830,142	2,573,919	7,303,032	1,140,406	10,263,654	0	10,263,654	0	10,263,654	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

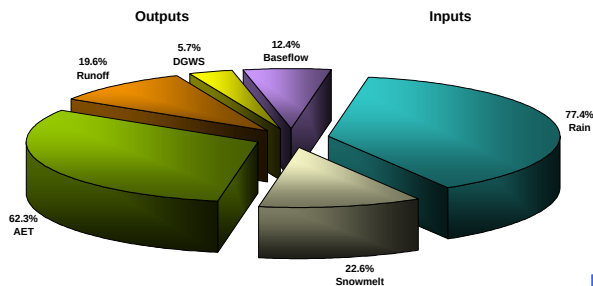
Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
206.0		30.0			70.0				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m ³)									
1,477,065	430,553	1,221,617	572,286	1,335,333	667,666	1,135,033	467,367	667,666	200,300

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Calibrated Infiltration Factor					HYDAT Data (mm)				
Topography	Soils	Cover	Total		Streamflow	Baseflow	Runoff		
Annual	0.091	0.311	0.134	0.536	Annual	297.7	126.8	170.9	
Component Area (ha)		Weighted WHC (mm)			BF Factor				
206.0		30.0			70.0				
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m ³)									
1,477,065	430,553	1,221,617	572,286	1,335,333	667,666	1,135,033	467,367	667,666	200,300

TOTAL VOLUME (m ³)									
242,273,688	70,620,922	200,374,194	194,816,955	118,077,655	56,747,760	100,099,965	38,770,070	61,329,895	17,977,689
TOTAL DEPTH (mm)									
717.0	209.0	593.0	576.6	349.4	167.9	296.2	114.7	181.5	53.2
INPUTS					OUTPUTS				
% Rain	% Melt	% AET			% BF	% RO	% DGWS		
77.4	22.6	62.3			12.4	19.6	5.7		

TOTAL VOLUME (m ³)									
242,273,560	70,620,884	200,374,088	189,684,938	123,209,507	54,680,154	105,887,248	37,357,895	68,529,353	17,322,258
TOTAL DEPTH (mm)									
717.0	209.0	593.0	561.4	364.6	161.8	313.4	110.6	202.8	51.3
INPUTS					OUTPUTS				
% Rain	% Melt	% AET			% BF	% RO	% DGWS		
77.4	22.6	60.6			11.9	21.9	5.5		

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)

groundwater storage (-3.6%), and a decrease in baseflow (-3.6%). Additional water balance calculation sheets for all identified catchments within the Willow Creek Subwatershed are provided in **Appendix E**.

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3.3 Stormwater Control Targets for Future Development

It is premature at this time to size and to establish recommended locations of required stormwater management facilities. Pond sizes and locations will be established at the Secondary Plan (SP) and/or Functional Servicing Plan (FSP) stage. It is important at this time, to establish the recommended levels of stormwater control targets and measures (section 3.4) within the Willow Creek Subwatershed in order to help achieve the aquatic ecosystem objectives and targets outlined in section 2.2.2 of this plan:

- SWM ponds constructed within the Willow Creek Subwatershed must provide Level 1(maximum) protection
- The minimum erosion requirement shall consist of the 25 mm post-development peak flow released over a 24-hour period. Should it be identified at the SP or FSP stage that erosion control over and above the 25 mm 24-hr minimum criteria is necessary, and then an erosion analysis shall be completed to determine the required level of protection
- The minimum level of protection for quantity control shall be post-to-pre flow control for the 2-yr through 100-yr design storms, unless, it can be demonstrated that an alternate level of control can be provided while still maintaining post-to-pre flow conditions at identified flow nodes downstream of the proposed development
- Wherever possible, efforts should be made to minimize temperature impacts on receiving waters by incorporating measures such as littoral plantings and bottom draw outlet structures into the overall design of SWM facilities
- Design of SWM control measures must conform to the guidelines as identified in the *Stormwater Management Planning and Design Manual* (MOE Draft Final report, November 1999) and the *Technical Standards for Stormwater Management Within the NVCA Watershed* (NVCA, May 2000)

3.4 Stormwater Management Control Measures

There are three main categories of stormwater controls; these include source controls, conveyance controls and end-of-pipe controls. It is desirable to combine various stormwater controls within the overall strategy, wherever possible. Opportunities for combining stormwater controls with various industry needs should also be encouraged and specific controls are recommended for control of runoff from construction sites.

Source Controls

Lot level (source controls) are measures utilized to reduce the quantity of runoff from developed properties within a subwatershed. Typical source controls include the following:

- Reduced lot grading

- Roof leaders directed to ponding areas
- Roof leaders directed to soakaway pits
- Sump pumping of foundation drains.

Conveyance Controls

Conveyance controls are designed to reduce the quantity of runoff transported from properties within a subwatershed to the receiving waters. Examples of conveyance controls include:

- Pervious pipe systems
- Catch basin modifications
- Grassed swales
- Pervious catch basins

End-of Pipe Controls

End-of-pipe controls are measures used to service multiple lots, residential subdivisions and industrial/commercial areas. They can be designed to provide both quantity and quality/erosion control to meet a variety of stormwater management requirements.

Examples of end-of-pipe facilities include the following:

- Dry ponds
- Wet ponds
- Constructed wetlands
- Hybrid wetland/wet ponds
- Infiltration trenches
- Infiltration basins
- Buffer strips
- Filter strips
- Oil/grit separator.

Opportunities for Re-use and Recycling of Stormwater for Irrigation and Industrial Purposes and for Maintaining and Enhancing Existing Baseflow Conditions

Opportunities for incorporating local agricultural and recreational/industrial needs for water with stormwater management plans should be encouraged within the Subwatershed. As an example, irrigation needs for crops and/or golf course greens and fairways could be considered when designing and locating stormwater management ponds. With proper design skills, excess runoff that would normally be released to the stream could be stored and used at a later time during dry periods for irrigation purposes. This approach is currently being considered in Alliston, where options are being explored to combine polished wastewater treatment plant effluent with stormwater runoff for irrigation of surrounding farmland. Measures such as this, along with a review of irrigation and water use practices within the subwatershed, could help reduce the impact on baseflow conditions and subsequent impacts on aquatic habitat and health, particularly during the summer months.

An example of incorporating industry needs with site stormwater management is the collection of roof runoff for use as cooling water for equipment such as refrigeration units. Not only does this help to reduce the volume of runoff from the site but it also reduces the amount of water that would otherwise be pumped from underground aquifers.

In order to quantify the impacts of existing and future surface and groundwater use on baseflow conditions, the water balance model completed for the Willow Creek Subwatershed could be refined further to include information (if available) such as water taking permits, well records, farm irrigation records and practices, commercial/industrial water use records and practices, and additional flow monitoring as required. With appropriate modifications, the water balance model could potentially be used to evaluate proposed surface and groundwater management strategies and to determine the preferred option(s).

Erosion and Sediment Controls During Construction

In order to reduce sediment loading of streams during construction of the proposed lands within the Subwatershed, it is important that sediment and erosion control measures be identified and incorporated into site plans prior to initiation of earthworks on site. Following implementation, sediment controls must be properly checked, cleaned and maintained in place during all phases of construction. Erosion and sediment control measures which should be considered for implementation into individual site plans include, but are not limited to:

- Site management practices
- Construction scheduling
- Temporary sediment basins
- Temporary sediment traps
- Silt fences
- Seeding and mulching
- Drainage diversions
- Brush barriers
- Check dams
- Storm drainage inlet protection
- Vibration pads
- Conveyance channels

The guidelines for the design of erosion and sediment control measures provided in the following documents should be followed:

- *Guidelines on Erosion and Sediment Control for Urban Construction Sites* (MNR, et al, 1987)
- *Technical Guidelines, Erosion and Sediment Control* (MNR, 1989)
- *Erosion and Sediment Control*. MTC. Drainage Manual, Volume 2, Chapter F (MTO, 1985)
- *Erosion and Sediment Control Training Manual*, (MOE,1997)

All stormwater management facilities should adhere to the recommended design guidelines as set out in the *Stormwater Management Planning and Design Manual - Draft Final Report* (MOE, 1999). In addition, the following should be completed for each SWMP

- A geotechnical investigation to assess the suitability of the proposed site to accommodate a stormwater management pond, particularly in regard to groundwater levels and slope stability concerns
- A landscape plan, including recommended plantings about the facility
- A construction phasing plan

Development proponents should prepare a detailed Storm Water Management Report that discusses how storm water generated from the proposed Plan of Subdivision will be managed in accordance to the intent of the recommended master drainage plan. Likewise, any alterations to urban storm water management strategies resulting from servicing difficulties/constraints identified during the detailed design stage should be discussed and rationalized in the Storm Water Management Report.

All new development proposals must prepare site-specific storm water management reports that shall include:

- The proposed drainage scheme for the development
- The proposed Storm Water Management Practices that will be incorporated into the system
- The proposed methods for minimizing erosion and sedimentation during construction

3.5 Water Management Recommendations

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As part of the Water Management Component of the Willow Creek Subwatershed Plan, the following recommendations are presented to enable proper management of stormwater and water balance in the future:

- 7. The recommended stormwater control targets and measures as outlined in sections 3.3 and 3.4 should be followed.**
- 8. The existing flow characteristics should be maintained at the flow nodes identified in Table 3.1 and shown on Map 6 Sub-catchments.**
- 9. The hydrologic model should be calibrated and verified.**
- 10. Once the hydrologic model is calibrated, and as development proceeds, floodplain mapping should be revised/completed for the Willow Creek Subwatershed.**
- 11. Stormwater management pond locations and sizing should be established at the Secondary Plan or Functional Servicing Plan stage.**

- 12. A hydrologic computer model such as Visual OTTHYMO should be used by development proponents for calculating flows to size flood control facilities at the Functional Servicing Plan stage. Site-specific parameter values should be established during the Secondary Plan stage.**
- 13. Functional Servicing Plans should be completed as part of Secondary Plans and should be integrated with on-going water management projects by the NVCA (e.g. flood forecasting model and the Simcoe County groundwater management study).**
- 14. The existing water balance should be maintained or enhanced throughout the Willow Creek Subwatershed (maximizing infiltration to counteract the increase in hard surfaces) as future development occurs.**
- 15. As additional funding becomes available, the water balance model should be refined to include surface and groundwater usage such as for agricultural, domestic, commercial and industrial purposes. A more accurate estimate of water takings will help ensure long-term sustainable water usage.**

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4.0 SUMMARY OF RECOMMENDATIONS, IMPLEMENTATION STRATEGY AND MONITORING

Recommendations, implementation and monitoring requirements are outlined in **Table 4.1**. It is a summary of management recommendations for the Willow Creek Subwatershed based on hydrologic modeling, stream health assessments and the public consultation process.

A great deal of the plan recommendations will be implemented through the municipal planning process. Policies and development criteria and standards may be recommended for inclusion in planning documents and utilized during the plan review processes of approval authorities and review agencies.

Computer models, data and other information will be maintained and updated by the appropriate review agencies, approval authorities and municipalities. NVCA will play a major role as keeper and updater of the data and computer models, ensuring that cumulative impacts from development and cross-boundary water management issues are addressed. This information will be placed on the Internet through NVCA's web site at www.nvca.on.ca.

Monitoring:

Despite our best efforts to establish a subwatershed management plan for the study area to maintain and enhance the features and functions of the natural environment, the plan is based on a finite set of information and assumptions about future land use and development. Consequently, it is very important that a set of "indicators" be established that can be monitored over time to determine the environmental health of the subwatershed.

The following **Table 4.1** outlines the specifics of the monitoring recommendations as part of the implementation strategy.

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Table 4.1: Summary of Recommendations and Implementation Strategy.

Subwatershed Component	Recommendations	Lead/Support Agencies	Implementation Mechanism	Time Frame
Natural Heritage System	#1 Municipalities should incorporate policies in their official plan indicating that "no development or site alteration" shall be permitted within all evaluated wetlands. All wetlands (as defined by the province) should be evaluated.	Municipalities /NVCA and MNR for wetland evaluations	Official Plans/Zoning By-laws and Approval Authorities reviews	Next Official Plan /Zoning Update
	#2 The proposed additions to Willow Creek Natural Heritage System, as identified in Map 4 should be incorporated into municipal planning documents. Policies to protect the system and its functions from incompatible land use and development should also be included.	Municipalities /NVCA	Official Plans /Zoning by-laws and Approval Authorities	Next Official Plan /Zoning Update

	and rehabilitation areas identified in Map 5 when identifying projects. Rehabilitation of headwater streams and wetlands should be a priority along with re-vegetation of the Willow Creek riparian areas in Midhurst between St Vincent Street and Highway 27 to reduce the effects of erosion.	groups and organizations (DU, Scouts etc)		
Aquatic Ecosystem	# 4 No development or site alteration should occur within a minimum of 30m on either side of a natural stream or watercourse, maintaining the natural vegetation. In the case of municipal drains, a minimum 30 m wide vegetated buffer should be established on the side of the drain not accessed for clean out.	Municipalities& NVCA	Official Plans & Zoning By-laws; Approval Authorities reviews	Next Official Plan & Zoning updates
	#5 Phosphorus data from 2001 suggest that MOE would classify Willow Creek as a "Policy 2" receiver since phosphorus concentrations commonly exceed the provincial water quality objective (PWQO). MOE policy indicates that a remedial strategy for parameters exceeding the PWQO should be developed and that future discharges should not result in further PWQO exceedences (both magnitude and frequency). Matheson Creek appears to be a "Policy 1" receiver for phosphorus and future discharges should ensure that any phosphorus increases are not sufficient to result in PWQO exceedences for that (or any other) parameter.	Municipalities/ MOE; NVCA Approval Authorities;	Official Plan Updates; Secondary Plans; On-going Reviews; Health Water/ Futures Programs	As dev. proceeds through secondary plan; On-going restoration.
Subwatershed Component	Recommendations	Lead/ Support Agencies	Implementation Mechanism	Time Frame
	#6 Establish a long term monitoring program based on biological surveys at 5 sites in the subwatershed to track stream health impacts from land use change.	Municipalities Developers and NVCA	Through Development proposals and/or municipal commitments	monitoring will continue in 2002; long-term needed
Water Management	#7 The recommended stormwater control targets and measures as outlined in sections 3.3 and 3.4 should be followed.	Municipalities/ MOE; CA, Approval Authorities	Secondary and Functional Service Plans & Stormwater Management Plans	On-going, as development proceeds
	#8 The existing flow characteristics should be maintained at the flow nodes identified in Table 3.1 and shown on Map 6 Sub-catchments.	Municipalities./ MOE; NVCA, Appr. Authorities	Functional Service Plans & Stormwater Management Plans	On-going, as dev. proceeds
	#9 The hydrologic model should be calibrated and verified.	NVCA	Through existing or future programs (groundwater study)	2002-2003
	#10 Once the hydrologic model is calibrated, and as development proceeds, floodplain mapping should be revised/completed for the Willow Creek Subwatershed.	NVCA/ Municipalities	Through Secondary Plans & development proposals	On-going
	#11 Stormwater management pond locations and sizing should be established at the Secondary Plan or Functional Servicing Plan stage.	Municipalities/ MOE; NVCA, appro.	Secondary Plans & Functional Service Plans	As development.

		Authorities		proceeds
	#12 A hydrologic computer model such as Visual OTTHYMO should be used by development proponents for calculating flows to size flood control facilities at the Functional Servicing Plan stage. Site-specific parameter values should be established during the Secondary Plan stage.	Municipalities/ NVCA, Approval Authorities	Secondary Plans, Functional Service Plans & Stormwater Management Plans	As develop- ment. proceeds
Water Management	#13 Functional Servicing Plans should be completed as part of Secondary Plans and should be integrated with on-going water management projects by the NVCA (e.g. flood forecasting models and groundwater management study).	Municipalities/ MOE; NVCA, Approval Authorities	Secondary Plans, Functional Service Plans	As develop ment. proceeds
	#14 The existing water balance should be maintained or enhanced throughout the Willow Creek Subwatershed (maximizing infiltration to counteract the increase in hard surfaces) as future development occurs.	Municipalities/ MOE; NVCA, Approval Authorities	Secondary Plans, Functional Service Plans & Stormwater Management Plans	As develop ment. proceeds
	#15 As additional funding becomes available; the water balance model should be refined to include surface and groundwater usage such as for agricultural, domestic, commercial and industrial purposes. A more accurate estimate of water takings will help ensure long-term sustainable water usage.	Municipalities MOE, NVCA	MOE/NVCA Ground water Initiative	Next 18 mo. As project proceeds.

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**DRAFT
REPORT ON**

**PRELIMINARY GEOTECHNICAL INVESTIGATION
A. HICKLING PROPERTY
MIDHURST, ONTARIO**

Submitted to:

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

Distribution:

- 1 Copy (Digital) - Geranium Corporation, Markham, Ontario
- 1 Copy - Golder Associates Ltd., Whitby, Ontario

April, 2008

08-1186-0506B(G)



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April 18, 2008

08-1186-0506B(G)

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

**RE: PRELIMINARY GEOTECHNICAL INVESTIGATION
A. HICKLING PROPERTY
MIDHURST, ONTARIO**

This report presents the results of a preliminary geotechnical investigation carried out at the above referenced site, as shown on the Key Plan, Figure 1. The purpose of the investigation was to determine the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of shallow boreholes. Based on our interpretation of the borehole data, this report provides preliminary geotechnical information for the planning of a proposed residential and/or commercial development at the site. Authorization to proceed with this investigation was provided by Ms. Shauna Dudding, P.Eng. of Geranium Corporation, in an email dated March 3, 2008.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder Associates Ltd. (Golder) should be given an opportunity to confirm that the preliminary recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report", included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. Further, the environmental aspects (i.e. Phase I ESA) at the site are being addressed concurrently by Golder (reported under separate cover).



SITE DESCRIPTION

The site is located on the southwest corner of the intersection of Carson Road and Anne Street North in Midhurst Ontario. The site is presently agricultural land with a residence and is approximately 20.9 ha (51.7 ac) in size. The dwelling is located on the northwest portion of the site, the remaining portion is occupied by crops. The site is bounded by a residence (1407 Carson Road) and Carson Road to the north; Anne Street North to the east; forested land and Willow Creek to the west; and agricultural land to the south.

PHYSIOGRAPHY

The site lies near the border of the physiographic regions of Southern Ontario known as the Simcoe Lowlands and Simcoe Uplands (Chapman and Putnam 1984). Physiographic mapping in the immediate vicinity of the site indicates glaciolacustrine deposits of sands bordering on tills with predominantly sandy silt matrix (Map 2556, Quaternary Geology of Southern Ontario, Barnett, Cowan and Henry, 1991). This physiographic mapping is generally consistent with the results of the current investigation.

INVESTIGATION PROCEDURE

The field work for this preliminary investigation was carried out on March 31 and April 1, 2008, during which time eight boreholes (Nos. 12 to 19) were advanced at the locations shown on the Location Plan, Figure 2. The boreholes were drilled using a track-mounted drillrig supplied and operated by Eastern Soil Investigation Limited, under our supervision. Standard penetration testing and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment. The shallow groundwater conditions were noted in the open boreholes during drilling and the boreholes were backfilled and sealed upon completion of drilling. All of the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective classification testing.

The field work for this investigation was directed by members of our engineering staff who also determined the borehole locations in the field, logged the boreholes and cared for the samples obtained. The as-drilled borehole locations and corresponding ground surface elevations were provided by RPE Surveying and are understood to be referenced to geodetic datum.

SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing, are shown in detail on the Record of Borehole sheets following the text of this report. Lists of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. The soils laboratory test results are shown on Figures 3

to 8 following the borehole logs. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this preliminary investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying 0.15 to 0.2 m of topsoil, the subsoil conditions predominantly consist of deposits of silty sand till and/or sandy silt till and till-like materials, underlain by sands or silty sand at most locations. Shallow discontinuous deposits of silty clay and gravelly sand were also encountered in some of the boreholes. Shallow groundwater was encountered in only one of the eight boreholes, at a depth of 2.4 m below the existing ground surface.

TOPSOIL

Topsoil was encountered in all boreholes advanced at the site. The topsoil thickness encountered at the borehole locations ranged from 0.15 to 0.2 m, as summarized in the following table:

BOREHOLE	TOPSOIL THICKNESS (mm)
12	200
13	200
14	180
15	150
16	150
17	150
18	180
19	180

Silty Sand Till and Sandy Silt Till

Silty sand till and/or sandy silt till are the predominant native soil types at the site and were encountered in all boreholes. Boreholes 12, 15 and 17 were also terminated in these tills, which contain cobbles and boulders. Standard penetration tests carried out within the silty tills gave N values ranging from 13 to greater than 100 blows per 0.3 m, indicating a compact to very dense relative density. The natural water contents of the silty till samples ranged from 6 to 15 percent. One grain size distribution curve for samples of the silty sand till and sandy silt till, recovered from the 35 mm internal diameter split spoon sampler, are shown on Figures 3 and 4, respectively.

Silty Sand

Silty sand was encountered in Boreholes 13 and 14 underlying the tills. These boreholes were also terminated in the silty sand. Standard penetration tests carried out within the silty sand gave N values ranging from 75 to greater than 100 blows per 0.3 m, indicating a dense to very dense relative density. The natural water contents of the silty sand samples ranged from 6 to 7 percent.

Gravelly Sand

Deposits of gravelly sand were encountered in Boreholes 17 and 19, within the silty sand till or sand deposits. Two standard penetration tests carried out within the gravelly sand gave N values greater than 100 blows per 0.3 m, indicating a very dense relative density. The natural water contents of the gravelly sand samples were 2 and 3 percent. One grain size distribution curve for a sample of the gravelly sand, recovered from the 35 mm internal diameter split spoon sampler, is shown on Figure 5.

Fine to Medium Sand

Deposits of fine to medium sand were encountered underlying tills in Boreholes 16, 18 and 19. These boreholes were also terminated in the sand. Standard penetration tests carried out within the sand gave N values ranging from 58 to greater than 100 blows per 0.3 m, indicating a very dense relative density. The natural water contents of the sand samples ranged from 2 to 8 percent. A grain size distribution curve for a sample of the fine to medium sand is shown on Figure 6.

Till-like Silty Sand or Sandy Silt

Shallow strata of till-like silty sand or sandy silt were encountered in Boreholes 12, 13, 15, 16, 17 and 19, overlying the tills. Standard penetration tests carried out within the till-like materials gave N values ranging from 5 to 8 blows per 0.3 m, indicating a loose relative density. The natural water contents of the till-like samples ranged from 10 to 26 percent.

Silty Clay

Shallow layers of silty clay were encountered in Boreholes 15, 16, 17 and 18, overlying the till-like or till deposits. Standard penetration tests carried out within the silty clay gave N values ranging from 5 to 14 blows per 0.3 m, indicating a firm to stiff consistency. The natural water contents of the silty clay samples ranged from 15 to 38 percent. A grain size distribution curve for a sample of the silty clay is shown on Figure 7. The liquid and plastic limits for a sample of the silty clay were 56 and 29 percent, respectively; indicating an inorganic clay of high plasticity, as shown on the Plasticity Chart, Figure 8.

Fill

Shallow layers of fill consisting mainly of sandy silt to silty sand were encountered in Boreholes 14 and 18, overlying the silty sand till or silty clay deposits. This material could represent disturbed native soil due to agricultural operations. Two standard penetration tests carried out within the fill gave N values of 3 and 7 blows per 0.3 m, indicating a very loose to loose relative density. The in-situ water contents of the two fill samples were 24 and 43 percent.

Shallow Groundwater

Shallow groundwater was only encountered in Borehole 18 during drilling, at a depth of 2.4 m below the existing ground surface. All other boreholes were found to be dry upon completion of drilling. It should be noted that these observations reflect the shallow groundwater conditions encountered in the boreholes during the time of the field investigation (late-March to early April, 2008) and some seasonal fluctuations should be anticipated.

DISCUSSION

This section of the report provides preliminary geotechnical information based on our interpretation of the limited borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for planning and preliminary design purposes and is not sufficient for final design or construction purposes. Once the actual development plans and pertinent design details are available (e.g. road, lot and/or building layout, underground service locations/depths, etc.), the results of this preliminary investigation should be reviewed by the geotechnical engineer and an additional site specific investigation carried out, compatible with the final development plans for the site.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report and have not been investigated or addressed. However, as previously noted, Golder is providing concurrent Phase I ESA services for this site (reported under separate cover).

Preliminary Geotechnical Information

It is understood that consideration is being given to developing the site with a residential and/or commercial development. Based on the results of this preliminary investigation, the subsurface native soils encountered at the site are generally considered to be suitable for supporting the proposed development. The following preliminary geotechnical information is provided for the planning and preliminary design of residential houses or commercial buildings, underground services and paved roads at the site:

- Depending upon the final site grading scheme and proposed basement and/or at-grade floor slab elevations, the areas should be brought up to the underside of the footings and/or floor slabs, as required, using engineered fill. The materials proposed for use as engineered fill should be approved by qualified geotechnical personnel at the source, prior to hauling to the site. Most of the native soils at the site would be suitable for reuse as engineered fill. Imported materials meeting the requirements of OPSS Select Subgrade Material (SSM) would also be suitable for use as engineered fill. Details regarding placement and compaction requirements for engineered fill, if utilized at the site, can be provided once the actual development plans are available, as part of the final geotechnical recommendations for the project.
- The native subsoils at the site (underlying the fill or disturbed native soil) are considered to be suitable for supporting conventional residential houses (with basements) or single storey, slab-on-grade commercial buildings. A preliminary allowable bearing pressure in the range of 150 to 200 kPa may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed subsoils, at depths of approximately 0.8 to 1.8 m below the existing ground surface (or deeper as required for basements). It should be noted that the shallow, relatively loose till-like subsoils (vicinity of Boreholes 12, 13, 15, 16, 17 and 19) are generally not suitable for supporting houses/buildings. Footings founded on approved engineered fill, if utilized at the site, may be designed using a preliminary allowable bearing pressure in the range of 100 to 150 kPa.
- The need for and type of foundation drainage system required (perimeter drains and/or underslab drains; damp-proofing or water-proofing) depends upon the proposed founding elevations, soil types in the area and actual stabilized groundwater levels. Based on the results of this preliminary investigation, it is anticipated that conventional foundation drainage (i.e. perimeter drains and damp-proofing) would be adequate at most locations. However, basements founded in the wet sands below a depth of 4 m (vicinity of Borehole 18) may require water-proofing. For floor slabs at or above exterior grades, foundation drainage would likely not be required. In any event, the need for and type of foundation drainage should be confirmed by the geotechnical engineer once the site grading plans are available, as part of final design process.
- Based on the results of this preliminary investigation, for shallow excavations for underground services up to about 4 m in depth, groundwater control during excavation can probably be handled, if required, by pumping from properly constructed and filtered sumps located at the base of the excavation. However, it should be noted that cohesionless sandy subsoils are present underlying the tills at this site. Excavations into these soils, where they are below the local water table (e.g. vicinity of Borehole 18), may require more positive dewatering measures, in addition to pumping from sumps, to maintain the stability of the trench side slopes and base to facilitate construction. In this regard, stabilized groundwater levels at the site should be determined as part of the follow-up, site specific geotechnical

investigation at the site. The need for and type of groundwater control measures can then be reviewed by the geotechnical engineer as part of the final design process.

- It is anticipated that the trench excavations for underground servicing would consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, some local flattening of side slopes may be required in some areas in looser soil zones or where significant water seepage is encountered. Conventional bedding thicknesses are anticipated for underground services founded within the native competent subsoils at the site. Additional bedding thicknesses may be required for services founded in wet sands, depending upon the excavation depths and success of the contractor's groundwater control measures, if required.
- The majority of the native subsoils above the local water table are generally near their estimated optimum water contents for compaction and should be suitable for reuse as trench backfill, provided they are free of significant amounts of topsoil, organics and other deleterious materials. Excavated subsoils from below the local water table (i.e. for deeper excavations, if required) would likely require some drying prior to placement.
- Complete removal of any existing septic systems, wells, old foundations, etc. would likely be required as part of the site redevelopment.
- Based on the subsoil conditions encountered, conventional asphaltic (flexible) pavement designs are considered to be appropriate for a proposed residential and/or commercial development at the site. Typical pavement designs are as follows:

TYPICAL COMMERCIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)	
		Truck Routes and Main Access Roads	Car Parking and Internal Access Roads
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	50
Granular Material (OPSS 1010)	Granular A Base	150	150
	Granular B Type I Subbase	400	300
		Prepared and Approved Subgrade	

TYPICAL RESIDENTIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)		
		Local Street	Collector Street	Major Collector
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40	40
	HL 8 Binder Course	50	65	90
Granular Material (OPSS 1010)	Granular A Base	150	150	150
	Granular B Type I Subbase	300	400	450
		Prepared and Approved Subgrade		

Prior to placing the granular subbase material, the exposed soil subgrade should be heavily proof-rolled in conjunction with inspection by qualified geotechnical personnel. Deleterious, organic and/or softened native subsoils or fills will require subexcavation and replacement with approved material (i.e. controlled fill), as directed by geotechnical personnel.

We trust that this report provides sufficient preliminary geotechnical engineering information to aid in the planning and preliminary design of the proposed residential and/or commercial development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

DRAFT

David B. Liu, P.Eng.
Geotechnical Engineer

DRAFT

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Enclosures: Abbreviations & Symbols
 Record of Borehole Sheets 12 to 19
 Figures 1 to 8
 Appendix A – Important Information and Limitations of This Report

LIST OF ABBREVIATIONS

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

I SAMPLE TYPE		III SOIL DESCRIPTION		
AS	Auger sample	(a) Cohesionless Soils		
BS	Block sample	Density Index	N	
CS	Chunk sample	(Relative Density)	<u>Blows/300 mm</u>	
DO	Drive open		<u>or Blows/ft.</u>	
DS	Denison type sample	Very loose	0 to 4	
FS	Foil sample	Loose	4 to 10	
RC	Rock core	Compact	10 to 30	
SC	Soil core	Dense	30 to 50	
ST	Slotted tube	Very dense	over 50	
TO	Thin-walled, open			
TP	Thin-walled, piston			
WS	Wash sample			
II PENETRATION RESISTANCE		(b) Cohesive Soils		
Standard Penetration Resistance (SPT), N:		Consistency	c_u, s_u	
The number of blows by a 63.5 kg. (140 lb.)			<u>kPa</u>	<u>psf</u>
hammer dropped 760 mm (30 in.) required		Very soft	0 to 12	0 to 250
to drive a 50 mm (2 in.) drive open		Soft	12 to 25	250 to 500
sampler for a distance of 300 mm (12 in.).		Firm	25 to 50	500 to 1,000
		Stiff	50 to 100	1,000 to 2,000
		Very stiff	100 to 200	2,000 to 4,000
		Hard	over 200	over 4,000
Dynamic Penetration Resistance; N_d :		IV. SOIL TESTS		
The number of blows by a 63.5 kg (140 lb.)		w	water content	
hammer dropped 760 mm (30 in.) to drive		w_p	plastic limit	
uncased a 50 mm (2 in.) diameter, 60° cone		w_l	liquid limit	
attached to "A" size drill rods for a distance		C	consolidation (oedometer) test	
of 300 mm (12 in.).		CHEM	chemical analysis (refer to text)	
PH:	Sampler advanced by hydraulic pressure	CID	consolidated isotropically drained triaxial test ¹	
PM:	Sampler advanced by manual pressure	CIU	consolidated isotropically undrained triaxial	
WH:	Sampler advanced by static weight of hammer		test with porewater pressure measurement ¹	
WR:	Sampler advanced by weight of sampler and rod	D_R	relative density (specific gravity, G_s)	
Piezo-Cone Penetration Test (CPT):		DS	direct shear test	
An electronic cone penetrometer with		M	sieve analysis for particle size	
a 60° conical tip and a projected end area		MH	combined sieve and hydrometer (H) analysis	
of 10 cm ² pushed through ground		MPC	Modified Proctor compaction test	
at a penetration rate of 2 cm/s. Measure-		SPC	Standard Proctor compaction test	
ments of tip resistance (Q_t), porewater		OC	organic content test	
pressure (PWP) and friction along a		SO ₄	concentration of water-soluble sulphates	
sleeve are recorded electronically		UC	unconfined compression test	
at 25 mm penetration intervals.		UU	unconsolidated undrained triaxial test	
		V	field vane test (L.V-laboratory vane test)	
		γ	unit weight	

Note:

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

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (con't.)

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

(c) Hydraulic Properties

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

(d) Consolidation (one-dimensional)

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

(e) Shear Strength

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

Notes: 1. $\tau = c' + \sigma' \tan \phi'$

2. Shear strength = (Compressive strength)/2

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 12

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 31, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE												
							20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³				
							SHEAR STRENGTH		nat V.	+	Q -	WATER CONTENT PERCENT						
							Cu, kPa		rem V.	⊕	⊖	Wp — W — Wi						
							25	50	75	100		10	20	30	40			
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE																
		TOPSOIL		0.00	1A													
		Loose brown SILTY SAND, some clay, trace gravel (TILL-LIKE)		0.20	1B	50 DO	5											
1					2	50 DO	5											
		Compact to very dense, brown SANDY SILT, some clay, trace to some gravel, cobbles and boulders (TILL)		1.22	3	50 DO	20											
2					4	50 DO	29											
3					5	50 DO	55											
4					6	50 DO	90											
5				7	50 DO	50/ .10												
6																		
7		END OF BOREHOLE		6.35														
8																		
9																		
10																		

Borehole open and dry upon completion of drilling, March 31, 2008

DEPTH SCALE

1 : 50



LOGGED:

CHECKED:

Borehole open and dry
upon completion of
drilling, March 31,
2008

LDN_BHS 08-1186-0506B.GPJ GLDR LDN.GDT 4/18/08 DATA INPUT: PJV April 7, 2008

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 13

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 31, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH				WATER CONTENT PERCENT					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		

Borehole open and dry
upon completion of
drilling, March 31,
2008

DEPTH SCALE

1 : 50



LOGGED:

CHECKED:

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 14

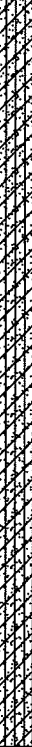
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 31, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m										
									20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³					
									SHEAR STRENGTH Cu, kPa				nat V. + Q - rem V. ⊕ U - ○					WATER CONTENT PERCENT Wp — WV — Wi
								25	50	75	100	10	20	30	40			
0		GROUND SURFACE																
	POWER AUGER 115 mm Diameter Solid Stem Augers	TOPSOIL		0.00	1A													
		Loose brown sandy silt to silty sand, trace clay, trace gravel (possible FILL or disturbed native soil)		0.18	1B	50 DO	7								○			
		Compact to very dense brown SILTY SAND, trace to some clay, trace to some gravel, cobbles and boulders (TILL)		0.61	2	50 DO	25								○			
					3	50 DO	42						○					
					4	50 DO	50						○					
					5	50 DO	73						○					
					6	50 DO	78						○					
					7	50 DO	50/ .15						○					
		Very dense brown SILTY SAND, trace gravel		5.56														
6			END OF BOREHOLE		6.25													
7																	Borehole open and dry upon completion of drilling, March 31, 2008	
10																		

Borehole open and dry
upon completion of
drilling, March 31,
2008

DEPTH SCALE

1 : 50



LOGGED:

CHECKED:

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 15

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 31, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE												
								SHEAR STRENGTH				WATER CONTENT PERCENT						
								Cu, kPa	nat V. rem V.	+ ⊕	Q - U -	● ○	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³
							20	40	60	80								
							25	50	75	100								
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE																
		TOPSOIL		0.00	1A													
		Firm brown SILTY CLAY, trace sand		0.15	1B	50 DO	7											
		Loose brown SANDY SILT, some clay, trace gravel, cobbles (TILL-LIKE)		0.61	2	50 DO	7											
1																		
						3	50 DO	5										
2			Compact to very dense brown SILTY SAND, trace clay, some gravel (TILL)		1.83	4	50 DO	13										
3					5	50 DO	72											
4																		
5					6	50 DO	90											
6																		

Borehole open and dry
upon completion of
drilling, March 31,
2008

DEPTH SCALE

1 : 50



LOGGED:

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LDN_BHS 08-1186-0506B.GPJ GLDR_LDN.GDT 4/18/08 DATA INPUT: PJV April 7, 2008

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 16

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 1, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		
								SHEAR STRENGTH Cu, kPa	nat V. + rem V. ⊕	Q - ● U - ○		WATER CONTENT PERCENT Wp ——— W ——— WI					
								25	50	75	100	10	20	30	40		
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE															
		TOPSOIL		0.00	1A												
		Firm brown SILTY CLAY, trace sand		0.15	1B	50 DO	5								○		
															○		
		Loose brown SILTY SAND, trace clay, trace gravel (TILL-LIKE)		0.61	2	50 DO	8								○		
1																	
		Compact to dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		1.22	3	50 DO	17								○		
															○		
2						4	50 DO	25							○		
3					5	50 DO	45							○			
4																	
5					6	50 DO	30							○			
6		Very dense brown fine to medium SAND, some silt, some gravel		5.56													
					7	50 DO	58							○			
7		END OF BOREHOLE		6.55													
8																	
9																	
10																	

Borehole open and dry upon completion of drilling, April 1, 2008

Borehole open and dry
upon completion of
drilling, April 1, 2008

DEPTH SCALE

1 : 50



LOGGED:

CHECKED:

LDN_BHS 08-1186-0506B.GPJ GLDR LDN.GDT 4/18/08 DATA INPUT: PJV April 7, 2008

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 17

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 31, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER		TYPE	20		40		60		80			
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - U -		WATER CONTENT PERCENT			
							25	50	75	100		10	20	30	40		
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE															
		TOPSOIL		0.00	1A												
		Firm brown SILTY CLAY, trace to some sand		0.15	1B	50 DO	7										
		Loose brown SILTY SAND, trace clay, trace gravel (TILL-LIKE)		0.61	2	50 DO	8										
1		Compact to dense brown SILTY SAND, trace to some clay, trace to some gravel, cobbles and boulders (TILL)		1.22	3	50 DO	14										
2					4	50 DO	22										
3					5	50 DO	35										
4		Very dense brown GRAVELLY SAND, some silt, cobbles and boulders		4.04	6	50 DO	50/.08										
5		Very dense brown SILTY SAND, trace clay, some gravel, cobbles and boulders (TILL)		5.46	7	50 DO	50/.08										
6		END OF BOREHOLE		6.33													
7																	
8																	
9																	
10																	

Borehole open and dry upon completion of drilling, March 31, 2008

Borehole open and dry upon completion of drilling, March 31, 2008

DEPTH SCALE

1 : 50



LOGGED:

CHECKED:

LDN_BHS 08-1186-0506B.GPJ GLDR LDN.GDT 4/18/08 DATA INPUT: PJV April 7, 2008

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 18

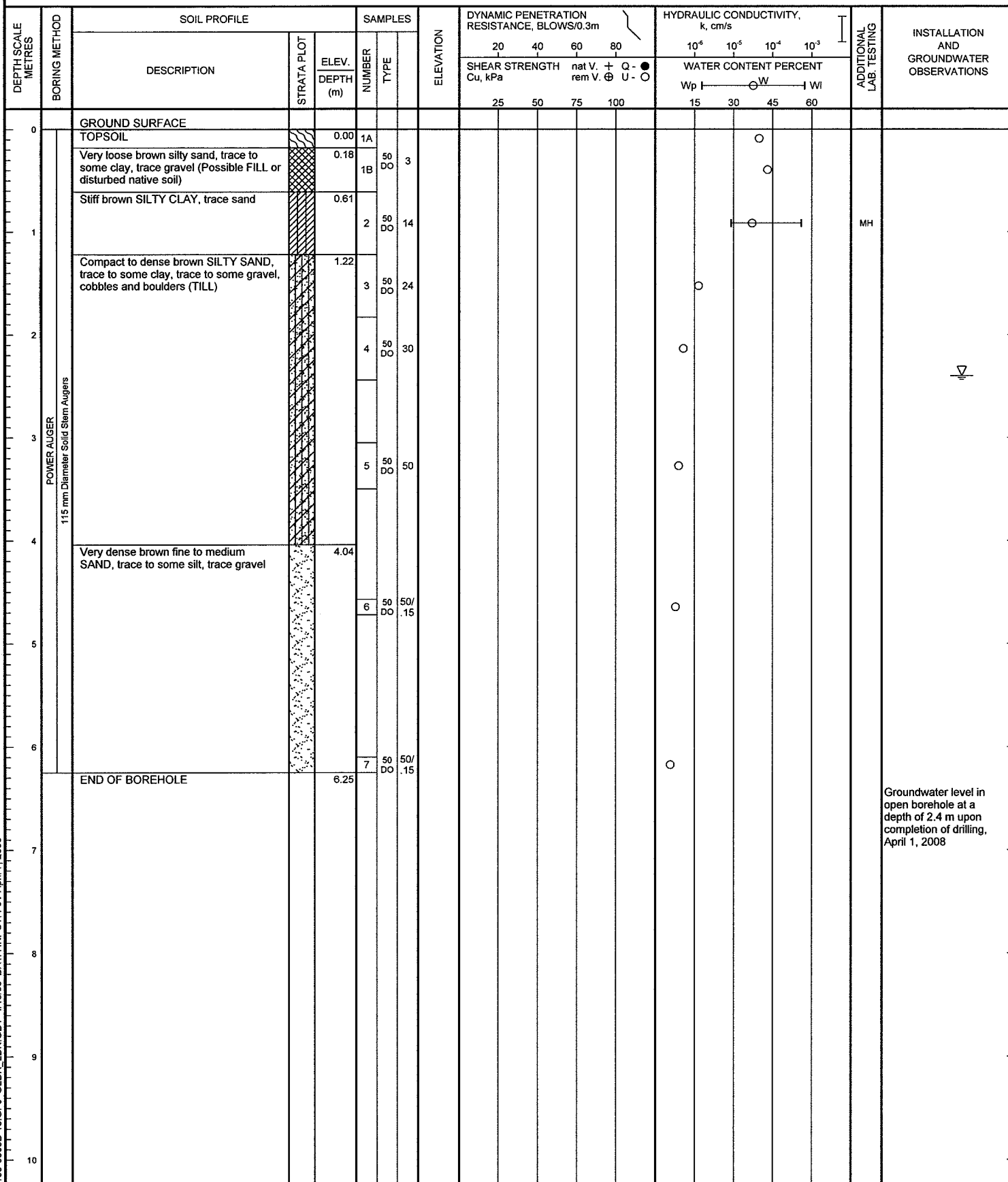
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 1, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE

1 : 50



LOGGED:

CHECKED:

PROJECT: 08-1186-0506B

RECORD OF BOREHOLE 19

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 1, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE											
								SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT Wp ———— W ———— Wi					
							20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³			

Borehole caved to a
depth of 5.8 m upon
completion of drilling,
April 1, 2008Borehole dry upon
completion of drilling
on April 1, 2008

DEPTH SCALE

1 : 50

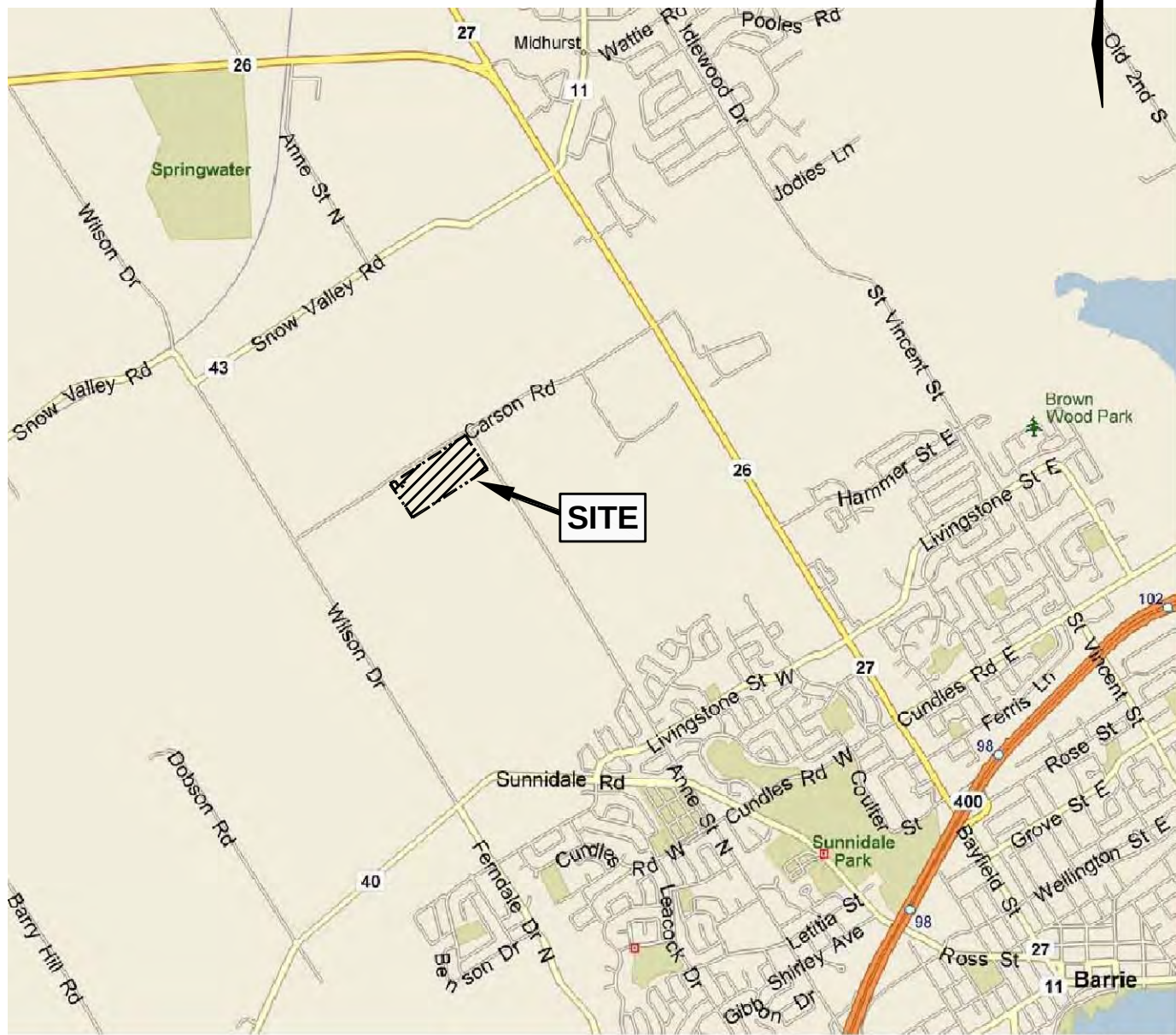


LOGGED:

CHECKED:

LDN BHS 08-1186-0506B.GPJ GLDR LDN.GDT 4/18/08 DATA INPUT: P/J April 7, 2008

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506B-002 - FIG 2008\03 A.Hickling - FIG 1-KP.dwg Apr 18, 2008 - 5:01pm



Base map by Microsoft Streets & Trips 2006
Microsoft Corp. and/or its suppliers, 1988- 2005;
NAVTEQ, 2004; and TeleAtlas North America,
Inc., 2004

PROJECT		Preliminary Geotechnical Investigation A. Hickling Property 1361 Carson Road Midhurst, Ontario			
TITLE		KEY PLAN			
 Whitby, Ontario		PROJECT No.08-1186-0506B-G		FILE No. 002	
		DESIGN		SCALE	AS SHOWN
		CADD	PJV	April 2008	REV.
		CHECK		FIGURE 1	
		REVIEW			

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506\A.Hickling\08-1186-0506B-001 -FIG 2008'03 A.Hickling - FIG 2.dwg Apr 18, 2008 - 5:01pm



NOT TO SCALE
ALL LOCATIONS ARE APPROXIMATE

LEGEND

 BOREHOLE LOCATION IN PLAN



Aerial Photograph by Google Earth Pro 2007,
Image 2008 First Base Solutions.

PROJECT		Preliminary Geotechnical Investigation A. Hickling Property 1361 Carson Road Midhurst, Ontario			
TITLE		SITE LOCATION PLAN			
	PROJECT	No.08-1186-0506B-G		FILE No.	001
	DESIGN			SCALE	AS SHOWN
	CADD	PJV	April, 2008		REV.
	CHECK				
	REVIEW				
FIGURE 2					

GRAIN SIZE DISTRIBUTION SILTY SAND TILL

FIGURE 3

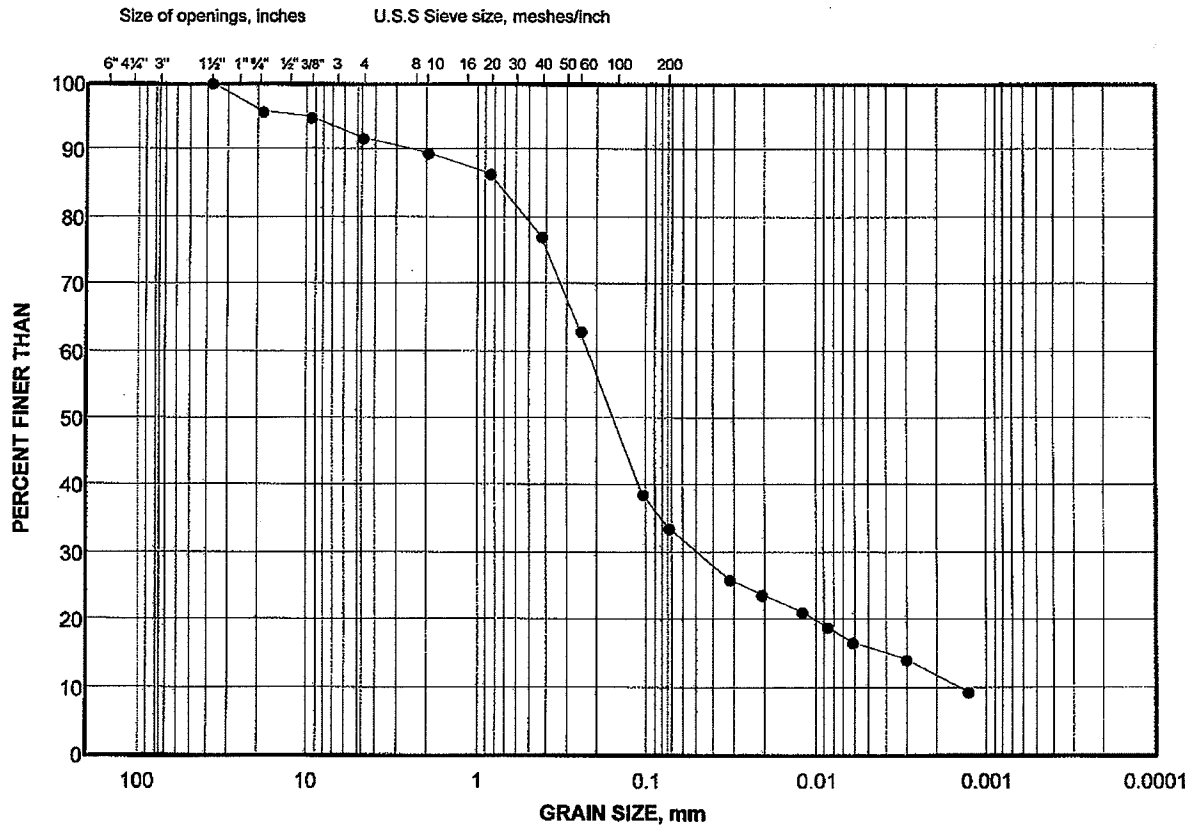


FIGURE 4

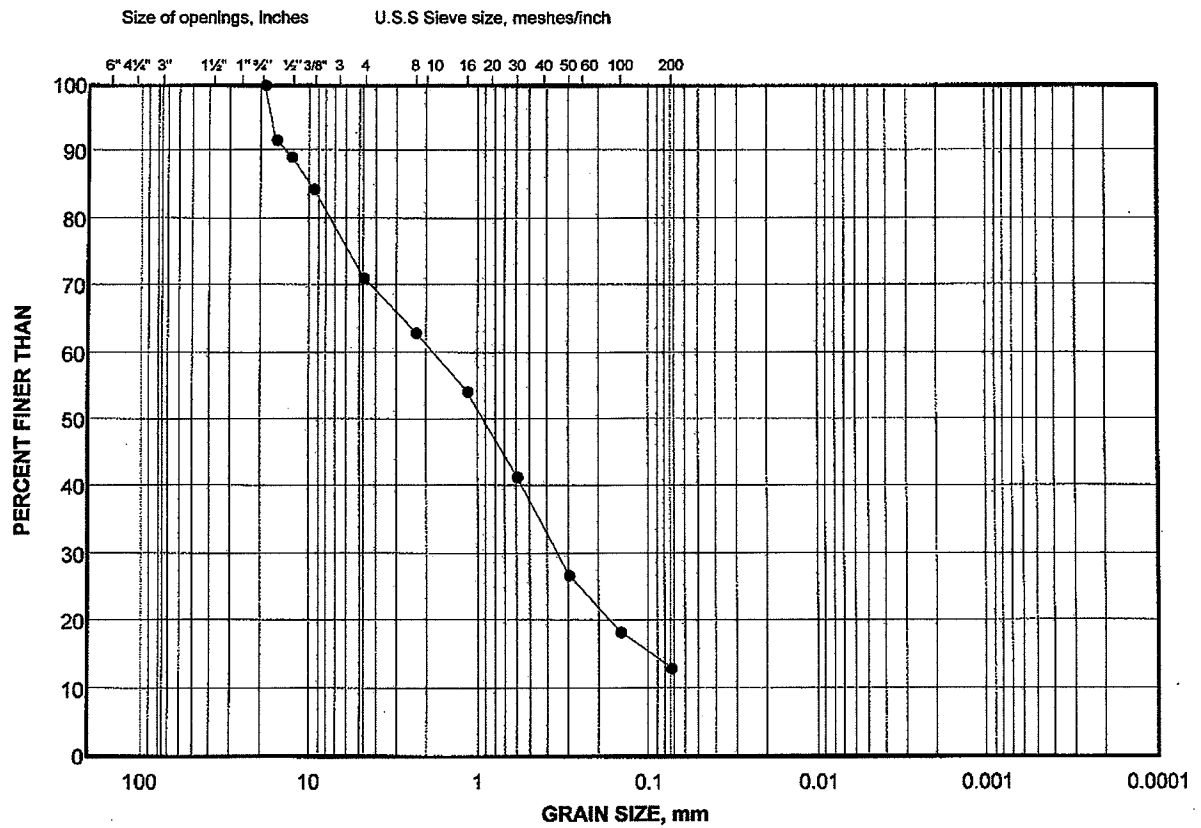


SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	12	3	1.20 - 1.80

Date: 15-Apr-08

GRAIN SIZE DISTRIBUTION GRAVELLY SAND

FIGURE 5



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	19	6	4.60 - 4.90

Project Number: 08-1186 0506B

Checked By: 

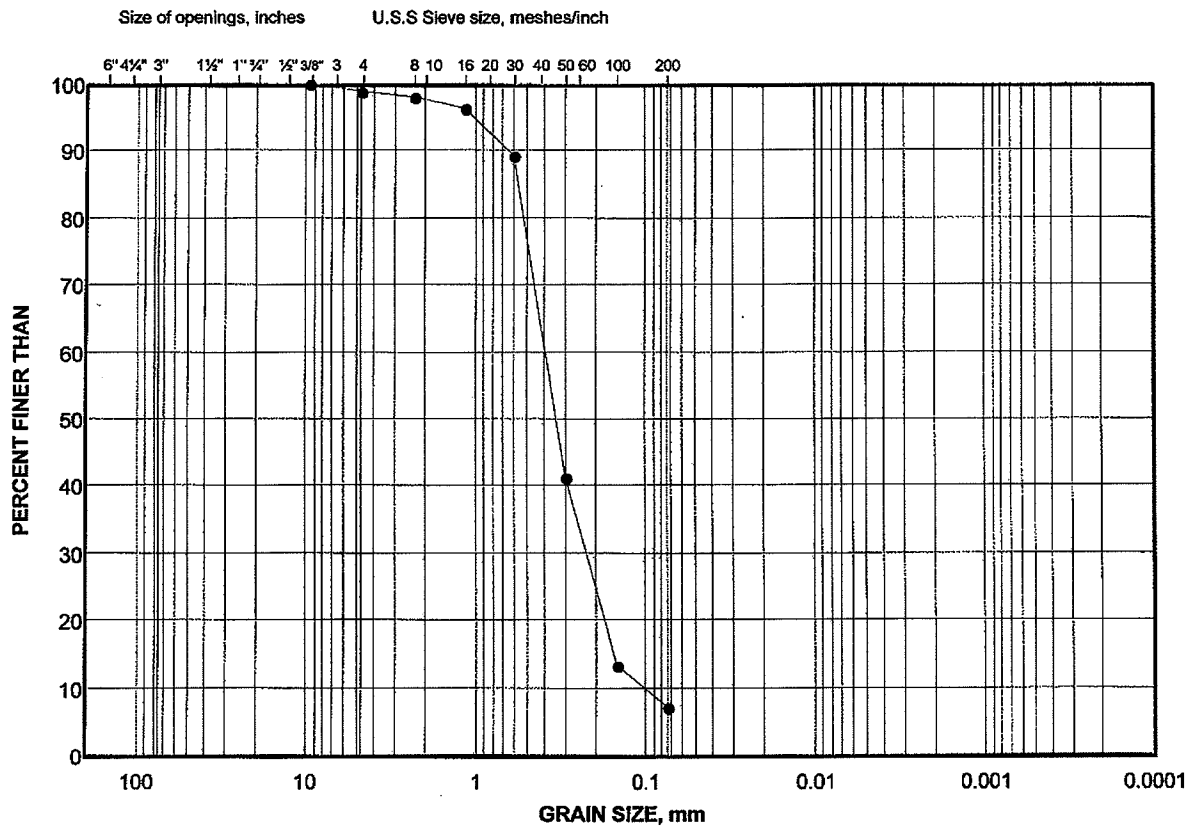
Golder Associates

Date: 15-Apr-08

GRAIN SIZE DISTRIBUTION

Fine to Medium SAND

FIGURE 6



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	19	7	6.10 - 6.30

Project Number: 08-1186 0506B

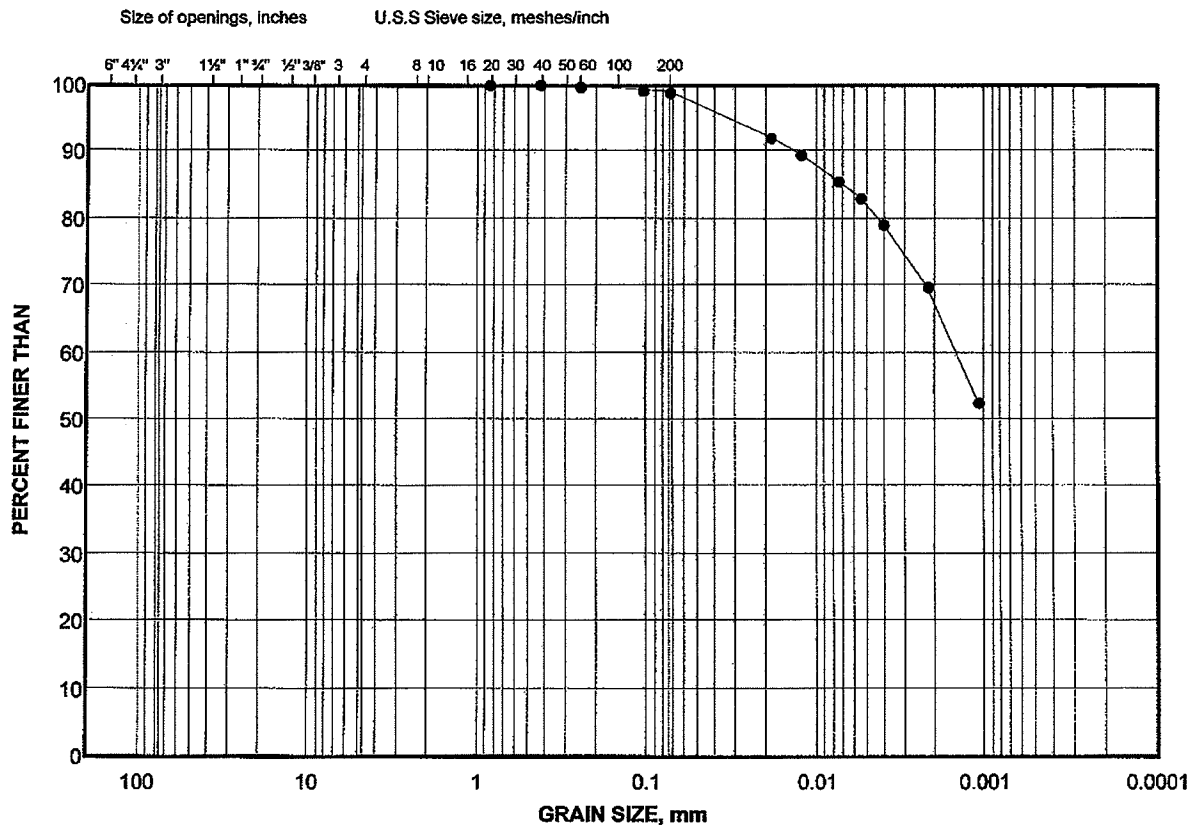
Checked By:

Golder Associates

Date: 15-Apr-08

GRAIN SIZE DISTRIBUTION SILTY CLAY

FIGURE 7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	18	2	0.60 - 1.20

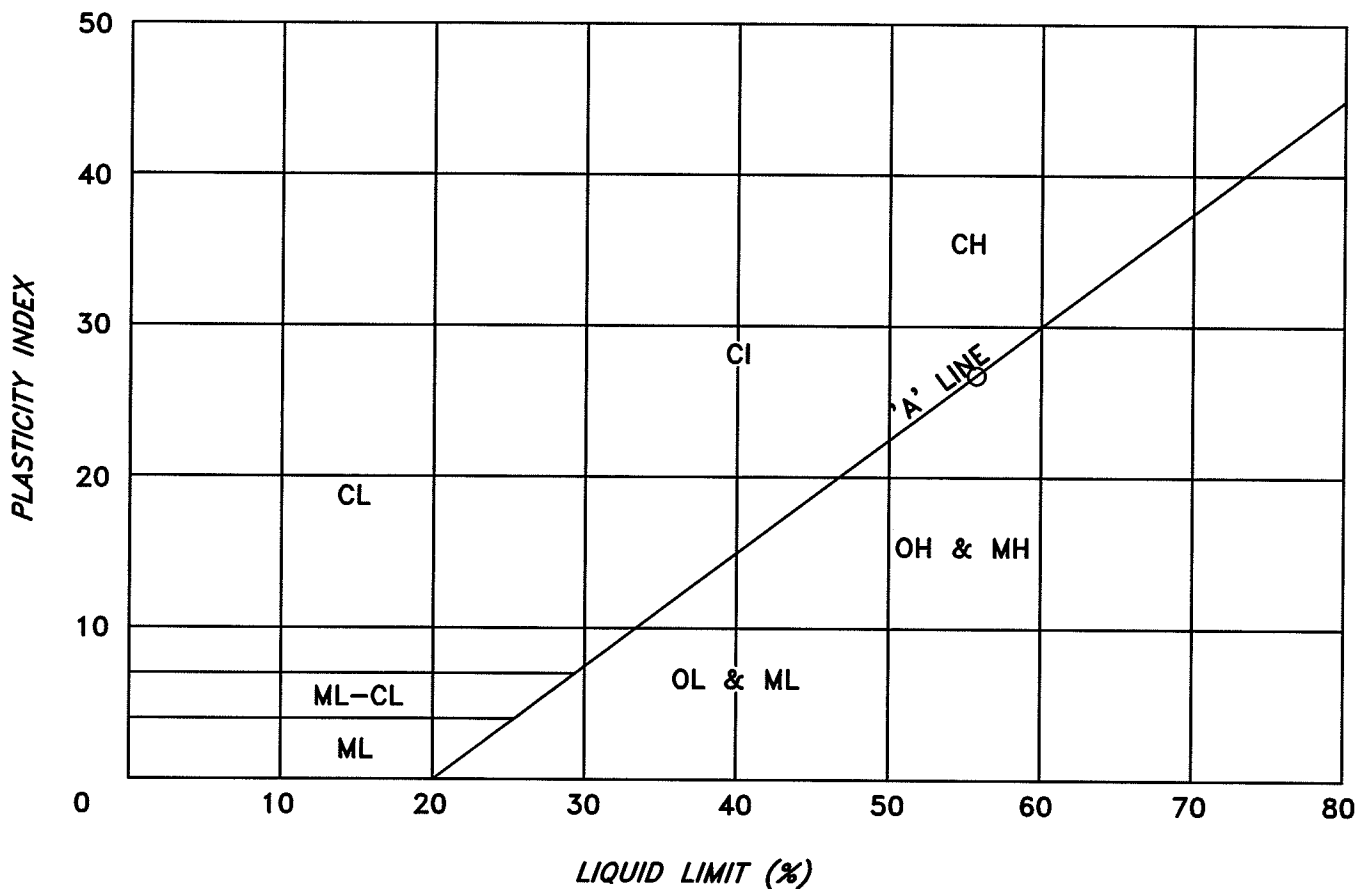
Project Number: 08-1186 0506B

Checked By: *[Signature]*

Golder Associates

Date: 15-Apr-08

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506\A.Hickling\08-1186-0506B-003 -FIG 2008'03 A.Hickling - FIG 3-- Plasticity.dwg Apr 18, 2008 -- 1:49pm



SOIL TYPE		PLASTICITY	
C	Clay	L	Low
M	Silt	I	Intermediate
O	Organic	H	High

	BOREHOLE	SAMPLE	SAMPLE DESCRIPTION
⊙	18	2	Silty Clay



Golder Associates
Whitby, Ontario

SCALE AS SHOWN
DATE 04/18/08
DESIGN
CADD PJV

TITLE

PLASTICITY CHART

FILE No. 003

CHECK

PROJECT No. 08-186-0506B REV.

REVIEW

FIGURE

8

Appendix A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing in Saskatchewan, subject to the time limits and physical constraints applicable to this report. No other warranty, express or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. *No other party may use or rely on this report or any portion thereof without Golder's express written consent. Golder will consent to any reasonable request by the Client to approve the use of this report by other parties as Approved Users.* The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media are susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. *In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use by any party of portions of the report without reference to the entire report.*

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (CONTINUED)

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgement, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction is necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

Golder Associates Ltd.

100 Scotia Court
Whitby, Ontario, Canada L1N 8Y6
Telephone: (905) 723-2727
Fax: (905) 723-2182



**DRAFT
REPORT ON**

**PRELIMINARY GEOTECHNICAL INVESTIGATION
ROME ELLIOTT PROPERTY
MIDHURST, ONTARIO**

Submitted to:

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

Distribution:

- 1 Copy (Digital) - Geranium Corporation, Markham, Ontario
- 1 Copy - Golder Associates Ltd., Whitby, Ontario

April, 2008

08-1186-0506D(G)



Golder Associates Ltd.

100 Scotia Court
Whitby, Ontario, Canada L1N 8Y6
Telephone: (905) 723-2727
Fax: (905) 723-2182



April 17, 2008

08-1186-0506D(G)

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

**RE: PRELIMINARY GEOTECHNICAL INVESTIGATION
ROME ELLIOTT PROPERTY
MIDHURST, ONTARIO**

This report presents the results of a preliminary geotechnical investigation carried out at the above referenced site, as shown on the Key Plan, Figure 1. The purpose of the investigation was to determine the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of shallow boreholes. Based on our interpretation of the borehole data, this report provides preliminary geotechnical information for the planning of a proposed residential and/or commercial development at the site. Authorization to proceed with this investigation was provided by Ms. Shauna Dudding, P.Eng. of Geranium Corporation, in an email dated March 3, 2008.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder Associates Ltd. (Golder) should be given an opportunity to confirm that the preliminary recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report", included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. Further, the environmental aspects (i.e. Phase I ESA) at the site are being addressed concurrently by Golder (reported under separate cover).



SITE DESCRIPTION

The site is located south of Carson Road, between Anne Street and Glenhuron Drive, in Midhurst, Ontario. The site is approximately 100 acres in size and is generally flat with gentle overall slope toward the west. The majority of the site is currently used for agricultural purposes; however, the eastern portion of the site is treed.

PHYSIOGRAPHY

The site lies near the border of the physiographic regions of Southern Ontario known as the Simcoe Lowlands and Simcoe Uplands (Chapman and Putnam 1984). Physiographic mapping in the immediate vicinity of the site indicates glaciolacustrine deposits of sands bordering on tills with predominantly sandy silt matrix (Map 2556, Quaternary Geology of Southern Ontario, Barnett, Cowan and Henry, 1991). This physiographic mapping is generally consistent with the results of the current investigation.

INVESTIGATION PROCEDURE

The field work for this preliminary investigation was carried out on March 27 and 28, 2008 during which time nine boreholes (Nos. 29 to 37) were advanced at the locations shown on the Location Plan, Figure 2. The boreholes were drilled using a track-mounted drillrig supplied and operated by Eastern Soil Investigation Limited, under our supervision. Standard penetration testing and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment. The shallow groundwater conditions were noted in the open boreholes during drilling and the boreholes were backfilled and sealed upon completion of drilling. All of the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective classification testing.

The field work for this investigation was directed by members of our engineering staff who also determined the borehole locations in the field, logged the boreholes and cared for the samples obtained. The as-drilled borehole locations and corresponding ground surface elevations were provided by RPE Surveying and are understood to be referenced to geodetic datum.

SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing, are shown in detail on the Record of Borehole sheets following the text of this report. Lists of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. The soils laboratory test results are shown on Figures 3 to 7 following the borehole logs. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an

exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this preliminary investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying 0.1 to 0.3 m of topsoil, the subsoil conditions predominantly consist of deposits of silty sand and fine to medium sand. Discontinuous deposits of silty sand till, silty clay and gravelly sand were also encountered in some of the boreholes. Shallow groundwater was encountered in only one of the nine boreholes, at a depth of 6.0 m below the existing ground surface.

TOPSOIL

Topsoil was encountered in all boreholes advanced at the site. The topsoil thickness encountered at the borehole locations ranged from 0.1 to 0.3 m, as summarized in the following table:

BOREHOLE	TOPSOIL THICKNESS (mm)
29	250
30	200
31	200
32	180
33	300
34	180
35	100
36	80
37	150

Silty Sand

Silty sand is one of the predominant native soil types at the site and was encountered in all boreholes. Boreholes 34, 35 and 37 were also terminated in the silty sand. Standard penetration tests carried out within the silty sand gave variable N values ranging from 4 to greater than 100 blows per 0.3 m, indicating a very loose to very dense relative density. The natural water contents of the silty sand samples ranged widely from 3 to 24 percent. Two grain size distribution curves for samples of the silty sand are shown on Figure 3.

Fine to Medium Sand

Fine to medium sand is the other predominant native soil type at the site and was encountered in six of the nine boreholes advanced at the site. Boreholes 29 to 32 and 36 were also terminated in the sand. Standard penetration tests carried out within the fine to medium sand gave N values ranging from 11 to greater than 100 blows per 0.3 m, indicating a compact to very dense relative

density. The natural water content of the sand samples ranged from 2 to 10 percent. A grain size distribution curve for a sample of the fine to medium sand is shown on Figure 4.

Silty Sand Till

Strata of silty sand till was encountered in Boreholes 29, 32 and 33, within or underlying the sandy deposits. Borehole 33 was terminated in the silty sand till. Although not encountered in the boreholes, the till is known to contain cobbles and boulders. Standard penetration tests carried out within the silty sand till gave variable N values ranging from 7 to 63 blows per 0.3 m, indicating a loose to very dense relative density. The natural water contents of the silty sand till samples ranged from 10 to 13 percent. A grain size distribution curve for a sample of the silty sand till, recovered from the 35 mm internal diameter split spoon sampler, is shown on Figure 5.

Silty Clay

Shallow layers of silty clay were encountered in Boreholes 30 and 35, overlying or within the silty sand deposits. Standard penetration tests carried out within the silty clay gave N values ranging from 4 to 10 blows per 0.3 m, indicating a soft to stiff consistency. The natural water contents of the silty clay samples ranged from 33 to 35 percent. A grain size distribution curve for a sample of the silty clay is shown on Figure 6. The liquid and plastic limits for a sample of the silty clay were 46 and 24 percent, respectively; indicating an inorganic clay of intermediate plasticity, as shown on the Plasticity Chart, Figure 7.

Shallow Groundwater

Shallow groundwater was only encountered in Borehole 33 during drilling, at a depth of 6.0 m below the existing ground surface. All other boreholes were found to be dry upon completion of drilling. It should be noted that these observations reflect the shallow groundwater conditions encountered in the boreholes during the time of the field investigation (late-March, 2008) and some seasonal fluctuations should be anticipated.

DISCUSSION

This section of the report provides preliminary geotechnical information based on our interpretation of the limited borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for planning and preliminary design purposes and is not sufficient for final design or construction purposes. Once the actual development plans and pertinent design details are available (e.g. road, lot and/or building layout, underground service locations/depths, etc.), the results of this preliminary investigation should be reviewed by the geotechnical engineer and an additional site specific investigation carried out, compatible with the final development plans for the site.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or

undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report and have not been investigated or addressed. However, as previously noted, Golder is providing concurrent Phase I ESA services for this site (reported under separate cover).

Preliminary Geotechnical Information

It is understood that consideration is being given to developing the site with a residential and/or commercial development. Based on the results of this preliminary investigation, the subsurface native soils encountered at the site are generally considered to be suitable for supporting the proposed development. The following preliminary geotechnical information is provided for the planning and preliminary design of residential houses or commercial buildings, underground services and paved roads at the site:

- Depending upon the final site grading scheme and proposed basement and/or at-grade floor slab elevations, the areas should be brought up to the underside of the footings and/or floor slabs, as required, using engineered fill. The materials proposed for use as engineered fill should be approved by qualified geotechnical personnel at the source, prior to hauling to the site. Most of the native soils at the site would be suitable for reuse as engineered fill. Imported materials meeting the requirements of OPSS Select Subgrade Material (SSM) would also be suitable for use as engineered fill. Details regarding placement and compaction requirements for engineered fill, if utilized at the site, can be provided once the actual development plans are available, as part of the final geotechnical recommendations for the project.
- The native subsoils at the site are considered to be suitable for supporting conventional residential houses (with basements) or single storey, slab-on-grade commercial buildings. A preliminary allowable bearing pressure in the range of 100 to 150 kPa may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed subsoils, at depths of approximately 0.8 to 1.8 m below the existing ground surface (or deeper as required for basements). Footings founded on approved engineered fill, if utilized at the site, may be designed using a preliminary allowable bearing pressure in the range of 100 to 150 kPa.
- The need for and type of foundation drainage system required (perimeter drains and/or underslab drains; damp-proofing or water-proofing) depends upon the proposed founding elevations, soil types in the area and actual stabilized groundwater levels. Based on the results of this preliminary investigation, it is anticipated that conventional foundation drainage (i.e. perimeter drains and damp-proofing) would be adequate at most locations. For floor slabs at or above exterior grades, foundation drainage would likely not be required. In

any event, the need for and type of foundation drainage should be confirmed by the geotechnical engineer once the site grading plans are available, as part of final design process.

- Based on the results of this preliminary investigation, for shallow excavations for underground services up to about 5 m in depth, groundwater control during excavation can probably be handled, if required, by pumping from properly constructed and filtered sumps located at the base of the excavation. However, it should be noted that cohesionless sandy subsoils are the predominant soil types at this site. Excavations into these soils, where they are below the local water table, may require more positive dewatering measures, in addition to pumping from sumps, to maintain the stability of the trench side slopes and base to facilitate construction. In this regard, stabilized groundwater levels at the site should be determined as part of the follow-up, site specific geotechnical investigation at the site. The need for and type of groundwater control measures can then be reviewed by the geotechnical engineer as part of the final design process.
- It is anticipated that the trench excavations for underground servicing would consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, some local flattening of side slopes may be required in some areas in looser soil zones or where significant water seepage is encountered. Conventional bedding thicknesses are anticipated for underground services founded within the native competent subsoils at the site. Additional bedding thicknesses may be required for services founded in wet sands, depending upon the excavation depths and success of the contractor's groundwater control measures, if required.
- The majority of the native subsoils above the local water table are generally near their estimated optimum water contents for compaction and should be suitable for reuse as trench backfill, provided they are free of significant amounts of topsoil, organics and other deleterious materials. Excavated subsoils from below the local water table (i.e. for deeper excavations, if required) would likely require some drying prior to placement.
- Complete removal of any existing septic systems, wells, old foundations, etc. would likely be required as part of the site redevelopment.
- Based on the subsoil conditions encountered, conventional asphaltic (flexible) pavement designs are considered to be appropriate for a proposed residential and/or commercial development at the site. Typical pavement designs are as follows:

TYPICAL COMMERCIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)	
		Truck Routes and Main Access Roads	Car Parking and Internal Access Roads
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	50
Granular Material (OPSS 1010)	Granular A Base	150	150
	Granular B Type I Subbase	400	300
		Prepared and Approved Subgrade	

TYPICAL RESIDENTIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)		
		Local Street	Collector Street	Major Collector
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40	40
	HL 8 Binder Course	50	65	90
Granular Material (OPSS 1010)	Granular A Base	150	150	150
	Granular B Type I Subbase	300	400	450
		Prepared and Approved Subgrade		

Prior to placing the granular subbase material, the exposed soil subgrade should be heavily proof-rolled in conjunction with inspection by qualified geotechnical personnel. Deleterious, organic and/or softened native subsoils or fills will require subexcavation and replacement with approved material (i.e. controlled fill), as directed by geotechnical personnel.

We trust that this report provides sufficient preliminary geotechnical engineering information to aid in the planning and preliminary design of the proposed residential and/or commercial development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

DRAFT

David B. Liu, P.Eng.
Geotechnical Engineer

DRAFT

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Senior Geotechnical Engineer, Associate

Enclosures: Abbreviations & Symbols
 Record of Borehole Sheets 29 to 37
 Figures 1 to 7
 Appendix A – Important Information and Limitations of This Report

AC/DL/DGG/tf
08-1186-0506 D-G REP 2008'04'17-Final

LIST OF ABBREVIATIONS

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

I	SAMPLE TYPE	III.	SOIL DESCRIPTION					
AS	Auger sample	(a)	Cohesionless Soils					
BS	Block sample	Density Index (Relative Density)	N	<u>Blows/300 mm</u>				
CS	Chunk sample				<u>or Blows/ft.</u>			
DO	Drive open			0 to 4				
DS	Denison type sample			4 to 10				
FS	Foil sample			10 to 30				
RC	Rock core			30 to 50				
SC	Soil core			over 50				
ST	Slotted tube							
TO	Thin-walled, open	(b)	Cohesive Soils					
TP	Thin-walled, piston	Consistency	C_u, S_u	kPa	psf			
WS	Wash sample							
						Very soft	0 to 12	0 to 250
						Soft	12 to 25	250 to 500
						Firm	25 to 50	500 to 1,000
						Stiff	50 to 100	1,000 to 2,000
		Very stiff	100 to 200	2,000 to 4,000				
		Hard	over 200	over 4,000				
II. PENETRATION RESISTANCE.		IV.	SOIL TESTS					
Standard Penetration Resistance (SPT), N:		w	water content					
The number of blows by a 63.5 kg. (140 lb.)		w _p	plastic limit					
hammer dropped 760 mm (30 in.) required		w _l	liquid limit					
to drive a 50 mm (2 in.) drive open		C	consolidation (oedometer) test					
sampler for a distance of 300 mm (12 in.).		CHEM	chemical analysis (refer to text)					
Dynamic Penetration Resistance; N _d :		CID	consolidated isotropically drained triaxial test ¹					
The number of blows by a 63.5 kg (140 lb.)		CIU	consolidated isotropically undrained triaxial					
hammer dropped 760 mm (30 in.) to drive			test with porewater pressure measurement ¹					
uncased a 50 mm (2 in.) diameter, 60° cone		D _R	relative density (specific gravity, G _s)					
attached to "A" size drill rods for a distance		DS	direct shear test					
of 300 mm (12 in.).		M	sieve analysis for particle size					
PH:	Sampler advanced by hydraulic pressure	MH	combined sieve and hydrometer (H) analysis					
PM:	Sampler advanced by manual pressure	MPC	Modified Proctor compaction test					
WH:	Sampler advanced by static weight of hammer	SPC	Standard Proctor compaction test					
WR:	Sampler advanced by weight of sampler and rod	OC	organic content test					
Piezo-Cone Penetration Test (CPT):		SO ₄	concentration of water-soluble sulphates					
An electronic cone penetrometer with		UC	unconfined compression test					
a 60° conical tip and a projected end area		UU	unconsolidated undrained triaxial test					
of 10 cm ² pushed through ground		V	field vane test (LV-laboratory vane test)					
at a penetration rate of 2 cm/s. Measure-		γ	unit weight					
ments of tip resistance (Q _t), porewater								
pressure (PWP) and friction along a								
sleeve are recorded electronically								
at 25 mm penetration intervals.								

Note:

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

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (con't.)

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

(c) Hydraulic Properties

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

(d) Consolidation (one-dimensional)

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

(e) Shear Strength

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

Notes: 1. $\tau = c' + \sigma' \tan \phi'$

2. Shear strength = (Compressive strength)/2

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 29

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 27, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE												
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³			
								SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT Wp ———— W ———— Wi						
								25	50	75	100		10	20	30	40		
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE																
		TOPSOIL		0.00	1A													
		Loose brown SILTY SAND, trace gravel		0.25	1B	50 DO	5											
					2	50 DO	7											
1					3	50 DO	5											
					4	50 DO	12											
2			Compact to very dense light brown SILTY SAND, trace to some clay, trace gravel (TILL)		1.83	5	50 DO	44										
					6	50 DO	60											
3					7	50 DO	64											
4			Very dense light brown GRAVELLY SAND, some silt		4.04													
					8	50 DO	50/ .13											
5																		
6			Very dense light brown fine to medium SAND, some silt, some gravel		5.56													
7		END OF BOREHOLE		6.38													Borehole open and dry upon completion of drilling, Mar. 27/08	
8																		
9																		
10																		

Borehole open and dry
upon completion of
drilling, Mar. 27/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506.GPJ GLDR LDN.GDT 4/10/08 DATA INPUT: PJV April 1/08

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 30

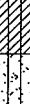
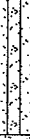
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 27, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE											
								SHEAR STRENGTH Cu, kPa		nat V. + Q - ● rem V. ⊕ U - ○		WATER CONTENT PERCENT Wp ———— W ———— Wi					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		
							25	50	75	100	10	20	30	40			
0		GROUND SURFACE															
	POWER AUGER 115 mm Diameter Solid Stem Augers	TOPSOIL		0.00	1A												
		Firm to stiff brown SILTY CLAY, some sand		0.20	1B	50 DO 6											
					2	50 DO 10											
1		Compact brown SILTY SAND, some gravel		1.22	3	50 DO 22											
					4	50 DO 23											
2		Dense to very dense light brown fine to medium SAND, some silt, trace to some gravel		2.44	5	50 DO 36											
					6	50 DO 64											
3																	
				7	50 DO 84												
4																	
5																	
6																	
7		END OF BOREHOLE		6.40	8	50 DO 50/.15											
8																	
9																	
10																	

Borehole open and dry upon completion of drilling, Mar. 27/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506.GPJ GLDR_LDN.GDT 4/10/08 DATA INPUT: PJV April 1/08

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 32

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 27, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER		TYPE	SHEAR STRENGTH Cu, kPa		nat V. + Q - ● rem V. ⊕ U - ○		WATER CONTENT PERCENT Wp ——— W ——— WI					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³
0		GROUND SURFACE		0.00	1A												
		TOPSOIL		0.18	1B												
		Loose brown SILTY SAND, trace gravel		0.61	2												
1		Loose brown SILTY SAND, some clay, trace gravel (TILL)		1.22	3												
		Dense to very dense light brown fine to medium SAND, some silt, trace gravel			4												
2					5												
					6												
3					7												
					8												
4																	
5																	
6																	
7																	
8																	
9																	
10																	
		END OF BOREHOLE		6.40													

Borehole open and dry
upon completion of
drilling, Mar. 27/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506.GPJ GLDR_LDN.GDT 4/10/08 DATA INPUT: PJV April 1/08

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 33

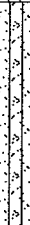
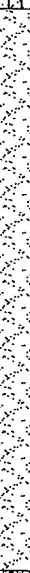
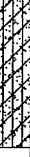
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 27, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH Cu, kPa		nat V. + Q - rem V. 6 U -		WATER CONTENT PERCENT Wp — W — Wi					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		
							25	50	75	100		10	20	30	40		
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE TOPSOIL		0.00	1A	50 DO											
		Very loose to dense brown SILTY SAND, trace gravel		0.30	1B	50 DO											
				2	50 DO												
1				3	50 DO												
		Very dense light brown fine to medium SAND, some silt, trace gravel		1.83	4	50 DO											
2				5	50 DO												
				6	50 DO												
3				7	50 DO												
4						82											
5			Very dense brown SILTY SAND, trace clay, trace gravel (TILL)		5.56												
6	8	50 DO															
		END OF BOREHOLE		6.55													
7																	
8																	
9																	
10																	

Groundwater level in open borehole at a depth of 6.0 m upon completion of drilling, Mar. 27/08

Groundwater level in open borehole at a depth of 6.0 m upon completion of drilling, Mar. 27/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506.GPJ GLDR LDN.GDT 4/10/08 DATA INPUT: PJV April 1/08

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 34

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 27, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE				SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS							
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	20		40		60		80		10 ⁻⁶		10 ⁻⁵				10 ⁻⁴		10 ⁻³				
							SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U -		●		○										
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE		0.00	1A																						
		TOPSOIL		0.18	1B	50 DO	17																				
		Compact to very dense brown SILTY SAND, trace gravel																									
1				2	50 DO	17																					
				3	50 DO	36																					
2				4	50 DO	75																					
				5	50 DO	80																					
3				6	50 DO	80																					
4																											
5					7	50 DO	50/.15																				
6					8	50 DO	50/.10																				
		END OF BOREHOLE		6.35																							
7																											
8																											
9																											
10																											

Borehole open and dry upon completion of drilling, Mar. 27/08

Borehole open and dry upon completion of drilling, Mar. 27/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506.GPJ GLDR_LDN.GDT 4/10/08 DATA INPUT: PJV April 1/08

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 35

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 28, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER		TYPE	20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³		
								SHEAR STRENGTH Cu, kPa		nat V. rem V.	+ ⊕	Q - ⊗	U - ○	WATER CONTENT PERCENT					
								25	50	75	100	Wp	W	Wi					
0		GROUND SURFACE																	
	POWER AUGER 115 mm Diameter Solid Stem Augers	TOPSOIL			1A														
		Very loose to loose brown SILTY SAND, trace gravel		0.10	1B	50 DO	4												
					2A	50 DO	4												
1		Soft to firm brown SILTY CLAY, trace to some sand		0.91	2B	50 DO	4												
					3A														
		Dense to very dense brown to light brown SILTY SAND, trace gravel, cobbles		1.35	3B	50 DO	38												
2					4	50 DO	49												
					5	50 DO	48												
3					6	50 DO	63												
4																			
5					7	50 DO	50/ .15												
6					8	50 DO	50/ .15												
		END OF BOREHOLE		6.25															
7																			
8																			
9																			
10																			

Borehole open and dry upon completion of drilling, Mar. 28/08

Borehole open and dry upon completion of drilling, Mar. 28/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 36

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 28, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER		TYPE	20		40		60		80			
								SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U -			
							25	50	75	100							
0		GROUND SURFACE			1A												
		TOPSOIL		0.08	1B	50 DO 8											
		Loose to very dense dark brown to light brown SILTY SAND, trace gravel, cobbles			2	50 DO 6											
1					3A	50 DO 11											
					3B	50 DO 12											
2					4	50 DO 12											
					5	50 DO 12											
3					6	50 DO 70											
4																	
					7	50 DO 50/.13											
5																	
		Very dense light brown fine to medium SAND, trace silt, some gravel		5.47													
6					8	50 DO 50/.13											
		END OF BOREHOLE		6.38													
7																	
8																	
9																	
10																	

Borehole open and dry upon completion of drilling, Mar. 28/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506.GPJ GLDR_LDN.GDT 4/10/08 DATA INPUT: PJV April 1/08

PROJECT: 08-1186-0506D

RECORD OF BOREHOLE BH 37

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: March 28, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER		TYPE	SHEAR STRENGTH Cu, kPa		nat V. + Q - ● rem V. ⊕ U - ○		WATER CONTENT PERCENT Wp ——— W ——— Wl					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³
0	POWER AUGER 115 mm Diameter Solid Stem Augers	GROUND SURFACE		0.00	1A												
		TOPSOIL		0.15	1B	50 DO	4										
		Very loose to very dense brown SILTY SAND, trace gravel, cobbles			2	50 DO	14										
1					3	50 DO	14										
					4	50 DO	14										
2					5	50 DO	50										
					6	50 DO	51										
3					7	50 DO	78										
4					8	50 DO	50/15										
5		END OF BOREHOLE		6.40													
6																	
7																	
8																	
9																	
10																	

MH

Borehole open and dry
upon completion of
drilling, Mar. 28/08

DEPTH SCALE

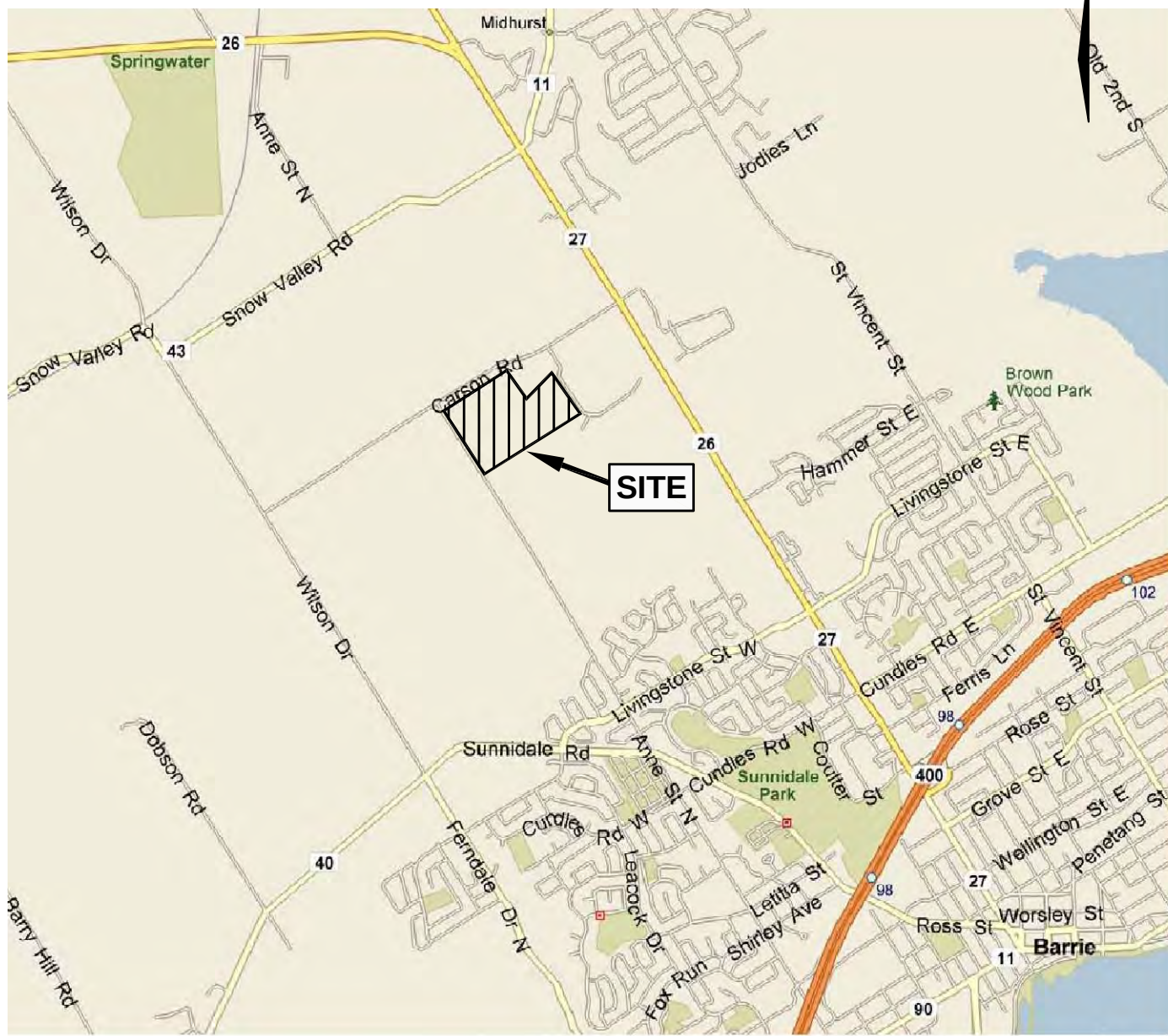
1 : 50



LOGGED: CR

CHECKED:

LDN.BHS 08-1186-0506.GPJ GLDR_LDN.GDT 4/10/08 DATA INPUT: PJV April 1/08



Base map by Microsoft Streets & Trips 2006
Microsoft Corp. and/or its suppliers, 1988- 2005;
NAVTEQ, 2004; and TeleAtlas North America,
Inc., 2004

PROJECT		Preliminary Geotechnical Investigation Rome Elliott Property 1193 Carson Rd. Midhurst, Ontario			
TITLE		KEY PLAN			
 Golder Associates Whitby, Ontario		PROJECT No.08-1186-05060-G		FILE No. 002	
		DESIGN			SCALE AS SHOWN
		CADD	PJV	April 2008	REV.
		CHECK			
		REVIEW			
FIGURE 1					

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506\Rome Elliott\08-1186-0506D-001 -FIG 2008'03 Rome Elliott - FIG 2.dwg Apr 18, 2008 - 4:14pm



Aerial Photograph by Google Earth Pro 2007,
Image 2008 First Base Solutions.



NOT TO SCALE
ALL LOCATIONS ARE APPROXIMATE

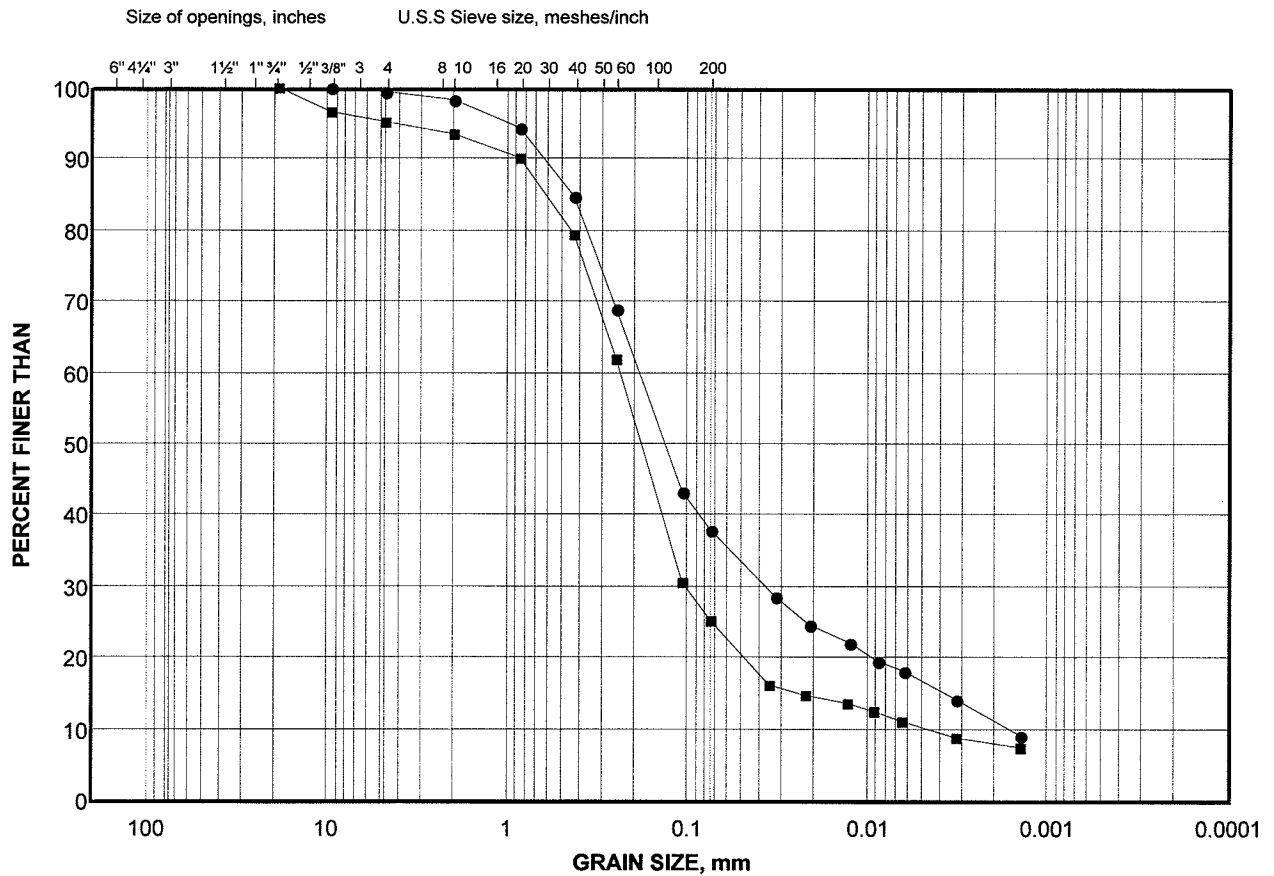
LEGEND

 BOREHOLE LOCATION IN PLAN

PROJECT		Preliminary Geotechnical Investigation Rome Elliott Property 1193 Carson Rd. Midhurst, Ontario			
TITLE		SITE LOCATION PLAN			
		PROJECT No08-1186-0506D-G		FILE No. 001	
		DESIGN		SCALE	AS SHOWN
		CADD	PJV	April 2008	REV.
		CHECK			
		REVIEW			
		FIGURE 2			

GRAIN SIZE DISTRIBUTION SILTY SAND

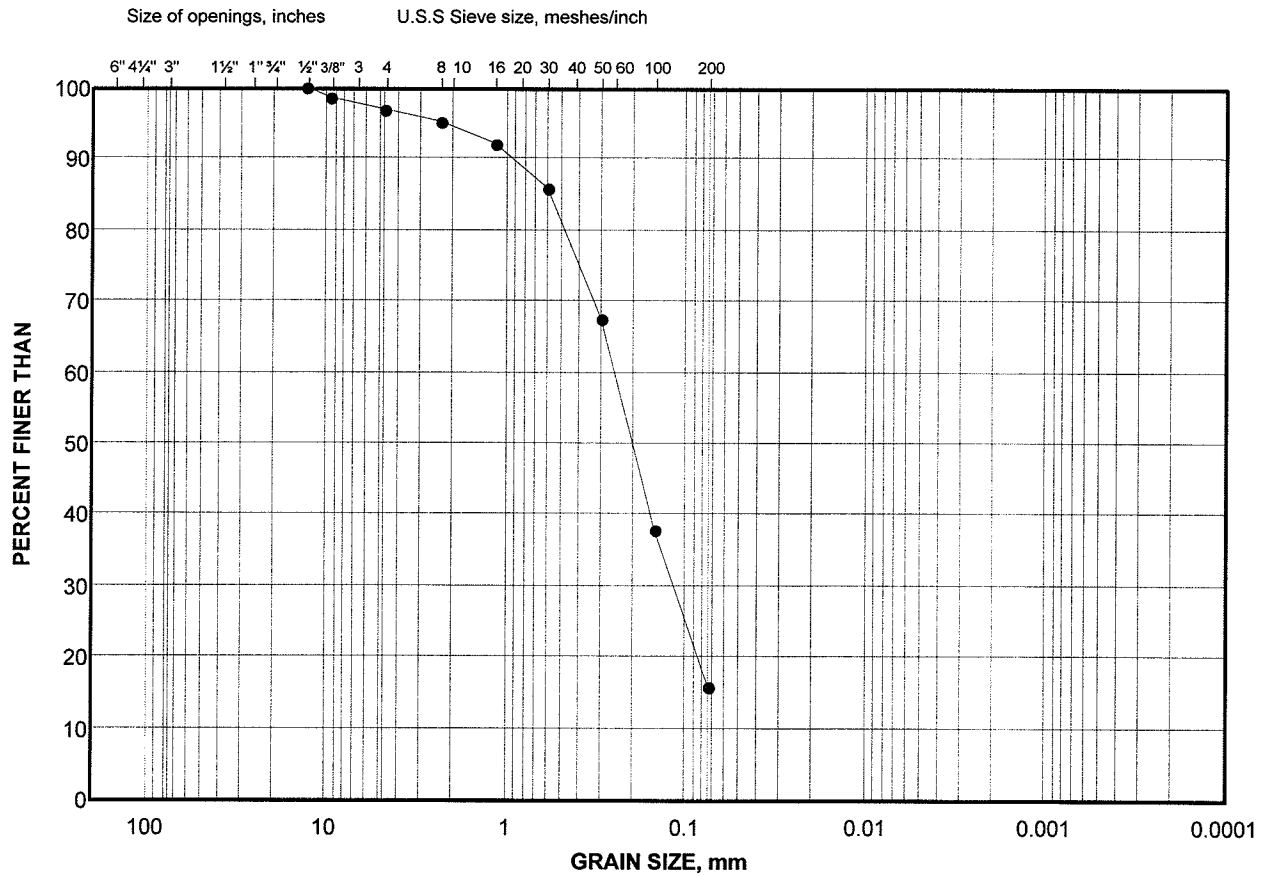
FIGURE 3



GRAIN SIZE DISTRIBUTION

Fine to Medium SAND

FIGURE 4



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	31	3	1.2 - 1.8

Project Number: 08-1186 0506D

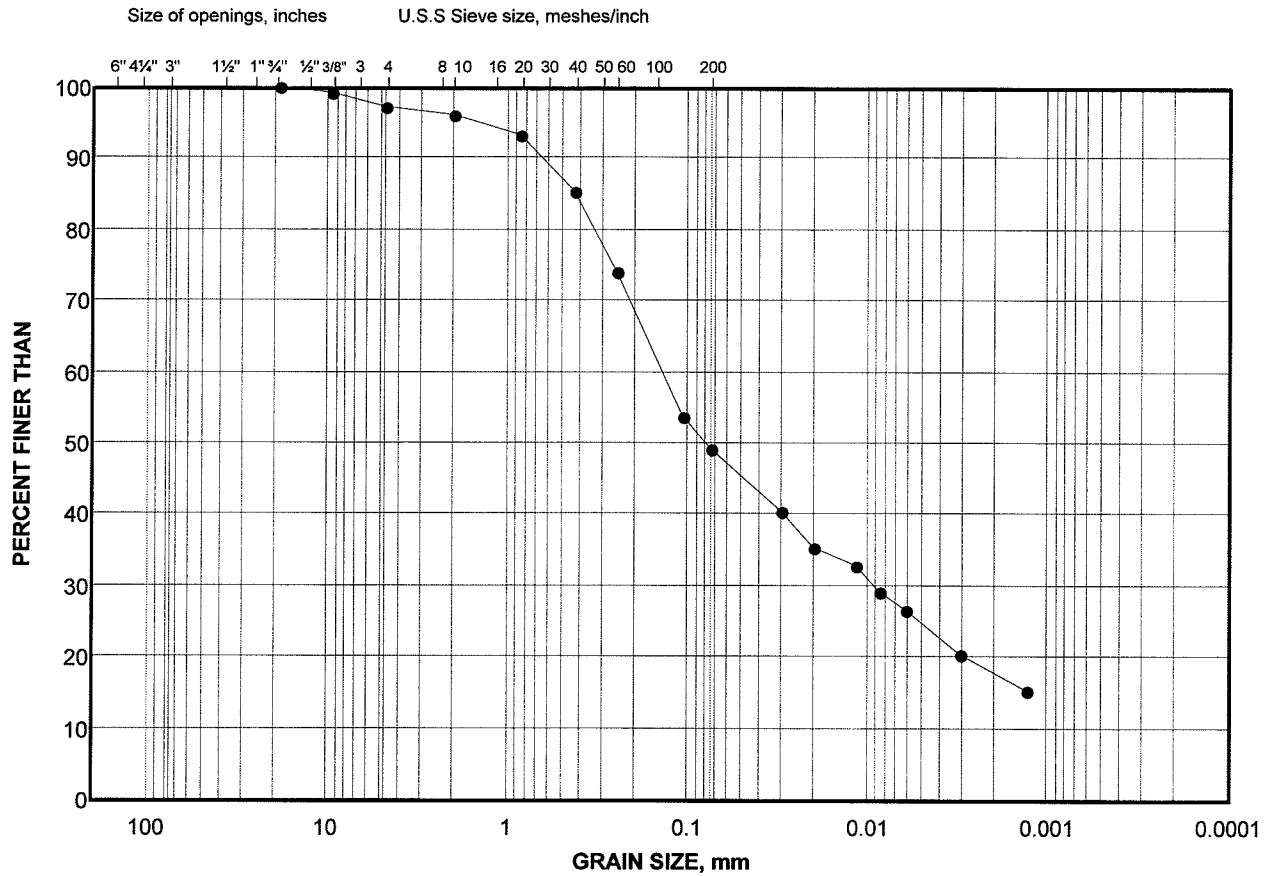
Checked By: AC

Golder Associates

Date: 07-Apr-08

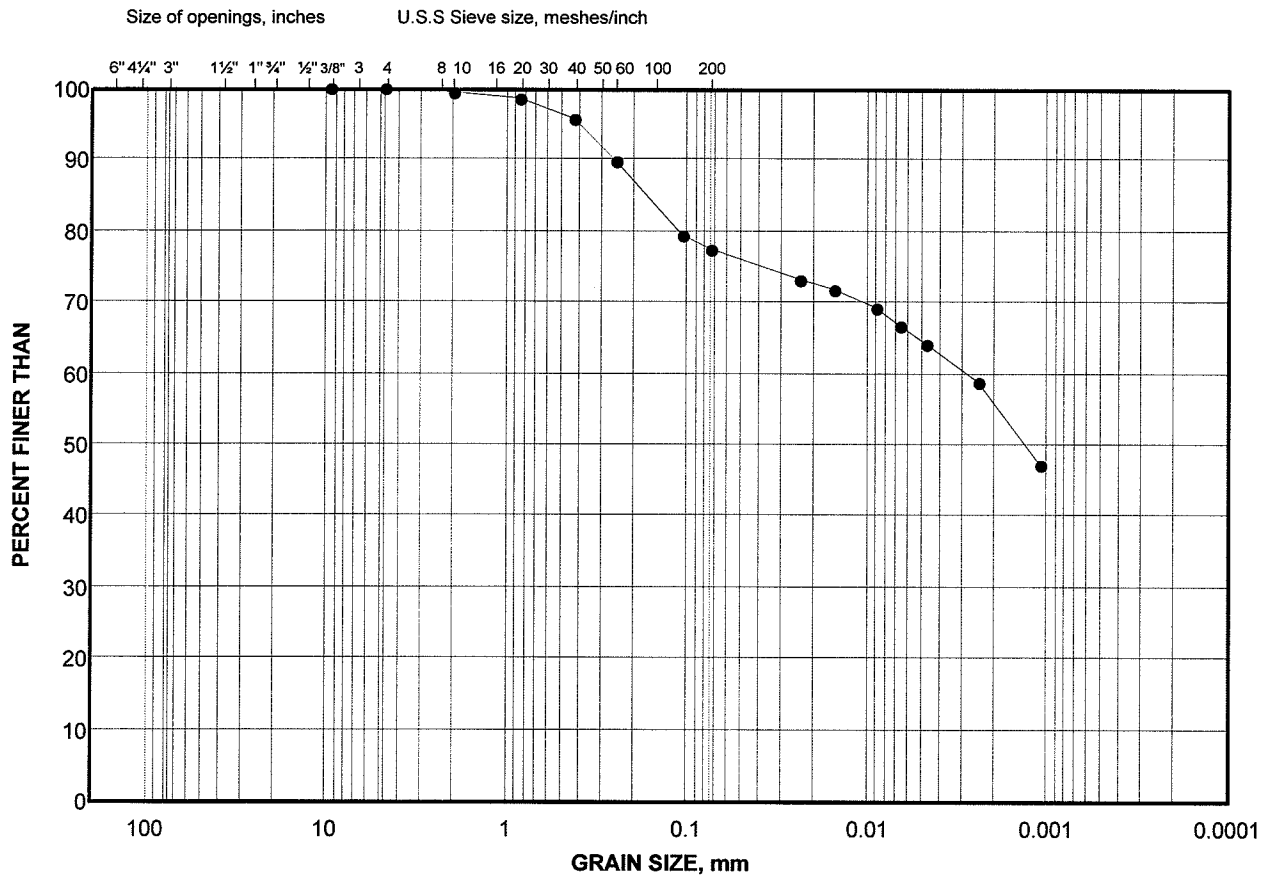
GRAIN SIZE DISTRIBUTION SILTY SAND TILL

FIGURE 5



GRAIN SIZE DISTRIBUTION SILTY CLAY

FIGURE 6



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

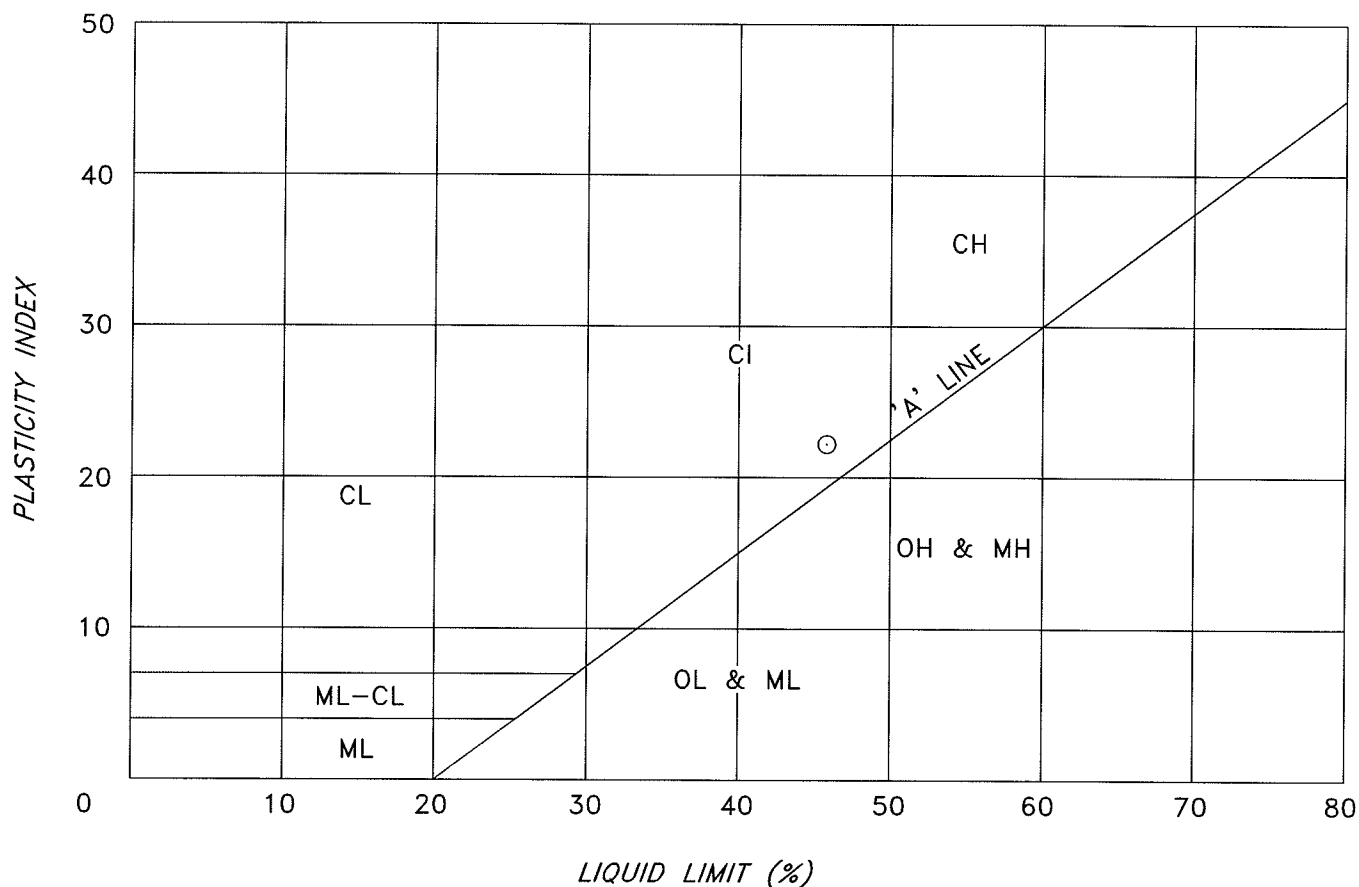
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	30	2	0.6 - 1.2

Project Number: 08-1186 0506D

Checked By: AC

Golder Associates

Date: 07-Apr-08



SOIL TYPE		PLASTICITY	
C	Clay	L	Low
M	Silt	I	Intermediate
O	Organic	H	High

BOREHOLE	SAMPLE	SAMPLE DESCRIPTION
○ 30	2	SILTY CLAY



SCALE	
DATE	Apr. 2008
DESIGN	
CADD	JLJ
CHECK	AC
REVIEW	

TITLE
PLASTICITY CHART

FILE No.	001
PROJECT No. 08-1186-0506D	REV.

FIGURE
7

Appendix A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing in Saskatchewan, subject to the time limits and physical constraints applicable to this report. No other warranty, express or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. *No other party may use or rely on this report or any portion thereof without Golder's express written consent. Golder will consent to any reasonable request by the Client to approve the use of this report by other parties as Approved Users.* The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media are susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. *In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use by any party of portions of the report without reference to the entire report.*

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (CONTINUED)

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgement, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction is necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

Golder Associates Ltd.

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**DRAFT
REPORT ON**

**PRELIMINARY GEOTECHNICAL INVESTIGATION
R. HICKLING PROPERTY
MIDHURST, ONTARIO**

Submitted to:

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

Distribution:

- 1 Copy (Digital) - Geranium Corporation, Markham, Ontario
- 1 Copy - Golder Associates Ltd., Whitby, Ontario

April, 2008

08-1186-0506C(G)



Golder Associates Ltd.

100 Scotia Court
Whitby, Ontario, Canada L1N 8Y6
Telephone: (905) 723-2727
Fax: (905) 723-2182



April 18, 2008

08-1186-0506C(G)

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

**RE: PRELIMINARY GEOTECHNICAL INVESTIGATION
R. HICKLING PROPERTY
MIDHURST, ONTARIO**

This report presents the results of a preliminary geotechnical investigation carried out at the above referenced site, as shown on the Key Plan, Figure 1. The purpose of the investigation was to determine the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of shallow boreholes. Based on our interpretation of the borehole data, this report provides preliminary geotechnical information for the planning of a proposed residential and/or commercial development at the site. Authorization to proceed with this investigation was provided by Ms. Shauna Dudding, P.Eng. of Geranium Corporation, in an email dated March 3, 2008.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder Associates Ltd. (Golder) should be given an opportunity to confirm that the preliminary recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report", included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. Further, the environmental aspects (i.e. Phase I ESA) at the site are being addressed concurrently by Golder (reported under separate cover).



SITE DESCRIPTION

The site is located on the west side of Anne Street North, about 0.5 km south of Carson Road, in Midhurst, Ontario. The site is comprised of agricultural property, generally at grade with surrounding properties, irregular in shape and approximately 38 hectares (97 acres) in size. The site is bounded to the north by a defined tree line and metal fencing, to the east by metal fencing followed by Anne Street North, agricultural land to the south, and to the west by forested land of Willow Creek. A residential property is located at 756 Anne Street North, adjacent to the east boundary line. Three headwater tributaries of Willow Creek originate in the central portion of the site and cross the site in a southeast to northwest trending direction. A hydro-electric corridor diagonally crosses the site approaching from Anne Street North, in a northeast to southwest direction.

PHYSIOGRAPHY

The site lies near the border of the physiographic regions of Southern Ontario known as the Simcoe Lowlands and Simcoe Uplands (Chapman and Putnam 1984). Physiographic mapping in the immediate vicinity of the site indicates glaciolacustrine deposits of sands bordering on tills with predominantly sandy silt matrix (Map 2556, Quaternary Geology of Southern Ontario, Barnett, Cowan and Henry, 1991). This physiographic mapping is generally consistent with the results of the current investigation.

INVESTIGATION PROCEDURE

The field work for this preliminary investigation was carried out on April 1 and 2, 2008 during which time nine boreholes (Nos. 20 to 28) were advanced at the locations shown on the Location Plan, Figure 2. The boreholes were drilled using a track-mounted drillrig supplied and operated by Eastern Soil Investigation Limited, under our supervision. Standard penetration testing and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment. The shallow groundwater conditions were noted in the open boreholes during drilling and the boreholes were backfilled and sealed upon completion of drilling. All of the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective classification testing.

The field work for this investigation was directed by members of our engineering staff who also determined the borehole locations in the field, logged the boreholes and cared for the samples obtained. The as-drilled borehole locations and corresponding ground surface elevations were provided by RPE Surveying and are understood to be referenced to geodetic datum.

SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing, are shown in detail on the Record of Borehole sheets following the text of this report. Lists of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. The soils laboratory test results are shown on Figures 3 to 7 following the borehole logs. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this preliminary investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying 0.1 to 0.4 m of topsoil, the subsoil conditions predominantly consist of deposits of silty sand till underlain by sand in most areas. Discontinuous deposits of till-like silty sand, sandy silt and/or gravelly sand were also encountered in some of the boreholes. Shallow groundwater was encountered in seven of nine boreholes, at depths varying from 0.3 to 3.1 m below the existing ground surface.

TOPSOIL

Topsoil was encountered in all boreholes advanced at the site. The topsoil thickness encountered at the borehole locations ranged from 0.1 to 0.4 m, as summarized in the following table:

BOREHOLE	TOPSOIL THICKNESS (mm)
20	200
21	180
22	100
23	300
24	250
25	180
26	380
27	250
28	300

Silty Sand Till

Silty sand till is one of the predominant native soil types at the site and was encountered in all boreholes except for Borehole 25. Boreholes 20, 26, 27 and 28 were also terminated in the silty sand till. The till contains cobbles and boulders. Standard penetration tests carried out within the

silty sand till gave N values ranging from 10 to greater than 100 blows per 0.3 m, indicating a compact to very dense relative density. The natural water contents of the silty sand till samples ranged from 7 to 13 percent. One grain size distribution curve for a sample of the silty sand till, recovered from 35 mm internal diameter split spoon sampler, is shown on Figure 3.

Fine to Medium Sand

Fine to medium sand is the other predominant native soil type at the site and was encountered in five of the nine boreholes advanced at the site. Boreholes 21 to 25 were also terminated in the sand. Standard penetration tests carried out within the sand gave N values ranging from 46 to greater than 100 blows per 0.3 m, indicating a dense to very dense relative density. The natural water contents of the sand samples ranged from 3 to 15 percent. A grain size distribution curve for a sample of the fine to medium sand is shown on Figure 4.

Fill

Shallow layers of fill mainly consisting of sandy silt and/or silty sand were encountered in Boreholes 21, 22, 25 and 26, overlying the silty sand till or till-like deposits. This material could represent disturbed native soil due to agricultural operations. Standard penetration tests carried out within the fill gave N values ranging from 2 to 7 blows per 0.3 m, indicating a very loose to loose relative density. The in-situ water contents of the fill samples ranged from 11 to 25 percent. A grain size distribution curve for a sample of the silty sand fill is shown on Figure 5.

Silty Sand

Strata of silty sand were encountered in Boreholes 23 and 28, overlying the silty sand till deposits. Standard penetration tests carried out within the silty sand gave N values ranging from 4 to 5 blows per 0.3 m, indicating a very loose to loose relative density. The natural water contents of the silty sand samples ranged from 16 to 21 percent. A grain size distribution curve for a sample of the silty sand is shown on Figure 6.

Till-like Silty Sand or Sandy Silt

Strata of till-like silty sand or sandy silt were encountered in Boreholes 20, 24, 25 and 27, overlying the silty sand till or sand deposits. This material is generally similar in gradation to silty sand or sandy silt till but has lower strength. Standard penetration tests carried out within the till-like soils gave N values ranging from 3 to 5 blows per 0.3 m, indicating a very loose to loose relative density. The natural water contents of the till-like samples ranged from 13 to 25 percent.

Gravelly Sand

A deposit of gravelly sand was encountered in Borehole 21, within the sand strata. The gravelly sand contained cobbles. One standard penetration test carried out within the gravelly sand gave an N value greater than 100 blows per 0.3 m, indicating a very dense relative density. The natural water content of the gravelly sand sample was 5 percent. A grain size distribution curve for a sample of the gravelly sand, recovered from the 35 mm internal diameter split spoon sampler, is shown on Figure 7.

Shallow Groundwater

Shallow groundwater was encountered in Boreholes 20, 22, 23, 24, 25, 26 and 28 during drilling, at depths ranging from 0.3 to 3.1 m below the existing ground surface. All other boreholes were found to be dry upon completion of drilling. It should be noted that these observations reflect the shallow groundwater conditions encountered in the boreholes during the time of the field investigation (early April, 2008) and some seasonal fluctuations should be anticipated.

DISCUSSION

This section of the report provides preliminary geotechnical information based on our interpretation of the limited borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for planning and preliminary design purposes and is not sufficient for final design or construction purposes. Once the actual development plans and pertinent design details are available (e.g. road, lot and/or building layout, underground service locations/depths, etc.), the results of this preliminary investigation should be reviewed by the geotechnical engineer and an additional site specific investigation carried out, compatible with the final development plans for the site.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report and have not been investigated or addressed. However, as previously noted, Golder is providing concurrent Phase I ESA services for this site (reported under separate cover).

Preliminary Geotechnical Information

It is understood that consideration is being given to developing the site with a residential and/or commercial development. Based on the results of this preliminary investigation, the subsurface native soils encountered at the site are generally considered to be suitable for supporting the proposed development. The following preliminary geotechnical information is provided for the planning and preliminary design of residential houses or commercial buildings, underground services and paved roads at the site:

- Depending upon the final site grading scheme and proposed basement and/or at-grade floor slab elevations, the areas should be brought up to the underside of the footings and/or floor slabs, as required, using engineered fill. The materials proposed for use as engineered fill should be approved by qualified geotechnical personnel at the source, prior to hauling to the site. Most of the native soils at the site would be suitable for reuse as engineered fill. Imported materials meeting the requirements of OPSS Select Subgrade Material (SSM) would also be suitable for use as engineered fill. Details regarding placement and compaction requirements for engineered fill, if utilized at the site, can be provided once the actual development plans are available, as part of the final geotechnical recommendations for the project.
- The native subsoils at the site (below the fill or disturbed native soils) are considered to be suitable for supporting conventional residential houses (with basements) or single storey, slab-on-grade commercial buildings. A preliminary allowable bearing pressure in the range of 100 to 200 kPa may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed subsoils, at depths of approximately 0.8 to 2.5 m below the existing ground surface (or deeper as required for basements). It should be noted that the shallow, relatively loose till-like subsoils (vicinity of Boreholes 20, 24, 25 and 27) are generally not suitable for supporting houses/buildings. Footings founded on approved engineered fill, if utilized at the site, may be designed using a preliminary allowable bearing pressure in the range of 100 to 150 kPa.
- The need for and type of foundation drainage system required (perimeter drains and/or underslab drains; damp-proofing or water-proofing) depends upon the proposed founding elevations, soil types in the area and actual stabilized groundwater levels. Based on the results of this preliminary investigation, it is anticipated that conventional foundation drainage (i.e. perimeter drains and damp-proofing) would be adequate at most locations. However, basements founded in the wet sands below a depth of about 3 m (vicinity of Boreholes 22, 23, 24 and 25) may require water-proofing. For floor slabs at or above exterior grades, foundation drainage would likely not be required. In any event, the need for and type of foundation drainage should be confirmed by the geotechnical engineer once the site grading plans are available, as part of final design process.
- Based on the results of this preliminary investigation, for shallow excavations for underground services up to about 5 m in depth, groundwater control during excavation can probably be handled, if required, by pumping from properly constructed and filtered sumps located at the base of the excavation. However, it should be noted that cohesionless sandy subsoils are the predominant soil types at this site. Excavations into these soils, where they are below the local water table (e.g. wet sands in the vicinity of Boreholes 22, 23, 24 and 25), may require more positive dewatering measures, in addition to pumping from sumps, to maintain the stability of the trench side slopes and base to facilitate construction. In this regard, stabilized groundwater levels at the site should be determined as part of the follow-up, site specific geotechnical investigation at the site. The need for and type of groundwater

control measures can then be reviewed by the geotechnical engineer as part of the final design process.

- It is anticipated that the trench excavations for underground servicing would consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, some local flattening of side slopes may be required in some areas in looser soil zones or where significant water seepage is encountered. Conventional bedding thicknesses are anticipated for underground services founded within the native competent subsoils at the site. Additional bedding thicknesses may be required for services founded in wet sands, depending upon the excavation depths and success of the contractor's groundwater control measures, if required.
- The majority of the native subsoils above the local water table are generally near their estimated optimum water contents for compaction and should be suitable for reuse as trench backfill, provided they are free of significant amounts of topsoil, organics and other deleterious materials. Excavated subsoils from below the local water table would likely require some drying prior to placement.
- Complete removal of any existing septic systems, wells, old foundations, etc. would likely be required as part of the site redevelopment.
- Based on the subsoil conditions encountered, conventional asphaltic (flexible) pavement designs are considered to be appropriate for a proposed residential and/or commercial development at the site. Typical pavement designs are as follows:

TYPICAL COMMERCIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)	
		Truck Routes and Main Access Roads	Car Parking and Internal Access Roads
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	50
Granular Material (OPSS 1010)	Granular A Base	150	150
	Granular B Type I Subbase	400	300
		Prepared and Approved Subgrade	

TYPICAL RESIDENTIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)		
		Local Street	Collector Street	Major Collector
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40	40
	HL 8 Binder Course	50	65	90
Granular Material (OPSS 1010)	Granular A Base	150	150	150
	Granular B Type I Subbase	300	400	450
		Prepared and Approved Subgrade		

Prior to placing the granular subbase material, the exposed soil subgrade should be heavily proof-rolled in conjunction with inspection by qualified geotechnical personnel. Deleterious, organic and/or softened native subsoils or fills will require subexcavation and replacement with approved material (i.e. controlled fill), as directed by geotechnical personnel.

We trust that this report provides sufficient preliminary geotechnical engineering information to aid in the planning and preliminary design of the proposed residential and/or commercial development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

DRAFT

David B. Liu, P.Eng.
Geotechnical Engineer

DRAFT

Doug G. Gorrill, P.Eng.
Senior Geotechnical Engineer, Associate

Enclosures: Abbreviations & Symbols
Record of Borehole Sheets 20 to 28
Figures 1 to 7
Appendix A – Important Information and Limitations of This Report

LIST OF ABBREVIATIONS

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

I	SAMPLE TYPE	III	SOIL DESCRIPTION	
AS	Auger sample	(a)	Cohesionless Soils	
BS	Block sample	Density Index	N	
CS	Chunk sample	(Relative Density)	<u>Blows/300 mm</u> <u>or Blows/ft.</u>	
DO	Drive open	Very loose	0 to 4	
DS	Denison type sample	Loose	4 to 10	
FS	Foil sample	Compact	10 to 30	
RC	Rock core	Dense	30 to 50	
SC	Soil core	Very dense	over 50	
ST	Slotted tube	(b)	Cohesive Soils	
TO	Thin-walled, open	Consistency	c_u, s_u	
TP	Thin-walled, piston		<u>kPa</u>	<u>psf</u>
WS	Wash sample	Very soft	0 to 12	0 to 250
		Soft	12 to 25	250 to 500
		Firm	25 to 50	500 to 1,000
		Stiff	50 to 100	1,000 to 2,000
		Very stiff	100 to 200	2,000 to 4,000
		Hard	over 200	over 4,000

II	PENETRATION RESISTANCE		IV.	SOIL TESTS	
Standard Penetration Resistance (SPT), N:			w	water content	
The number of blows by a 63.5 kg. (140 lb.)			w _p	plastic limit	
hammer dropped 760 mm (30 in.) required			w _l	liquid limit	
to drive a 50 mm (2 in.) drive open			C	consolidation (oedometer) test	
sampler for a distance of 300 mm (12 in.).			CHEM	chemical analysis (refer to text)	
Dynamic Penetration Resistance; N_d:			CID	consolidated isotropically drained triaxial test ¹	
The number of blows by a 63.5 kg (140 lb.)			CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹	
hammer dropped 760 mm (30 in.) to drive			D _R	relative density (specific gravity, G _s)	
uncased a 50 mm (2 in.) diameter, 60° cone			DS	direct shear test	
attached to "A" size drill rods for a distance			M	sieve analysis for particle size	
of 300 mm (12 in.).			MH	combined sieve and hydrometer (H) analysis	
PH:	Sampler advanced by hydraulic pressure		MPC	Modified Proctor compaction test	
PM:	Sampler advanced by manual pressure		SPC	Standard Proctor compaction test	
WH:	Sampler advanced by static weight of hammer		OC	organic content test	
WR:	Sampler advanced by weight of sampler and rod		SO ₄	concentration of water-soluble sulphates	
			UC	unconfined compression test	
			UU	unconsolidated undrained triaxial test	
			V	field vane test (LV-laboratory vane test)	
			γ	unit weight	

Piezo-Cone Penetration Test (CPT):		
An electronic cone penetrometer with		
a 60° conical tip and a projected end area		
of 10 cm ² pushed through ground		
at a penetration rate of 2 cm/s. Measure-		
ments of tip resistance (Q _t), porewater		
pressure (PWP) and friction along a		
sleeve are recorded electronically		
at 25 mm penetration intervals.		

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (con't.)

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

(c) Hydraulic Properties

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

(d) Consolidation (one-dimensional)

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

(e) Shear Strength

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

Notes: 1. $\tau = c' + \sigma' \tan \phi'$

2. Shear strength = (Compressive strength)/2

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 20

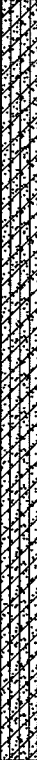
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 1, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m		SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
									20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³					
									nat V. + Q - ● rem V. ⊕ U - ○				Wp — W — Wi					
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																
		TOPSOIL		0.00	1A	.												
		Loose to very loose brown SANDY SILT, some clay, trace gravel (TILL-LIKE)		0.20	1B	50 DO	5											
1					2	50 DO	4											
		Compact to very dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		1.22	3	50 DO	12											
2					4	50 DO	24											
3																		
					5	50 DO	36											
4																		
					6	50 DO	50/.15											
5																		
6																		
		END OF BOREHOLE		6.25	7	50 DO	50/.15											
7																	Borehole caved to a depth of 3.7 m upon completion of drilling, Apr. 1/08	
8																	Groundwater level in open portion of borehole at a depth of 1.2 m upon completion of drilling, Apr. 1/08	
9																		
10																		

Borehole caved to a
depth of 3.7 m upon
completion of drilling,
Apr. 1/08Groundwater level in
open portion of
borehole at a depth of
1.2 m upon completion
of drilling, Apr. 1/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 21

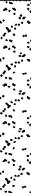
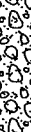
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 1, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT							
									20	40	60	80	nat V. + rem V. ⊕	Q - U - ●	10 ⁻⁶			10 ⁻⁵	10 ⁻⁴	10 ⁻³
								20	40	60	80	10	20	30	40					
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																		
		TOPSOIL		0.00	1A															
		Loose brown silty sand, trace clay, trace gravel, rootlets (Possible FILL or disturbed native soil)		0.18	1B	50	DO	5												
		Compact to dense brown SILTY SAND, trace clay, trace gravel (TILL)		0.61	2	50	DO	10												
1					3	50	DO	15												
					4	50	DO	35												
2																				
3		Very dense brown fine to medium SAND, trace to some silt, trace gravel, cobbles		2.74	5	50	DO	77												
4		Very dense brown GRAVELLY SAND, some silt, cobbles		4.04	6	50	DO	50/.15												
5																				
6	Very dense brown fine to medium SAND, trace to some silt, trace gravel, cobbles		5.49	7	50	DO	50/.15													
7	END OF BOREHOLE		6.40														Borehole open and dry upon completion of drilling, Apr. 1/08			
8																				
9																				
10																				

Borehole open and dry upon completion of drilling, Apr. 1/08

DEPTH SCALE

1 : 50



LOGGED: CR

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LDN_BHS 08-1186-0506C-G.GPJ GLDR_LDN.GDT 4/18/08 DATA INPUT: JJJ 200804

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 22

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 1, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m		20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³					
									SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
0		GROUND SURFACE																
		TOPSOIL			1A													
		Very loose to loose brown sandy silt, trace clay, trace gravel (Possible FILL or disturbed native soil)		0.10	1B	50 DO	4											
		Compact to very dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		0.61	2	50 DO	16											
1					3	50 DO	22											
					4	50 DO	38											
2																		
					5	50 DO	50/ .15											
3																		
4		Very dense brown SAND, some gravel to gravelly, some silt, cobbles		3.96	6	50 DO	50/ .15											
5																		
6					7	50 DO	50/ .08											
		END OF BOREHOLE		6.32														
7																		
8																		
9																		
10																		

Borehole caved to a
depth of 1.2 m upon
completion of drilling,
Apr. 1/08Groundwater level in
open portion of
borehole at a depth of
0.6 m upon completion
of drilling, Apr. 1/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN BHS 08-1186-0506C-G-GPJ GLDR LDN.GDT 4/18/08 DATA INPUT: JU 2008 04

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 23

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 2, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m	20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³					
									SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
									nat V. + Q - ● rem V. ⊕ U - ○				Wp ———— W ———— Wi					
								20	40	60	80	10	20	30	40			
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																
		TOPSOIL		0.00	1A	50 DO	4											
		Very loose to loose brown SILTY SAND, some gravel		0.30	1B	50 DO												
1					2	50 DO	4											
		Compact to dense brown SILTY SAND, trace to some gravel, trace clay (TILL)		1.22	3	50 DO	27											
2					4	50 DO	44											
3		Dense to very dense greyish-brown fine to medium SAND, trace to some gravel, trace to some silt		2.74	5A	50 DO	46											
					5B													
4																		
5					6	50 DO	70/ 30											
6																		
7		END OF BOREHOLE		6.55	7	50 DO	69											
8																		
9																		
10																		

Borehole caved to a depth of 2.7 m upon completion of drilling, Apr. 2/08

Groundwater level in open portion of borehole at a depth of 0.6 m upon completion of drilling, Apr. 2/08

Borehole caved to a
depth of 2.7 m upon
completion of drilling,
Apr. 2/08Groundwater level in
open portion of
borehole at a depth of
0.6 m upon completion
of drilling, Apr. 2/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 24

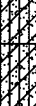
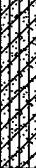
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 2, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m		SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
									20	40	60	80	nat V. rem V.	+ ⊕	Q - U -	● ○		
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE		0.00	1A													
		TOPSOIL		0.25	1B	50 DO	4											
		Loose to very loose dark brown SILTY SAND, some clay, trace gravel (TILL-LIKE)			2	50 DO	3											
1																		
		Compact greyish-brown SILTY SAND, some to trace clay, trace to some gravel (TILL)		1.22	3	50 DO	20											
2					4	50 DO	12											
		Very dense greyish-brown fine to medium SAND, some gravel, trace to some silt, zones of silty sand		2.74	5	50 DO	54											
3																		
				6	50 DO	50/.13												
4																		
5																		
6				7	50 DO	50/.13												
7		END OF BOREHOLE		6.38														
8																		
9																		
10																		


(enc.)

Groundwater encountered at a depth of 3.0 m during drilling, Apr. 2/08


 (enc.)

Groundwater encountered at a depth of 3.0 m during drilling, Apr. 2/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506C-G.GPJ GLDR LDN.GDT 4/19/08 DATA INPUT: JJJ 2008/04

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 25

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 2, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m	SHEAR STRENGTH				WATER CONTENT PERCENT							
									Cu, kPa		nat V. + rem V. ⊕		Q - ● U - ○		Wp ——— W ——— WI					
									20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³		
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE		0.00	1A															
		TOPSOIL		0.18	1B	50 DO	5													
		Very loose to loose brown silty sand, trace to some clay, trace gravel (Probable FILL or disturbed native)			2	50 DO	2													
1																				
		Very loose to loose brown SILTY SAND, trace to some clay, trace gravel (TILL-LIKE)		1.22	3	50 DO	4													
2																				
		Dense to very dense brown fine to medium SAND, trace to some silt, trace to some gravel, zones of silty sand, cobbles		2.74	5	50 DO	49													
3																				
4																				
5																				
6																				
7		END OF BOREHOLE		6.35																
8																				
9																				
10																				

Groundwater encountered during drilling at a depth of 3.1 m, Apr. 2/08

Borehole caved to a depth of 5.2 m upon completion of drilling, Apr. 2/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506C-G GPJ GLDR_LDN.GDT 4/18/08 DATA INPUT: JLU 2008/04

Groundwater
encountered during
drilling at a depth of
3.1 m, Apr. 2/08

Borehole caved to a
depth of 5.2 m upon
completion of drilling,
Apr. 2/08

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 26

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 2, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m		20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³						
									SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT						
									20 40 60 80										
0		GROUND SURFACE																	
	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A	50 DO	4										▽		
		Loose dark brown sandy silt, some clay, trace gravel (Possible FILL or disturbed native)		0.38	1B														
				2	50 DO	7													
1		Compact to very dense dark brown to greyish-brown SILTY SAND, some gravel, trace clay, cobbles and boulders (TILL)		1.22	3	50 DO	12												
				4	50 DO	27													
2																			
				5	50 DO	50/ 13													
3																			
4																			
5						6	50 DO	61											
6																			
7					7	50 DO	86												
		END OF BOREHOLE		6.55															
7																	Borehole caved to a depth of 0.9 m upon completion of drilling, Apr. 2/08 Groundwater level in open portion of borehole at a depth of 0.3 m upon completion of drilling, Apr. 2/08		
8																			
9																			
10																			

Borehole caved to a
depth of 0.9 m upon
completion of drilling,
Apr. 2/08Groundwater level in
open portion of
borehole at a depth of
0.3 m upon completion
of drilling, Apr. 2/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN BHS 08-1186-0506C-G.GPJ GLDR_LDN.GDT 4/18/08 DATA INPUT: JJJ 2008/04

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 27

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 2, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m		SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT						
									20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³			Wp
									20	40	60	80		10	20	30	40		
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE		0.00	1A														
		TOPSOIL		0.25	1B	50 DO	5												
		Loose to very loose brown SANDY SILT, trace to some gravel, trace clay (TILL-LIKE)			2	50 DO	4												
1			Compact to very dense brown SILTY SAND, some gravel, trace clay, cobbles and boulders (TILL)		1.22	3	50 DO	16											
2					4	50 DO	38												
3					5	50 DO	50/.15												
4					6	50 DO	50/.10												
5				7	50 DO	50/.13													
6		END OF BOREHOLE		6.38															
7																			
8																			
9																			
10																			

Borehole open and dry
upon completion of
drilling, Apr. 2/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

PROJECT: 08-1186-0506C-G

RECORD OF BOREHOLE 28

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 2, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m											
									20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³	
								SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT Wp ———— W ———— WI							
								20	40	60	80		10	20	30	40			
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																	
		TOPSOIL		0.00	1A	50 DO	4												
		Very loose to loose brown SILTY SAND, trace gravel		0.30	1B	50 DO													
1				2	50 DO	5													
				3	50 DO	4													
2		Compact to very dense brown to grey SILTY SAND, trace to some gravel, trace clay, cobbles and boulders (TILL)		1.83	4	50 DO	28												
3				5	50 DO	83/ .30													
4																			
5				6	50 DO	50/ .08													
6																			
7	END OF BOREHOLE		6.25	7	50 DO	50/ .15													
8																			
9																			
10																			

Borehole caved to a depth of 1.2 m upon completion of drilling, Apr. 2/08

Groundwater level in open portion of borehole at a depth of 0.6 m upon completion of drilling, Apr. 2/08

LDN BHS 08-1186-0506C-G.GPJ GLDR_LDN.GDT 4/18/08 DATA INPUT: JLLJ 2008/04

DEPTH SCALE

1 : 50



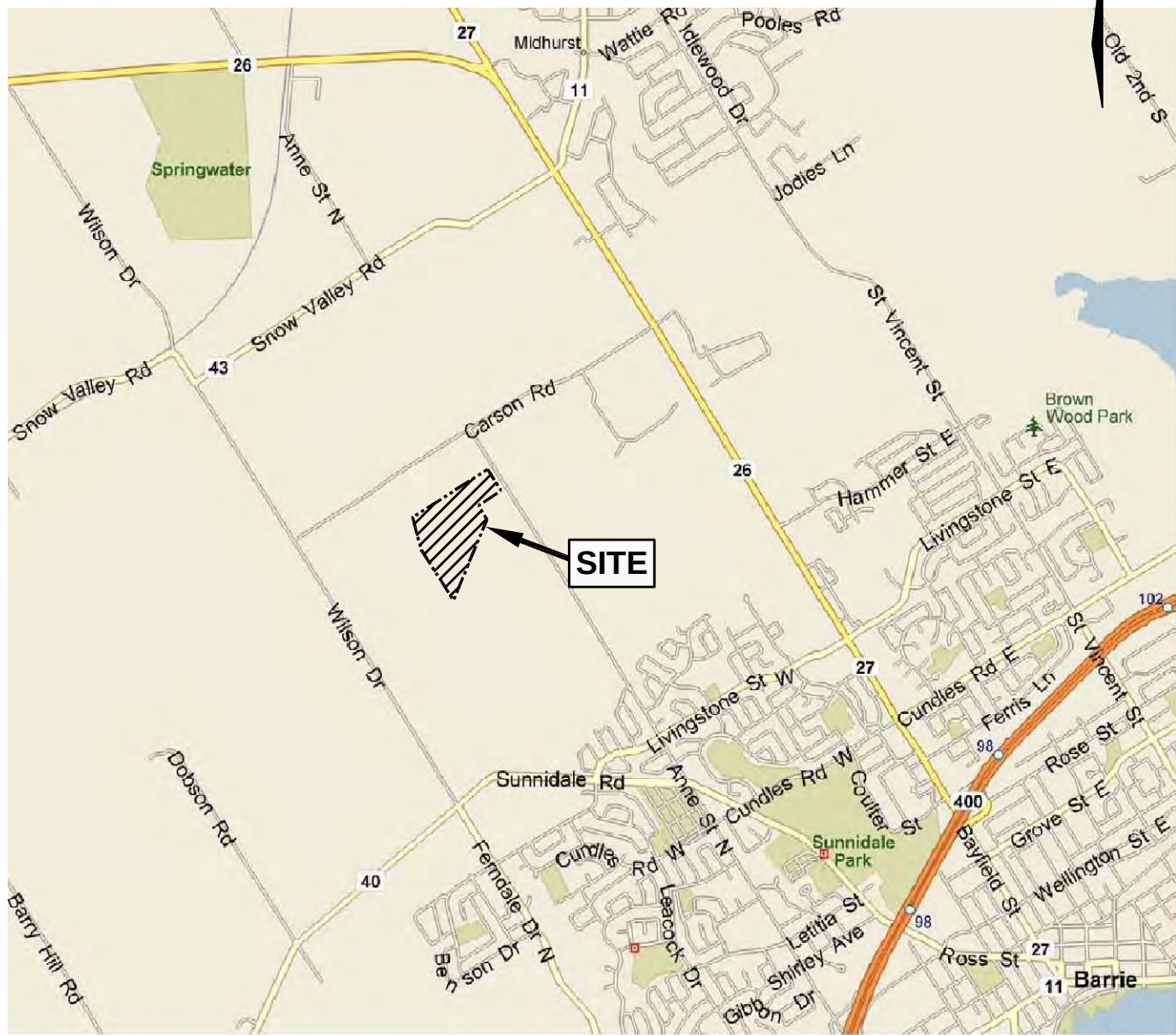
LOGGED: CR

CHECKED:

Borehole caved to a depth of 1.2 m upon completion of drilling, Apr. 2/08

Groundwater level in open portion of borehole at a depth of 0.6 m upon completion of drilling, Apr. 2/08

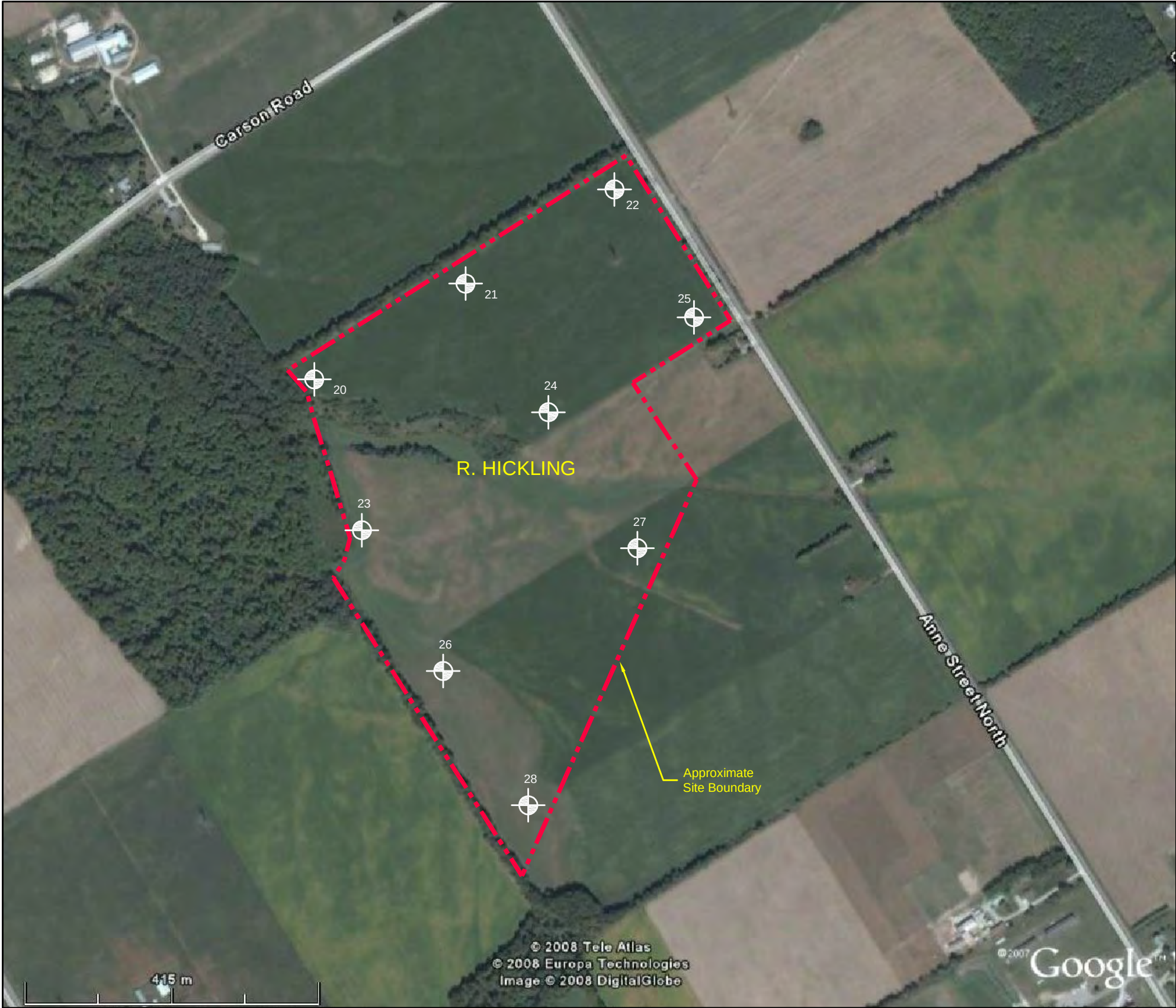
Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506C-E-002 -FIG 2008\03 R.Hickling - FIG 1-KP.dwg Apr 18, 2008 - 5:03pm



Base map by Microsoft Streets & Trips 2006
Microsoft Corp. and/or its suppliers, 1988- 2005;
NAVTEQ, 2004; and TeleAtlas North America,
Inc., 2004

PROJECT		Preliminary Geotechnical Investigation R. Hickling Site 668 Anne Street North Midhurst, Ontario			
TITLE		KEY PLAN			
 Whitby, Ontario		PROJECT No.08-1186-0506C-G		FILE No. 002	
		DESIGN		SCALE	AS SHOWN
		CADD	PJV	April 2008	REV.
		CHECK		FIGURE 1	
		REVIEW			

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506\R.Hickling\08-1186-0506C-E-001 -FIG 2008\03 R.Hickling - FIG 2.dwg Apr 18, 2008 - 5:03pm



Aerial Photograph by Google Earth Pro 2007,
Image 2008 First Base Solutions.



NOT TO SCALE
ALL LOCATIONS ARE APPROXIMATE

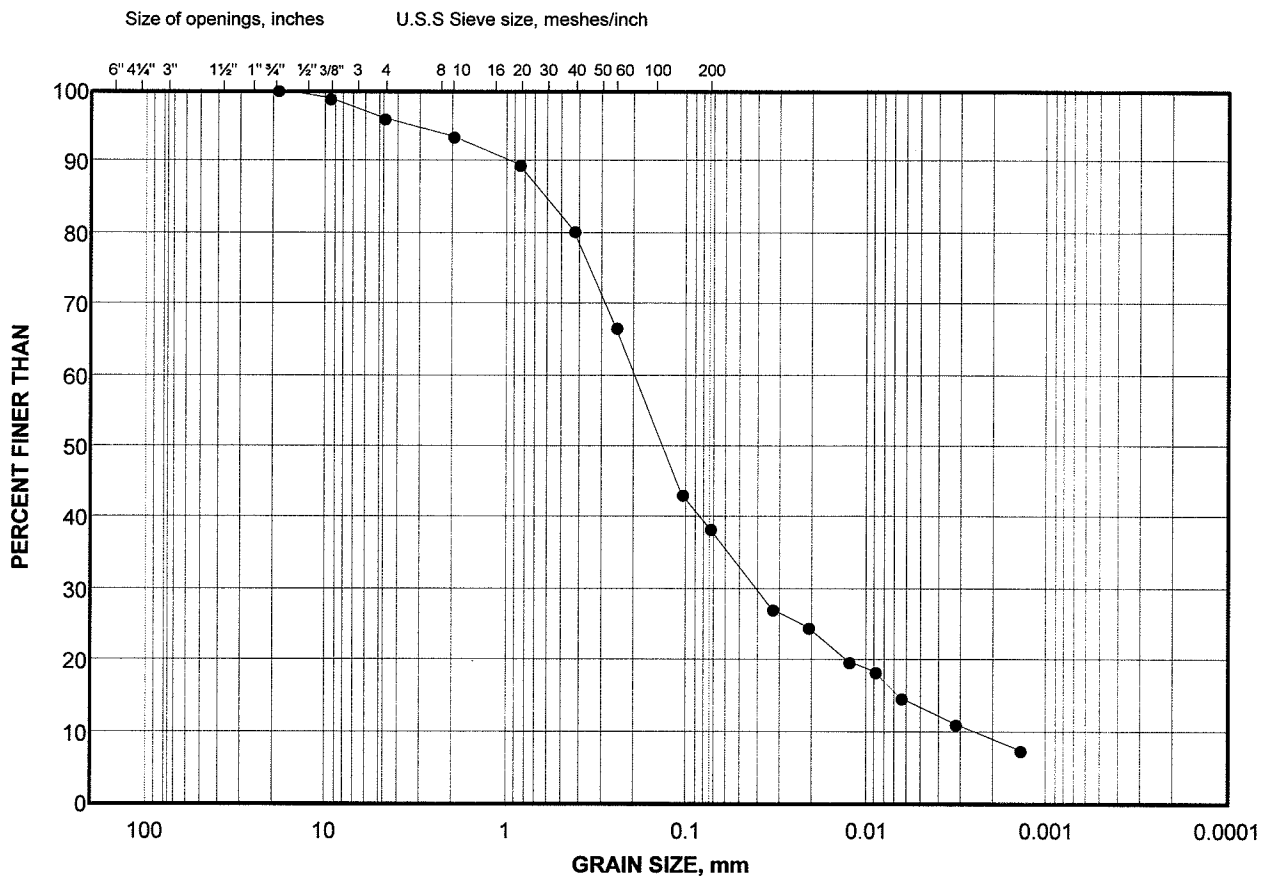
LEGEND

 BOREHOLE LOCATION IN PLAN

PROJECT		Preliminary Geotechnical Investigation R. Hickling Site 668 Anne Street North Midhurst, Ontario			
TITLE					
SITE LOCATION PLAN					
 Golder Associates Whitby, Ontario	PROJECT No.08-1186-0506C-G		FILE No. 001		
	DESIGN		SCALE	AS SHOWN	REV.
	CADD	PJV	April 2008	FIGURE 2	
	CHECK				
	REVIEW				

GRAIN SIZE DISTRIBUTION SILTY SAND TILL

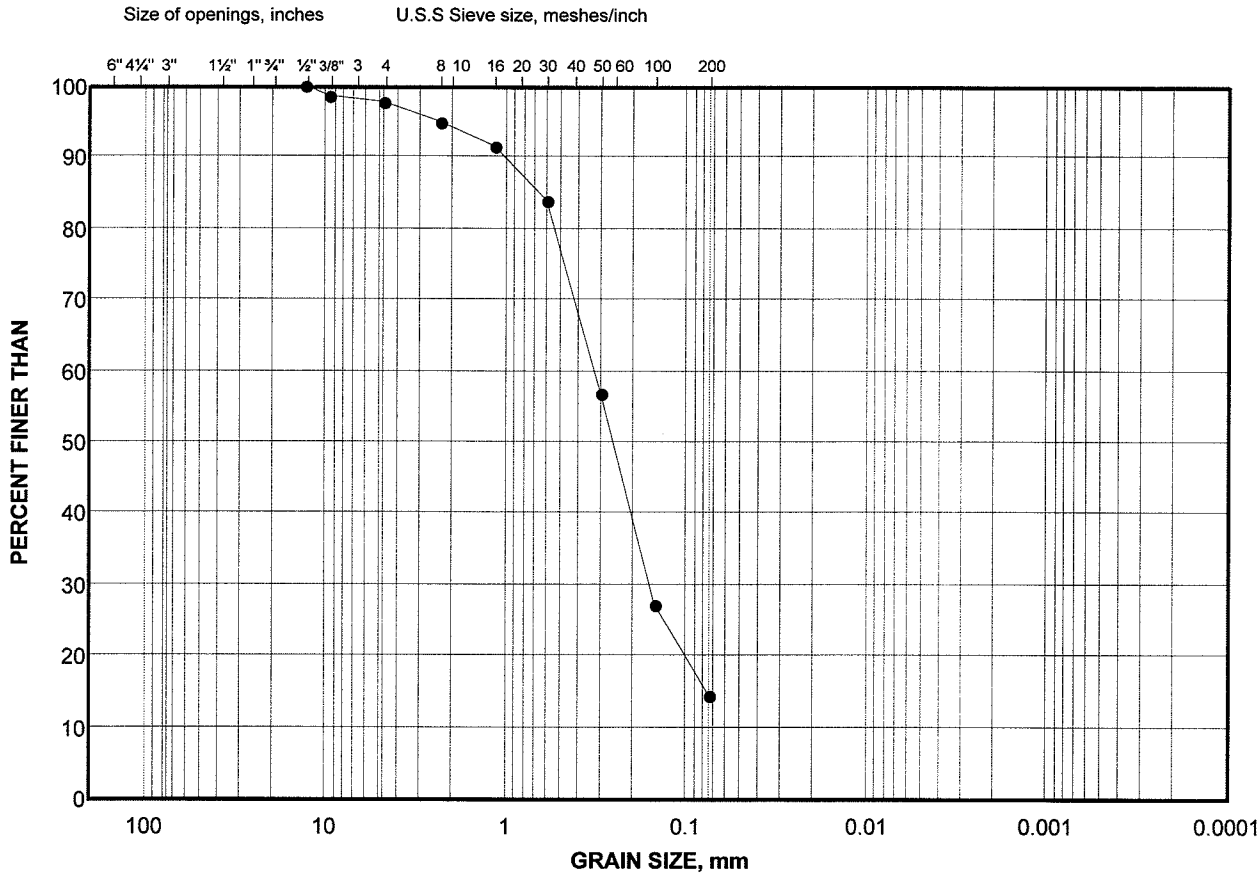
FIGURE 3



GRAIN SIZE DISTRIBUTION

Fine to Medium SAND

FIGURE 4



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	25	5	3.0 - 3.50

Project Number: 08-1186 0506C

Checked By: *DR*

Golder Associates

Date: 17-Apr-08

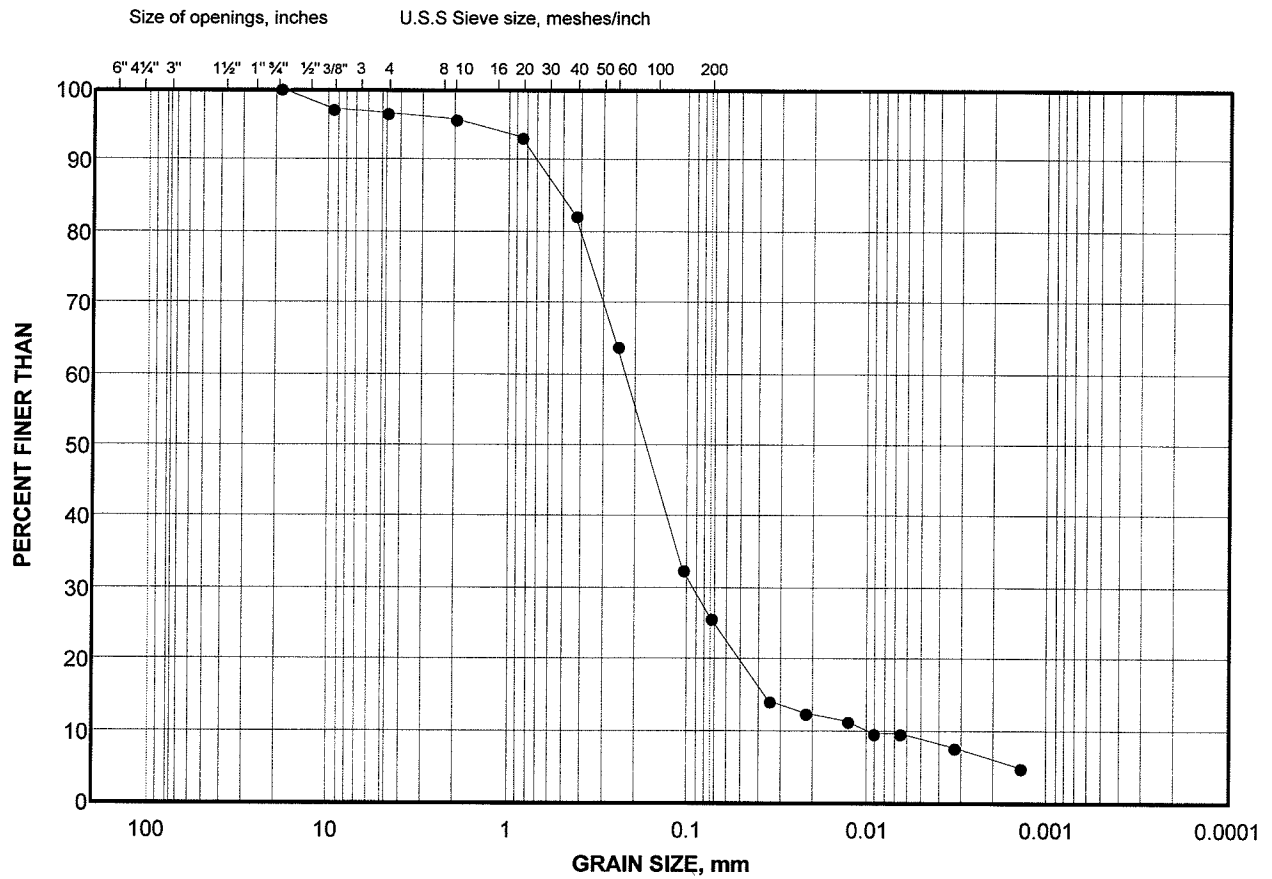
FIGURE 5



SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	25	1B	0.20 - 0.60

GRAIN SIZE DISTRIBUTION SILTY SAND

FIGURE 6



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	28	2	0.60 - 1.20

Project Number: 08-1186 0506C

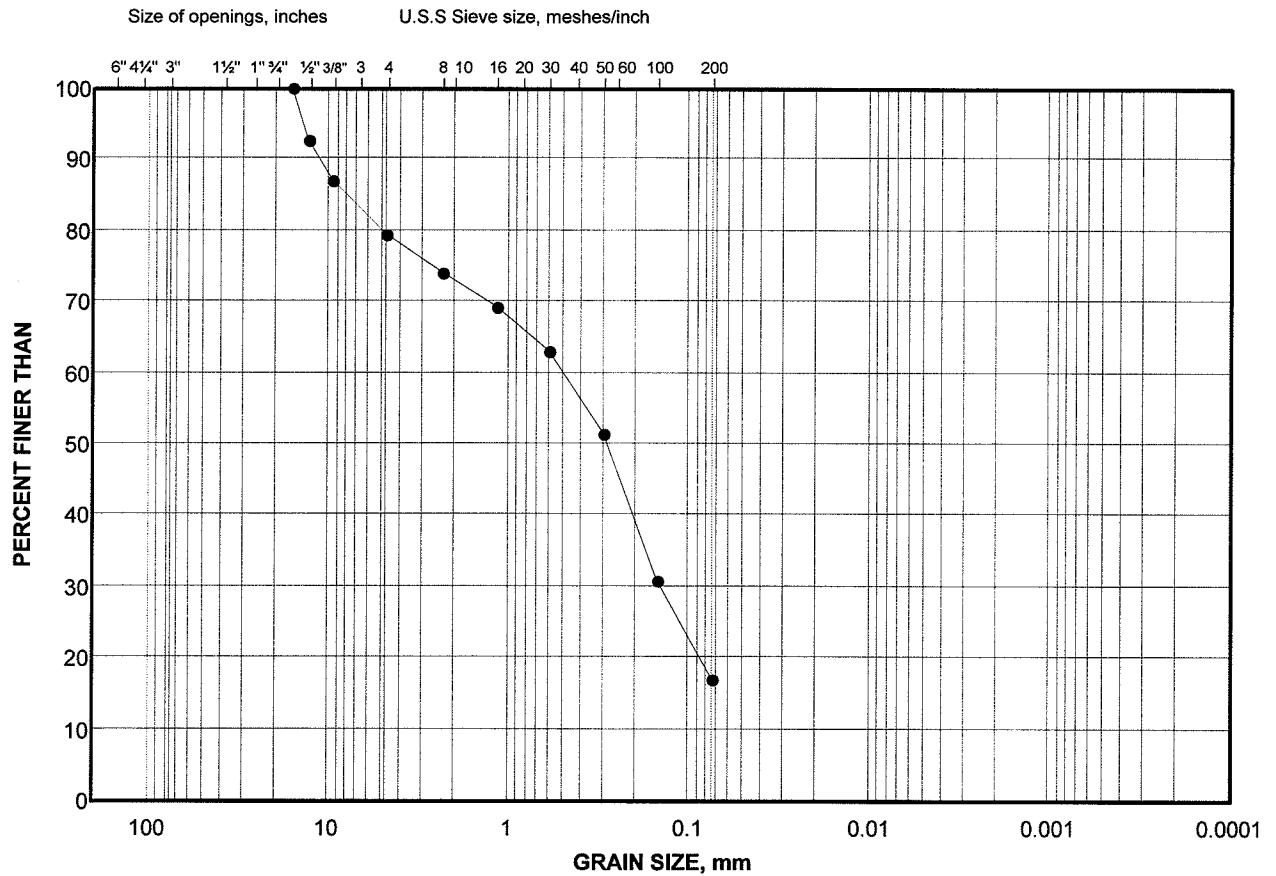
Checked By: DL

Golder Associates

Date: 17-Apr-08

GRAIN SIZE DISTRIBUTION GRAVELLY SAND

FIGURE 7



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	21	6	4.50 - 4.80

Project Number: 08-1186 0506C

Checked By:

Golder Associates

Date: 17-Apr-08

Appendix A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing in Saskatchewan, subject to the time limits and physical constraints applicable to this report. No other warranty, express or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. *No other party may use or rely on this report or any portion thereof without Golder's express written consent. Golder will consent to any reasonable request by the Client to approve the use of this report by other parties as Approved Users.* The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media are susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. *In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use by any party of portions of the report without reference to the entire report.*

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (CONTINUED)

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgement, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction is necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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**DRAFT
REPORT ON**

**PRELIMINARY GEOTECHNICAL INVESTIGATION
D. HICKLING PROPERTY
MIDHURST, ONTARIO**

Submitted to:

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

Distribution:

- 1 Copy (Digital) - Geranium Corporation, Markham, Ontario
- 1 Copy - Golder Associates Ltd., Whitby, Ontario

April, 2008

08-1186-0506A(G)



Golder Associates Ltd.

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Whitby, Ontario, Canada L1N 8Y6
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Fax: (905) 723-2182



April 23, 2008

08-1186-0506A(G)

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

**RE: PRELIMINARY GEOTECHNICAL INVESTIGATION
D. HICKLING PROPERTY
MIDHURST, ONTARIO**

This report presents the results of a preliminary geotechnical investigation carried out at the above referenced site, as shown on the Key Plan, Figure 1. The purpose of the investigation was to determine the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of shallow boreholes. Based on our interpretation of the borehole data, this report provides preliminary geotechnical information for the planning of a proposed residential and/or commercial development at the site. Authorization to proceed with this investigation was provided by Ms. Shauna Dudding, P.Eng. of Geranium Corporation, in an email dated March 3, 2008.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder Associates Ltd. (Golder) should be given an opportunity to confirm that the preliminary recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report", included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. Further, the environmental aspects (i.e. Phase I ESA) at the site are being addressed concurrently by Golder (reported under separate cover).



SITE DESCRIPTION

The site is located on the west side of Anne Street North, between Carson Road and Snow Valley Road, in Midhurst, Ontario. The site generally consists of agricultural property, approximately 84.3 ha (208.3 ac) in size, with a residence and farm buildings located on the southwest portion of the site. The northern portion of the site consists of a forested woodlot and is occupied by the Sno Voyageur Club, located at 1359 Snow Valley Road. Adjacent properties surrounding the site consist mainly of residential, agricultural properties and industrial properties (i.e., a quarry to the north).

PHYSIOGRAPHY

The site lies near the border of the physiographic regions of Southern Ontario known as the Simcoe Lowlands and Simcoe Uplands (Chapman and Putnam 1984). Physiographic mapping in the immediate vicinity of the site indicates glaciolacustrine deposits of sands, silt and clay, bordering on tills with predominantly sandy silt matrix (Map 2556, Quaternary Geology of Southern Ontario, Barnett, Cowan and Henry, 1991). This physiographic mapping is generally consistent with the results of the current investigation.

INVESTIGATION PROCEDURE

The field work for this preliminary investigation was carried out on April 3, 4 and 7, 2008 during which time eleven boreholes (Nos. 1 to 11) were advanced at the locations shown on the Location Plan, Figure 2. The boreholes were drilled using a track-mounted drillrig supplied and operated by Eastern Soil Investigation Limited, under our supervision. Standard penetration testing and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment. The shallow groundwater conditions were noted in the open boreholes during drilling and the boreholes were backfilled and sealed upon completion of drilling. All of the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective classification testing.

The field work for this investigation was directed by members of our engineering staff who also determined the borehole locations in the field, logged the boreholes and cared for the samples obtained. The as-drilled borehole locations and corresponding ground surface elevations were provided by RPE Surveying and are understood to be referenced to geodetic datum.

SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing, are shown in detail on the Record of Borehole sheets following the text of this report. Lists of abbreviations and symbols are provided to assist

in the interpretation of the borehole logs. The soils laboratory test results are shown on Figures 3 to 7 following the borehole logs. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this preliminary investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying 0.15 to 0.3 m of topsoil, the native subsoil conditions predominantly consist of deposits of silty sand till, sand and silty sand. Discontinuous deposits of till-like silty sand, clayey silt and silty clay were also encountered in some of the boreholes. Shallow groundwater was encountered in six of eleven boreholes, at depths varying from 0.3 m to 5.8 m below the existing ground surface.

TOPSOIL

Topsoil was encountered in all boreholes advanced at the site. The topsoil thickness encountered at the borehole locations ranged from 0.15 to 0.3 m, as summarized in the following table:

BOREHOLE	TOPSOIL THICKNESS (mm)
1	180
2	200
3	200
4	180
5	230
6	180
7	150
8	200
9	200
10	300
11	150

Fill

Shallow layers of fill materials, consisting mainly of silty sand, were encountered underlying the topsoil in all boreholes. This material may represent disturbed native soil due to agricultural operations. Standard penetration tests carried out within the fill gave N values ranging from 2 to 5 blows per 0.3 m, indicating a very loose to loose relative density. The in-situ water contents of the fill samples ranged from 9 to 22 percent.

Silty Sand Till

Silty sand is one of the predominant native soil types at the site and was encountered in all boreholes except for Borehole 5. Boreholes 3, 4, 6, 7, 9 and 10 were also terminated in the silty sand till. The silty sand till contained cobbles and boulders. Standard penetration tests carried out within the silty sand till gave N values ranging from 10 to greater than 100 blows per 0.3 m, indicating a compact to very dense relative density. The natural water contents of the silty sand till samples ranged from 6 to 12 percent. One grain size distribution curve for a sample of the silty sand till, recovered from the 35 mm internal diameter split spoon sampler, is shown on Figure 3.

Sand and Silty Sand

Deposits of sand and silty sand were encountered in seven of the eleven boreholes advanced at the site. Boreholes 1, 2, 5, 8 and 11 were also terminated in the sands. Standard penetration tests carried out within the sands gave variable N values ranging from 5 to greater than 100 blows per 0.3 m, indicating a loose to very dense relative density. The natural water contents of the sand samples ranged from 3 to 13 percent. A grain size distribution curve for a sample of the fine sand is shown on Figure 4.

Till-like Silty Sand

Strata of till-like silty sand were encountered in Boreholes 1, 2, 6, 8, 9, 10 and 11, overlying the silty sand till or till-like silty sand. Standard penetration tests carried out within the till-like silty sand soils gave N values ranging from 2 to 9 blows per 0.3 m, indicating a very loose to loose relative density. The natural water contents of the till-like samples ranged from 11 to 21 percent. A grain size distribution curve for a sample of the till-like silty sand is shown on Figure 5.

Clayey Silt and Silty Clay

Strata of clayey silt or silty clay were encountered in Boreholes 1, 4 and 7, overlying the silty sand till. Standard penetration tests carried out within the silty clay and clayey silt gave N values varying from 4 to 22 blows per 0.3 m, indicating a soft to very stiff consistency. The natural water contents of the clayey silt and silty clay samples ranged from 21 to 51 percent. A grain size distribution curve for a sample of the silty clay is shown on Figure 6. The liquid and plastic limits for a sample of the silty clay were 54 and 34 percent, respectively; indicating an inorganic clay of high plasticity, as shown on the Plasticity Chart, Figure 7.

Shallow Groundwater

Shallow groundwater was encountered in Boreholes 4, 6, 7, 9, 10 and 11 during drilling at depths varying from 0.3 to 5.2 m below the existing ground surface. All other boreholes were found to be dry upon completion of drilling. It should be noted that these observations reflect the shallow

groundwater conditions encountered in the boreholes during the time of the field investigation (early April, 2008) and some seasonal fluctuations should be anticipated.

DISCUSSION

This section of the report provides preliminary geotechnical information based on our interpretation of the limited borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for planning and preliminary design purposes and is not sufficient for final design or construction purposes. Once the actual development plans and pertinent design details are available (e.g. road, lot and/or building layout, underground service locations/depths, etc.), the results of this preliminary investigation should be reviewed by the geotechnical engineer and an additional site specific investigation carried out, compatible with the final development plans for the site.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report and have not been investigated or addressed. However, as previously noted, Golder is providing concurrent Phase I ESA services for this site (reported under separate cover).

Preliminary Geotechnical Information

It is understood that consideration is being given to developing the site with a residential and/or commercial development. Based on the results of this preliminary investigation, the subsurface native soils encountered at the site are generally considered to be suitable for supporting the proposed development. The following preliminary geotechnical information is provided for the planning and preliminary design of residential houses or commercial buildings, underground services and paved roads at the site:

- Depending upon the final site grading scheme and proposed basement and/or at-grade floor slab elevations, the areas should be brought up to the underside of the footings and/or floor slabs, as required, using engineered fill. The materials proposed for use as engineered fill should be approved by qualified geotechnical personnel at the source, prior to hauling to the site. Most of the native soils at the site would be suitable for reuse as engineered fill. Imported materials meeting the requirements of OPSS Select Subgrade Material (SSM)

would also be suitable for use as engineered fill. Details regarding placement and compaction requirements for engineered fill, if utilized at the site, can be provided once the actual development plans are available, as part of the final geotechnical recommendations for the project.

- The native subsoils at the site (underlying the fill or disturbed native soil) are considered to be suitable for supporting conventional residential houses (with basements) or single storey, slab-on-grade commercial buildings. A preliminary allowable bearing pressure in the range of 100 to 150 kPa may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed subsoils, at depths of approximately 0.8 to 2.7 m below the existing ground surface (or deeper as required for basements). It should be noted that the shallow, relatively loose till-like subsoils (vicinity of Boreholes 1, 2, 6, 8, 9, 10 and 11) are generally not suitable for supporting houses/buildings. Footings founded on approved engineered fill, if utilized at the site, may be designed using a preliminary allowable bearing pressure in the range of 100 to 150 kPa.
- The need for and type of foundation drainage system required (perimeter drains and/or underslab drains; damp-proofing or water-proofing) depends upon the proposed founding elevations, soil types in the area and actual stabilized groundwater levels. Based on the results of this preliminary investigation, it is anticipated that conventional foundation drainage (i.e. perimeter drains and damp-proofing) would be adequate at most locations. However, basements founded in wet sand below a depth of about 3 m (vicinity of Borehole 10) may require water-proofing. For floor slabs at or above exterior grades, foundation drainage would likely not be required. In any event, the need for and type of foundation drainage should be confirmed by the geotechnical engineer once the site grading plans are available, as part of final design process.
- Based on the results of this preliminary investigation, for shallow excavations for underground services up to about 5 m in depth, groundwater control during excavation can probably be handled, if required, by pumping from properly constructed and filtered sumps located at the base of the excavation. However, it should be noted that cohesionless sandy subsoils are the predominant soil types at this site. Excavations into these soils, where they are below the local water table (e.g. Vicinity of Borehole 10), may require more positive dewatering measures, in addition to pumping from sumps, to maintain the stability of the trench side slopes and base to facilitate construction. In this regard, stabilized groundwater levels at the site should be determined as part of the follow-up, site specific geotechnical investigation at the site. The need for and type of groundwater control measures can then be reviewed by the geotechnical engineer as part of the final design process.
- It is anticipated that the trench excavations for underground servicing would consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, some local flattening of side slopes may be required in some areas in looser soil zones or where significant water seepage is encountered. Conventional bedding thicknesses are anticipated for underground services founded within the native competent subsoils at the site. Additional bedding thicknesses may be required for services founded in wet sands, depending upon the excavation depths and success of the contractor's groundwater control measures, if required.
- The majority of the native subsoils above the local water table are generally near their estimated optimum water contents for compaction and should be suitable for reuse as trench backfill, provided they are free of significant amounts of topsoil, organics and other deleterious materials. Excavated subsoils from below the local water table would likely require some drying prior to placement.

- Complete removal of any existing septic systems, wells, old foundations, etc. would likely be required as part of the site redevelopment.
- Based on the subsoil conditions encountered, conventional asphaltic (flexible) pavement designs are considered to be appropriate for a proposed residential and/or commercial development at the site. Typical pavement designs are as follows:

TYPICAL COMMERCIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)	
		Truck Routes and Main Access Roads	Car Parking and Internal Access Roads
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	50
Granular Material (OPSS 1010)	Granular A Base	150	150
	Granular B Type I Subbase	400	300
		Prepared and Approved Subgrade	

TYPICAL RESIDENTIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)		
		Local Street	Collector Street	Major Collector
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40	40
	HL 8 Binder Course	50	65	90
Granular Material (OPSS 1010)	Granular A Base	150	150	150
	Granular B Type I Subbase	300	400	450
		Prepared and Approved Subgrade		

Prior to placing the granular subbase material, the exposed soil subgrade should be heavily proof-rolled in conjunction with inspection by qualified geotechnical personnel. Deleterious, organic, softened or loosened native subsoils or fills will require subexcavation and replacement with approved material (i.e. controlled fill), as directed by geotechnical personnel.

We trust that this report provides sufficient preliminary geotechnical engineering information to aid in the planning and preliminary design of the proposed residential and/or commercial development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

DRAFT

David B. Liu, P.Eng.
Geotechnical Engineer

DRAFT

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Enclosures: Abbreviations & Symbols
 Record of Borehole Sheets 1 to 11
 Figures 1 to 7
 Appendix A – Important Information and Limitations of This Report

AC/DL/DGG/tf
08-1186-0506 A-G REP 2008'04'23

LIST OF ABBREVIATIONS

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

I SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

III SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

II PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.).

Dynamic Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT):

An electronic cone penetrometer with a 60° conical tip and a projected end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
γ	unit weight

Note:

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

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (con't.)

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

(c) Hydraulic Properties

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

(d) Consolidation (one-dimensional)

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

(e) Shear Strength

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

Notes: 1. $\tau = c' + \sigma' \tan \phi'$

2. Shear strength = (Compressive strength)/2

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 4, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m													
									SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT						
									20	40	60	80		10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³			
									nat V. + Q - rem V. ⊕ U - ●					Wp — W — WI						
									25	50	75	100		10	20	30	40			
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																		
		TOPSOIL		0.00	1A		.													
		Very loose to loose brown silty sand, trace to some clay, trace gravel, rootlets (FILL or disturbed native soil)		0.18	1B	50 DO	4													
1		Firm brown CLAYEY SILT, trace to some sand, trace gravel		0.61	2	50 DO	6													
		Loose brown SILTY SAND, trace clay, trace gravel (TILL-LIKE)		1.22	3	50 DO	7													
2		Compact to dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		1.83	4	50 DO	10													
3					5	50 DO	28													
4																				
5					6	50 DO	40													
6		Very dense brown SAND, trace silt, trace gravel		5.56																
				7	50 DO	50/ .10														
		END OF BOREHOLE		6.35																
7																				
8																				
9																				
10																				

Borehole dry and open upon completion of drilling, April 4/08

Borehole dry and open
upon completion of
drilling, April 4/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 4, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m													
									SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT						
									20	40	60	80		10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³			
									nat V. + Q - rem V. ⊕ U - ● ○					Wp ———— W ———— WI						
									25	50	75	100		10	20	30	40			
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																		
		TOPSOIL		0.00	1A		.									○				
		Very loose to loose brown silty sand, trace clay, trace gravel, rootlets (FILL or disturbed native soil)		0.20	1B	50 DO	4									○				
1		Loose brown SILTY SAND, trace to some clay, trace gravel (TILL-LIKE)		0.61	2	50 DO	9									○			MH	
		Very dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		1.22	3	50 DO	52									○				
2					4	50 DO	72									○				
		Very dense brown fine SAND, trace silt, trace to some gravel		2.74	5	50 DO	80									○				
3					6	50 DO	90/ .20									○				
5					7	50 DO	50/ .15									○				
6																				
7		END OF BOREHOLE		6.40															Borehole dry and open upon completion of drilling, Apr. 4/08	
8																				
9																				
10																				

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 3

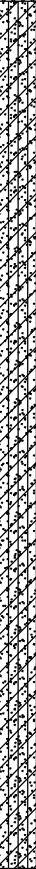
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 4, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m															
									SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT								
									20	40	60	80		10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³					
									nat V. + Q - rem V. ⊕ U - ●													
									25	50	75	100		Wp	W	WI						
														10	20	30	40					
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																				
		TOPSOIL		0.00	1A		.															
		Very loose to loose brown silty sand, trace clay, trace gravel, rootlets (FILL or disturbed native soil)		0.20	1B	50 DO	4															
1		Compact to very dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		0.61	2	50 DO	13															
					3	50 DO	25															
2					4	50 DO	33															
3					5	50 DO	50															
4	6				50 DO	90/ .25																
5	7				50 DO	50/ .10																
6		END OF BOREHOLE		6.35																		
7																						
8																						
9																						
10																						

Borehole dry and open upon completion of drilling, Apr. 4/08

Borehole dry and open
upon completion of
drilling, Apr. 4/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 3, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m	SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT					
									20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE		0.00	1A	.												
		TOPSOIL		0.23	1B	50 DO	5											
		Loose brown silty sand, rootlets (FILL or disturbed native soil)		0.61	2	50 DO	5											
1		Loose to very dense brown fine SAND, trace to some silt			3	50 DO	24											
2				4	50 DO	41												
3				5	50 DO	90/25												
4				6	50 DO	50/15												
5			7	50 DO	50/10													
6		END OF BOREHOLE		6.35														
7																		
8																		
9																		
10																		

Borehole open and dry upon completion of drilling, Apr. 3/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 7, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT						
								20 40 60 80					10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³						
								nat V. + Q - rem V. ⊕ U - ○					Wp ———— W ———— WI						
							25	50	75	100		10	20	30	40				
0		GROUND SURFACE																	
	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A														
		Very loose brown silty sand, trace clay, trace gravel, rootlets (FILL or disturbed native soil)		0.18	1B	50 DO	3												
		Very loose to loose brown SILTY SAND, trace clay, trace gravel (TILL-LIKE)		0.61	2	50 DO	4												
1						3	50 DO	6											
		Compact to very dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		1.83	4	50 DO	30												
2						5	50 DO	30											
3						6	50 DO	31											
4						7	50 DO	50/.15											
5																			
6																			
7		END OF BOREHOLE		6.40															
8																			
9																			
10																			

Borehole caved to a depth of 4.9 m upon completion of drilling, Apr. 7/08

Groundwater level in open portion of borehole at a depth of 0.3 m upon completion of drilling, Apr. 7/08

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

Borehole caved to a depth of 4.9 m upon completion of drilling, Apr. 7/08

Groundwater level in open portion of borehole at a depth of 0.3 m upon completion of drilling, Apr. 7/08

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 7

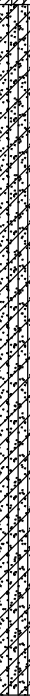
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 3, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS						
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m		20		40		60		80		10 ⁻⁶				10 ⁻⁵		10 ⁻⁴		10 ⁻³	
									SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U -		Wp				W		WI			
									25	50	75	100					10	20	30	40						
0		GROUND SURFACE																								
	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A																					
		Loose brown sand, some silt, trace gravel, rootlets (FILL or disturbed native soil)		0.15	1B	50 DO	5																			
		Soft to stiff brown varved SILTY CLAY, trace sand		0.61	2	50 DO	4																			
					3	50 DO	14																			
1																										
2		Compact to very dense brown SILTY SAND, trace clay, trace to some gravel, cobbles and boulders (TILL)		1.83	4	50 DO	10																			
3					5	50 DO	82/.25																			
4																										
5					6	50 DO	50/.15																			
6				7	50 DO	50/.15																				
		END OF BOREHOLE		6.40																						
7																										
8																										
9																										
10																										

Borehole caved to a depth of 5.5 m upon completion of drilling, Apr. 3/08

Groundwater level in open portion of borehole at a depth of 3.7 m upon completion of drilling, Apr. 3/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

Borehole caved to a depth of 5.5 m upon completion of drilling, Apr. 3/08

Groundwater level in open portion of borehole at a depth of 3.7 m upon completion of drilling, Apr. 3/08

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 8

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 3, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m													
									SHEAR STRENGTH Cu, kPa				WATER CONTENT PERCENT							
									20	40	60	80		10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³			
									nat V. + Q - ● rem V. ⊕ U - ○				Wp ——— W ——— WI							
									25	50	75	100		10	20	30	40			
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																		
		TOPSOIL		0.00	1A															
		Very loose to loose brown silty sand, trace clay, trace gravel, rootlets (Possible FILL or disturbed native soil)		0.20	1B	50 DO	4													
1		Loose brown SILTY SAND, trace gravel, trace clay (TILL-LIKE)		0.61	2	50 DO	9													
		Compact to dense brown SILTY SAND, trace clay, trace gravel, cobbles (TILL)		1.22	3	50 DO	18													
2					4	50 DO	50													
		Very dense brown fine SAND, some silt, cobbles		2.44																
3				5	50 DO	85/ .25														
4																				
5				6	50 DO	95/ .23														
6																				
7				7	50 DO	80														
		END OF BOREHOLE		6.55																
7																			Borehole dry and open upon completion of drilling, Apr. 3/08	
8																				
9																				
10																				

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 9

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 7, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m												
									SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT						
								20	40	60	80		10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³				
								nat V. + Q - rem V. ⊕ U -					Wp — W — WI							
								25	50	75	100		10	20	30	40				
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																		
		TOPSOIL		0.00	1A	.														
		Very loose to loose dark brown silty sand to sandy silt, trace clay, trace gravel, rootlets and organics (FILL or disturbed native soil)		0.20	1B	50 DO	2													
					2	50 DO	5													
1					3	50 DO	7													
		Loose brown SILTY SAND, trace clay, trace gravel (TILL-LIKE)		1.22																
					4	50 DO	7													
2					5	50 DO	56													
		Very dense brown SILTY SAND, trace clay, some gravel, cobbles and boulders (TILL)		2.74																
					6	50 DO	90/.25													
3					7	50 DO	50/.08													
4			END OF BOREHOLE	6.32																
7																	Borehole caved to a depth of 2.7 m upon completion of drilling, Apr. 7/08			
8																	Groundwater level in open portion of borehole at a depth of 0.6 m upon completion of drilling, Apr. 7/08			
9																				
10																				

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

DEPTH SCALE

1 : 50



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PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 10

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 3, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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									SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JLJ

DEPTH SCALE

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Borehole caved to a depth of 5.0 m upon completion of drilling, Apr. 3/08

Groundwater level in open portion of borehole at a depth of 0.6 m upon completion of drilling, Apr. 3/08

PROJECT: 08-1186-0506A-G

RECORD OF BOREHOLE 11

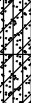
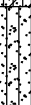
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 3, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m	SHEAR STRENGTH Cu, kPa		nat V. rem V. + ⊕ Q - ● U - ○			WATER CONTENT PERCENT Wp ———— W ———— WI							
									20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³					
								25	50	75	100		10	20	30	40					
0	TRACK-MOUNTED POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																			
		TOPSOIL		0.00	1A		.														
		Very loose to loose brown silty sand, trace gravel (FILL or disturbed native soil)		0.15	1B	50 DO	4														
		Very loose to loose brown SILTY SAND, trace clay, trace gravel (TILL-LIKE)		0.61	2	50 DO	4														
1		Compact to very dense brown SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)		1.22	3	50 DO	16														
					4	50 DO	34														
2																					
					5	50 DO	65														
4	Very dense brown SILTY SAND, trace gravel		4.04	6	50 DO	50/ .10															
5																					
				7	50 DO	90															
	END OF BOREHOLE		6.55																		
7																					
8																					
9																					
10																					

Groundwater level in open borehole at a depth of 5.8 m upon completion of drilling, Apr. 3/08

LDN_BHS 08-1186-0506A-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JJJ

DEPTH SCALE

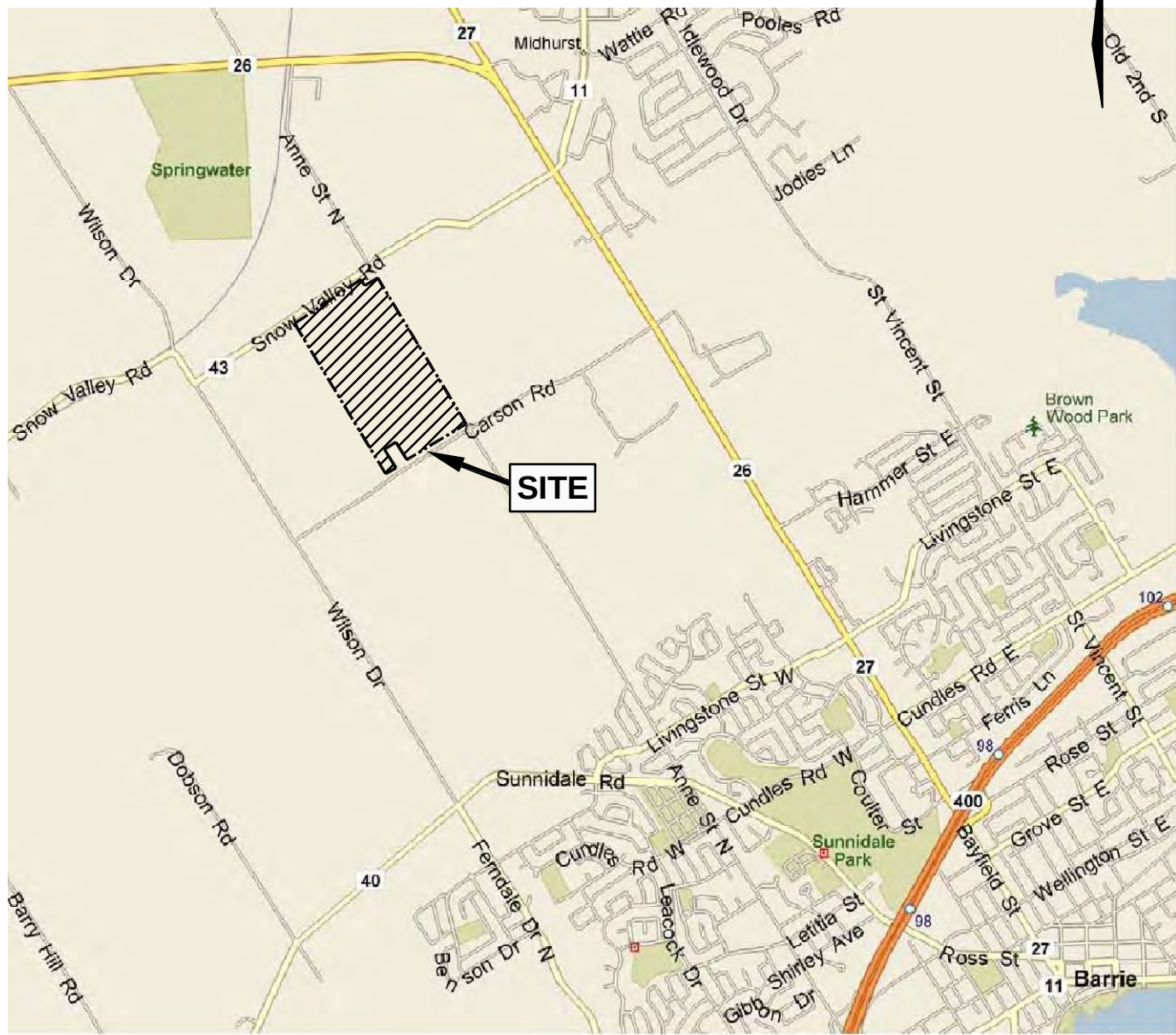
1 : 50



LOGGED: CR

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Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506A-001 -FIG 2008\03 D.Hickling - FIG 1-KP.dwg Apr 23, 2008 - 3:23pm



Base map by Microsoft Streets & Trips 2006
Microsoft Corp. and/or its suppliers, 1988- 2005;
NAVTEQ, 2004; and TeleAtlas North America,
Inc., 2004

PROJECT		Preliminary Geotechnical Investigation D. Hickling Property 1404 Carson Road Midhurst, Ontario	
TITLE		KEY PLAN	
 Golder Associates Whitby, Ontario	PROJECT No.08-1186-0506A-G		FILE No. 002
	DESIGN		SCALE AS SHOWN REV.
	CADD	PJV Apr. 2008	FIGURE 1
	CHECK		
	REVIEW		

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506\08-1186-0506A-001 -FIG 2008\03 D.Hickling - FIG 2.dwg Apr 23, 2008 - 3:23pm



Aerial Photograph by Google Earth Pro 2007,
Image 2008 First Base Solutions.



NOT TO SCALE
ALL LOCATIONS ARE APPROXIMATE

LEGEND

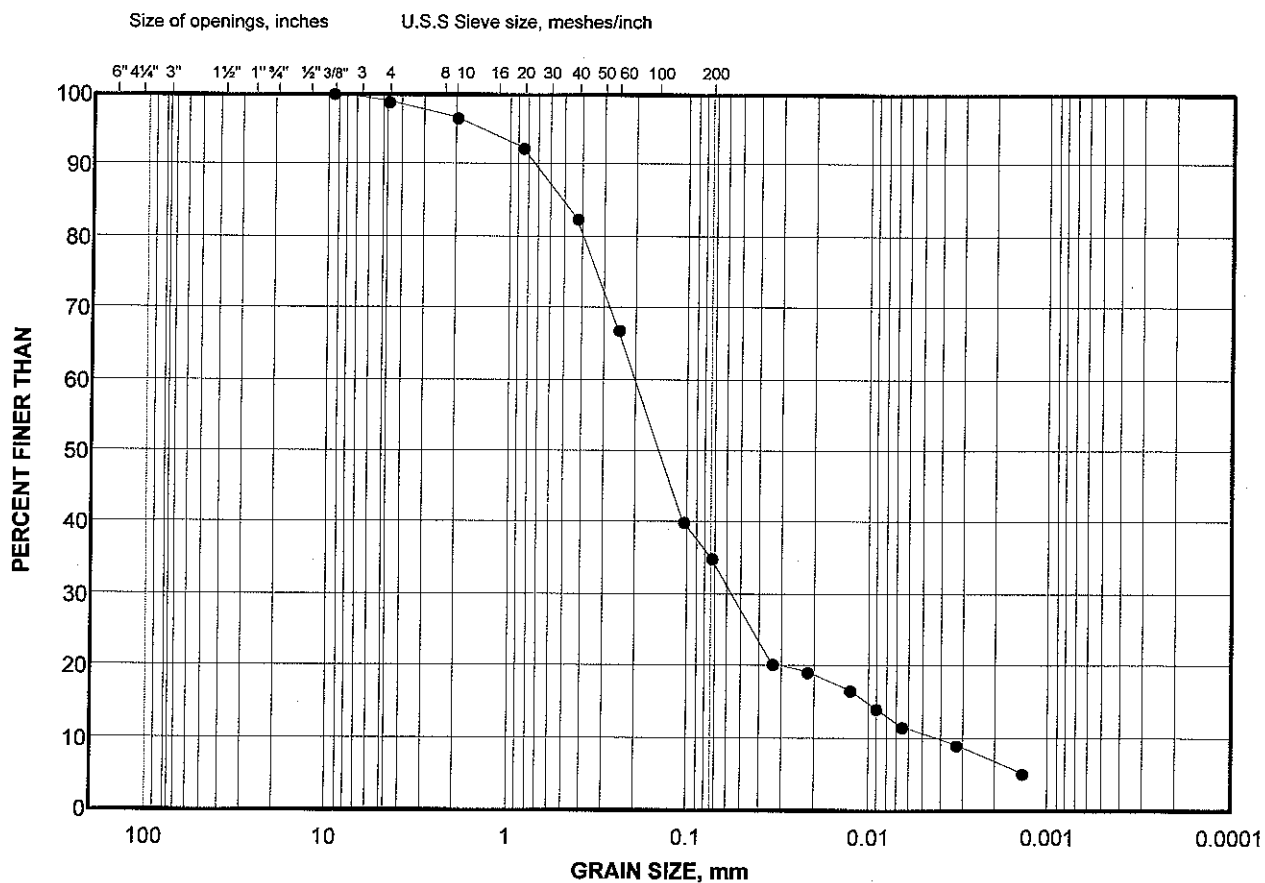


BOREHOLE LOCATION IN PLAN

PROJECT		Preliminary Geotechnical Investigation D. Hickling Property 1404 Carson Road Midhurst, Ontario			
TITLE		LOCATION PLAN			
	PROJECT No.08-1186-0506A-G		FILE No.		
	DESIGN		SCALE	AS SHOWN	REV.
	CADD	PJV	April 2008	FIGURE 2	
	CHECK				
	REVIEW				

GRAIN SIZE DISTRIBUTION SILTY SAND TILL

FIGURE 3



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	7	4	1.80 - 2.40

Project Number: 08-1186 0506A

Checked By: *df*

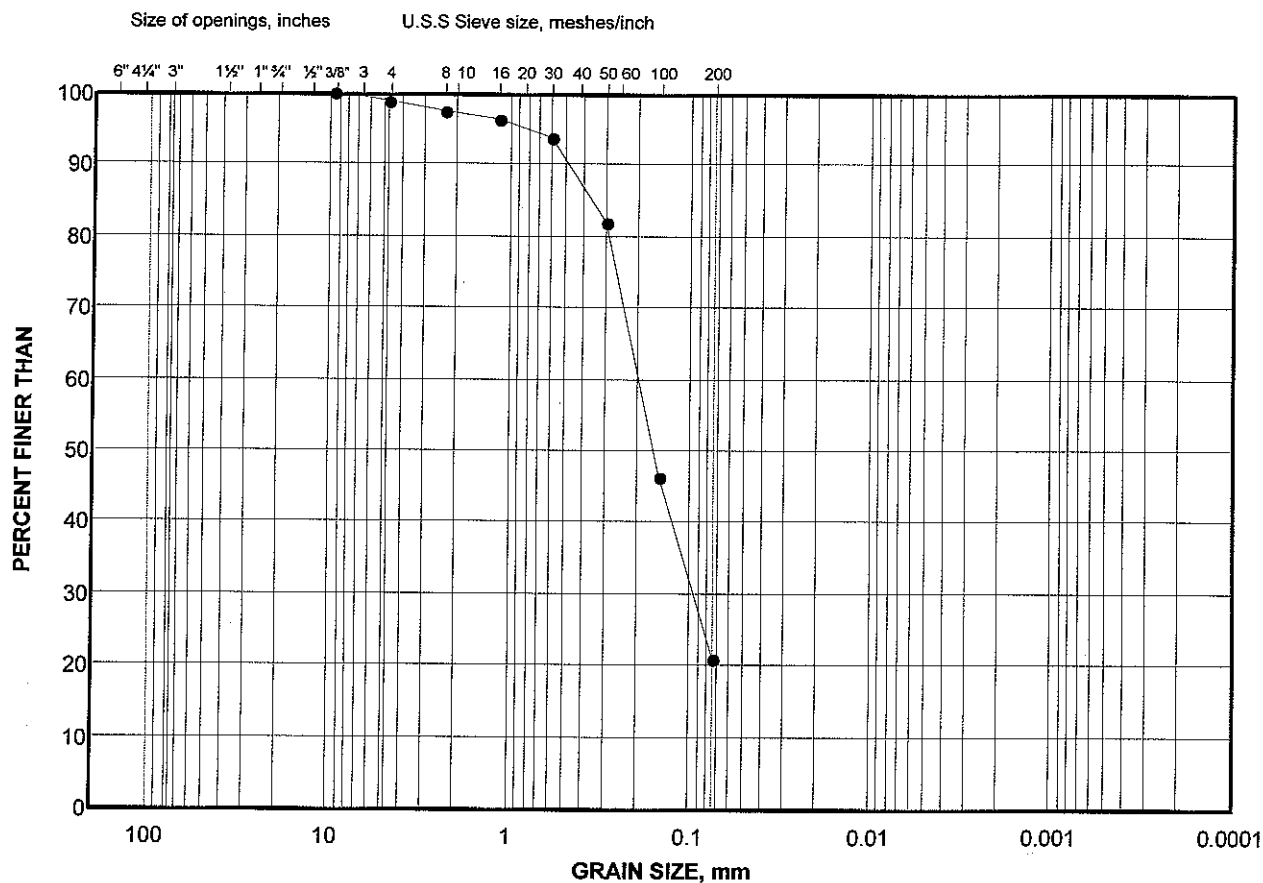
Golder Associates

Date: 18-Apr-08

GRAIN SIZE DISTRIBUTION

Fine SAND

FIGURE 4



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	10	5	3.0 - 3.45

Project Number: 08-1186 0506A

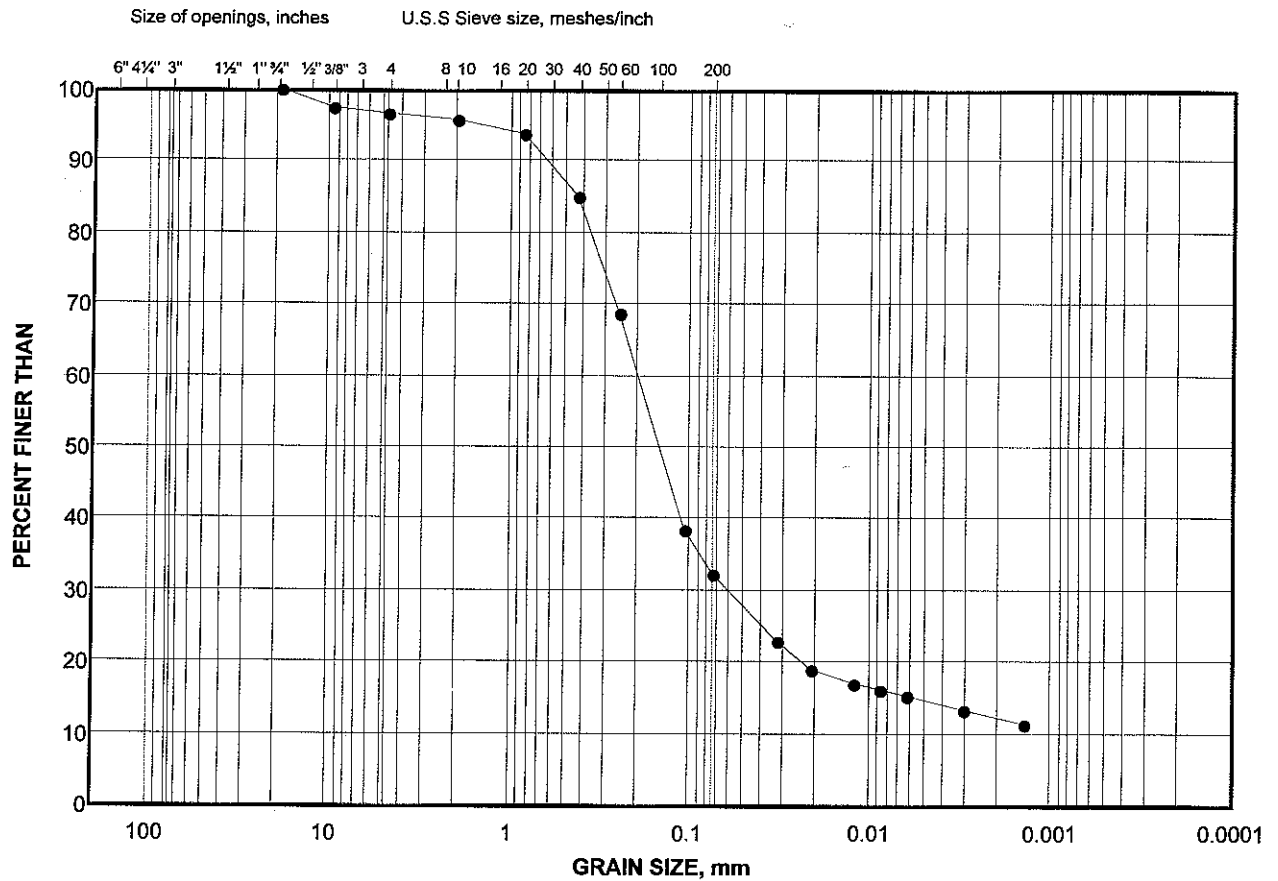
Checked By:

Golder Associates

Date: 18-Apr-08

GRAIN SIZE DISTRIBUTION SILTY SAND (Till-like)

FIGURE 5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	2	2	0.60 - 1.20

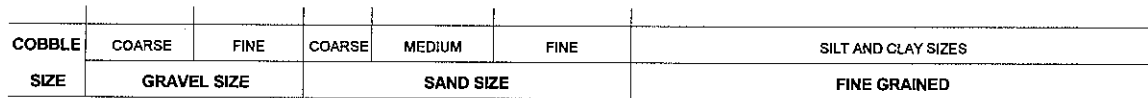
Project Number: 08-1186 0506A

Checked By:

Golder Associates

Date: 18-Apr-08

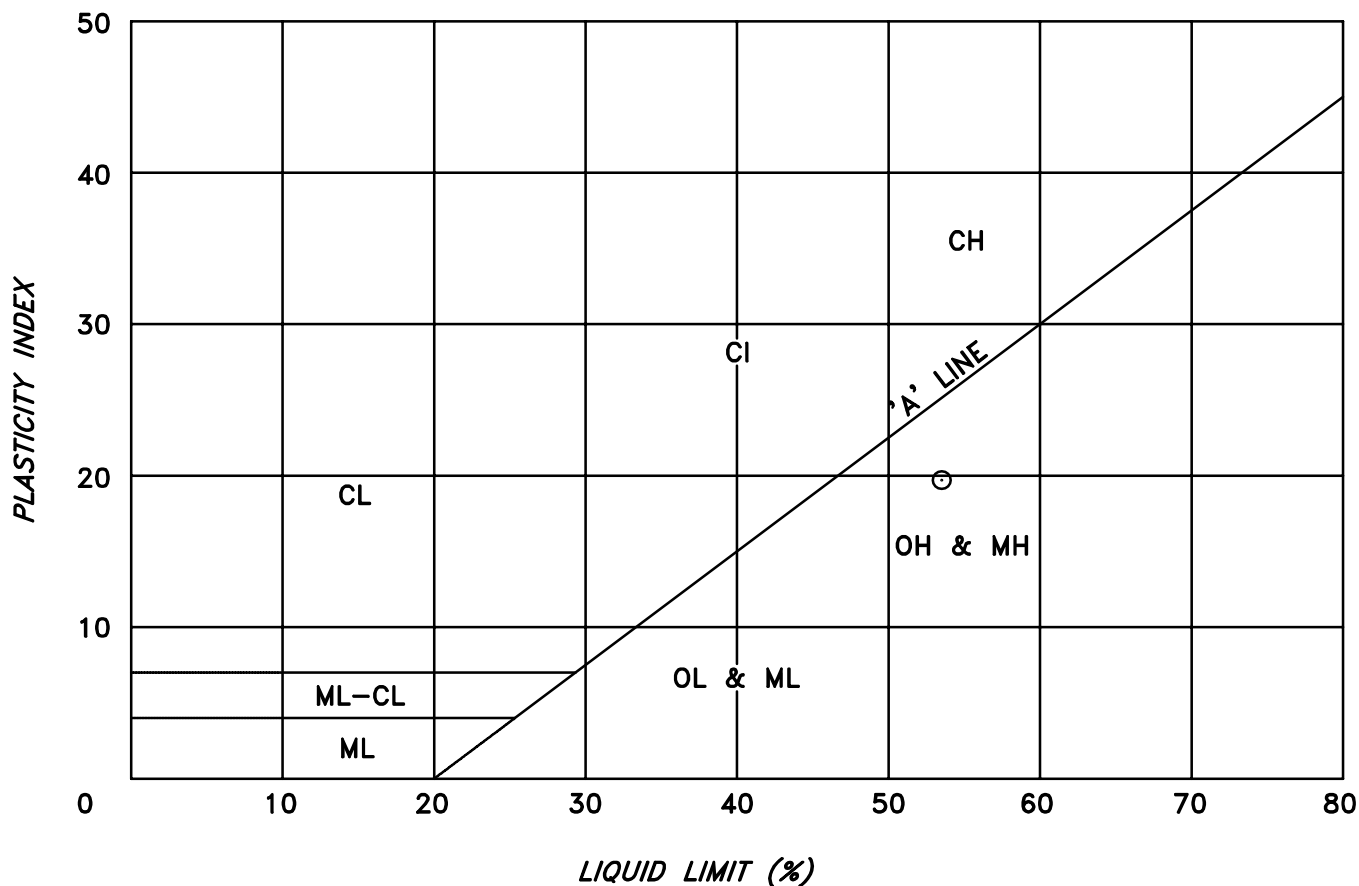
FIGURE 6



SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	4	3	1.20 - 1.80

Date: 18-Apr-08

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506A-003 -FIG 2008\04 D.Hickling - FIG 3- Plasticity.dwg Apr 23, 2008 - 3:23pm



SOIL TYPE		PLASTICITY	
C	Clay	L	Low
M	Silt	I	Intermediate
O	Organic	H	High

	BOREHOLE	SAMPLE	SAMPLE DESCRIPTION
○	4	3	Silty Clay



SCALE	AS SHOWN
DATE	04/18/08
DESIGN	
CADD	PJV
CHECK	
REVIEW	

TITLE

PLASTICITY CHART

FILE No.	003
PROJECT No.	08-186-0506A
REV.	

FIGURE

7

Appendix A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing in Saskatchewan, subject to the time limits and physical constraints applicable to this report. No other warranty, express or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. ***No other party may use or rely on this report or any portion thereof without Golder's express written consent. Golder will consent to any reasonable request by the Client to approve the use of this report by other parties as Approved Users.*** The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media are susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use by any party of portions of the report without reference to the entire report.***

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (CONTINUED)

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgement, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction is necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

Golder Associates Ltd.

100 Scotia Court
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Fax: (905) 723-2182



**DRAFT
REPORT ON**

**PRELIMINARY GEOTECHNICAL INVESTIGATION
COUTTS PROPERTY
MIDHURST, ONTARIO**

Submitted to:

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

Distribution:

- 1 Copy (Digital) - Geranium Corporation, Markham, Ontario
- 1 Copy - Golder Associates Ltd., Whitby, Ontario

April, 2008

08-1186-0506E(G)



Golder Associates Ltd.

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Whitby, Ontario, Canada L1N 8Y6
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Fax: (905) 723-2182



April 23, 2008

08-1186-0506E(G)

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

**RE: PRELIMINARY GEOTECHNICAL INVESTIGATION
COUTTS PROPERTY
MIDHURST, ONTARIO**

This report presents the results of a preliminary geotechnical investigation carried out at the above referenced site, as shown on the Key Plan, Figure 1. The purpose of the investigation was to determine the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of shallow boreholes. Based on our interpretation of the borehole data, this report provides preliminary geotechnical information for the planning of a proposed residential and/or commercial development at the site. Authorization to proceed with this investigation was provided by Ms. Shauna Dudding, P.Eng. of Geranium Corporation, in an email dated March 3, 2008.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder Associates Ltd. (Golder) should be given an opportunity to confirm that the preliminary recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report", included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. Further, the environmental aspects (i.e. Phase I ESA) at the site are being addressed concurrently by Golder (reported under separate cover).



SITE DESCRIPTION

The site is located on the south side of Pooles Road, west of Old Second Road South, in Midhurst, Ontario. The site consists of agricultural property approximately 44.5 ha (110 ac) with a house, a barn, four silos, three sheds and a former milk house. Agricultural land occupies the majority of the site. A small drainage ditch is located in the southeastern portion of the site. An irregular area of woodland is located in the western portion of the site which is vegetated with shrubs and trees. A hydro-electric transmission corridor crosses the northwest corner of the site. Adjacent land use consists of Pooles Road to the north, followed by farmland and woodland; Old Second Road South to the east, followed by farmland and woodland; woodland to the west; and farmland, a pond and woodland to the south.

PHYSIOGRAPHY

The site lies near the border of the physiographic regions of Southern Ontario known as the Simcoe Lowlands and Simcoe Uplands (Chapman and Putnam 1984). Physiographic mapping in the immediate vicinity of the site indicates glaciolacustrine deposits of sands, silt and clay bordering on tills with predominantly sandy silt matrix (Map 2556, Quaternary Geology of Southern Ontario, Barnett, Cowan and Henry, 1991). This physiographic mapping is generally consistent with the results of the current investigation.

INVESTIGATION PROCEDURE

The field work for this preliminary investigation was carried out on April 7 and 8, 2008 during which time eight boreholes (Nos. 38 to 45) were advanced at the locations shown on the Location Plan, Figure 2. The boreholes were drilled using a track-mounted drillrig supplied and operated by Eastern Soil Investigation Limited, under our supervision. Standard penetration testing and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment. The shallow groundwater conditions were noted in the open boreholes during drilling and the boreholes were backfilled and sealed upon completion of drilling. All of the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective classification testing.

The field work for this investigation was directed by members of our engineering staff who also determined the borehole locations in the field, logged the boreholes and cared for the samples obtained. The as-drilled borehole locations and corresponding ground surface elevations were provided by RPE Surveying and are understood to be referenced to geodetic datum.

SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing, are shown in detail on the Record of Borehole

sheets following the text of this report. Lists of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. The soils laboratory test results are shown on Figures 3 to 7 following the borehole logs. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this preliminary investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying 0.15 to 0.23 m of topsoil, the subsoil conditions predominantly consist of deposits of fill overlying silty sand till underlain by sand in most areas. Discontinuous deposits of silty clay, sandy silt, silty sand, till-like silty sand or sandy silt and clayey silt till were also encountered in some of the boreholes. Shallow groundwater was encountered in four of eight boreholes, at depths varying from 0.6 to 4.1 m below the existing ground surface.

TOPSOIL

Topsoil was encountered in all boreholes advanced at the site. The topsoil thickness encountered at the borehole locations ranged from 0.15 to 0.23 m, as summarized in the following table:

BOREHOLE	TOPSOIL THICKNESS (mm)
38	150
39	200
40	200
41	150
42	180
43	230
44	230
45	230

Silty Sand Till

Silty sand till is one of the predominant native soil types at the site and was encountered in all boreholes except for Boreholes 44 and 45. Borehole 43 was also terminated in the silty sand till, which contains cobbles and boulders. Standard penetration tests carried out within the silty sand till gave N values ranging from 10 to greater than 100 blows per 0.3 m, indicating a compact to very dense relative density. The natural water contents of the silty sand till samples ranged from 7 to 17 percent. One grain size distribution curve for a sample of the silty sand till, recovered from 35 mm internal diameter split spoon sampler, is shown on Figure 3.

Sand

Deposits of sand were encountered in all boreholes advanced at the site except for Boreholes 41 and 43. Boreholes 38, 39, 40 and 42 were also terminated in the sand. Standard penetration tests carried out within the sand gave N values ranging from 11 to greater than 100 blows per 0.3 m, indicating a compact to very dense relative density. The natural water contents of the sand samples ranged from 3 to 17 percent.

Fill

Shallow layers of fill mainly consisting of sandy silt, silty sand or clayey silt were encountered underlying the topsoil in all boreholes except for Boreholes 42, 44 and 45. This material could represent disturbed native soil due to agricultural operations. One standard penetration test carried out within the clayey fill gave an N value of 3 blows per 0.3 m, indicating a soft consistency. Standard penetration tests carried out within the silty fill gave N values ranging from 2 to 4 blows per 0.3 m, indicating a very loose to loose relative density. The in-situ water contents of the fill samples ranged from 16 to 33 percent.

Silty Fine Sand

Strata of silty fine sand were encountered in Boreholes 41, 44 and 45, underlying the topsoil or shallow soil deposits. Borehole 45 was also terminated in silty fine sand. Standard penetration tests carried out within the silty fine sand gave variable N values ranging from 4 to greater than 100 blows per 0.3 m, indicating a very loose and very dense relative density. The natural water contents of the silty fine sand samples ranged from 17 to 21 percent. One grain size distribution curve for a sample of the silty fine sand is shown on Figure 4.

Till-like Silty Sand or Sandy Silt

Strata of till-like silty sand or sandy silt were encountered in all boreholes except for Boreholes 39, 40, 44 and 45, overlying the silty sand till or silty fine sand deposits. This material is generally similar in gradation to silty sand or sandy silt till but has lower strength. Standard penetration tests carried out within the till-like soils gave N values ranging from 3 to 11 blows per 0.3 m, indicating a very loose to compact relative density. The natural water contents of the till-like soil samples ranged from 16 to 23 percent. One grain size distribution curve for a sample of the till-like sandy silt is shown on Figure 5.

Sandy Silt

Sandy silt was encountered in Boreholes 44 and 45, underlying the topsoil or sand deposits. Borehole 44 was also terminated in sandy silt. Standard penetration tests carried out within the sandy silt gave N variable values ranging from 5 to 90 blows per 0.3 m, indicating a loose to very

dense relative density. The natural water contents of the sandy silt samples ranged from 14 to 19 percent. One grain size distribution curve for a sample of the sandy silt is shown on Figure 6.

Silty Clay

Silty clay was encountered in Boreholes 39, 40 and 44, underlying the fill or silty fine sand deposits. Standard penetration tests carried out within the silty clay gave N values ranging from 6 to 18 blows per 0.3 m, indicating a firm to very stiff consistency. The natural water contents of the silty clay samples ranged from 13 to 38 percent. One grain size distribution curve for a sample of the silty clay is shown on Figure 7.

Clayey Silt Till

Clayey silt till was encountered in Borehole 41 underlying the silty sand till. This borehole was also terminated in the clayey silt till. The clayey silt till contains cobbles and boulders. Standard penetration tests carried out within the clayey silt till gave N values ranging from 24 to 48 blows per 0.3 m, indicating very stiff to hard consistency. The natural water contents of the clayey silt till samples ranged from 13 to 14 percent.

Shallow Groundwater

Shallow groundwater was encountered in Boreholes 41, 43, 44 and 45 during drilling, at depths ranging from 0.6 to 4.1 m below the existing ground surface. All other boreholes were found to be dry upon completion of drilling. It should be noted that these observations reflect the shallow groundwater conditions encountered in the boreholes during the time of the field investigation (early April, 2008) and some seasonal fluctuations should be anticipated.

DISCUSSION

This section of the report provides preliminary geotechnical information based on our interpretation of the limited borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for planning and preliminary design purposes and is not sufficient for final design or construction purposes. Once the actual development plans and pertinent design details are available (e.g. road, lot and/or building layout, underground service locations/depths, etc.), the results of this preliminary investigation should be reviewed by the geotechnical engineer and an additional site specific investigation carried out, compatible with the final development plans for the site.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report and have not been investigated or addressed. However, as previously noted, Golder is providing concurrent Phase I ESA services for this site (reported under separate cover).

Preliminary Geotechnical Information

It is understood that consideration is being given to developing the site with a residential and/or commercial development. Based on the results of this preliminary investigation, the subsurface native soils encountered at the site are generally considered to be suitable for supporting the proposed development. The following preliminary geotechnical information is provided for the planning and preliminary design of residential houses or commercial buildings, underground services and paved roads at the site:

- Depending upon the final site grading scheme and proposed basement and/or at-grade floor slab elevations, the areas should be brought up to the underside of the footings and/or floor slabs, as required, using engineered fill. The materials proposed for use as engineered fill should be approved by qualified geotechnical personnel at the source, prior to hauling to the site. Most of the native soils at the site would be suitable for reuse as engineered fill. Imported materials meeting the requirements of OPSS Select Subgrade Material (SSM) would also be suitable for use as engineered fill. Details regarding placement and compaction requirements for engineered fill, if utilized at the site, can be provided once the actual development plans are available, as part of the final geotechnical recommendations for the project.
- The native subsoils at the site are considered to be suitable for supporting conventional residential houses (with basements) or single storey, slab-on-grade commercial buildings. A preliminary allowable bearing pressure in the range of 100 to 200 kPa may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed subsoils, at depths of approximately 1.2 to 1.8 m below the existing ground surface (or deeper as required for basements). It should be noted that the shallow, relatively loose till-like subsoils (vicinity of Boreholes 38, 41, 42 and 43) are generally not suitable for supporting houses/buildings. Footings founded on approved engineered fill, if utilized at the site, may be designed using a preliminary allowable bearing pressure in the range of 100 to 150 kPa.
- The need for and type of foundation drainage system required (perimeter drains and/or underslab drains; damp-proofing or water-proofing) depends upon the proposed founding elevations, soil types in the area and actual stabilized groundwater levels. Based on the results of this preliminary investigation, it is anticipated that conventional foundation drainage (i.e. perimeter drains and damp-proofing) would be adequate at most locations. However, basements founded in the wet sands below a depth of about 3 m (vicinity of Boreholes 44 and 45) may require water-proofing. For floor slabs at or above exterior grades, foundation drainage would likely not be required. In any event, the need for and type of foundation drainage should be confirmed by the geotechnical engineer once the site grading plans are available, as part of final design process.

- Based on the results of this preliminary investigation, for shallow excavations for underground services up to about 5 m in depth, groundwater control during excavation can probably be handled, if required, by pumping from properly constructed and filtered sumps located at the base of the excavation. However, it should be noted that cohesionless sandy subsoils are the predominant soil types at this site. Excavations into these soils, where they are below the local water table (e.g. wet sands in the vicinity of Boreholes 44 and 45), may require more positive dewatering measures, in addition to pumping from sumps, to maintain the stability of the trench side slopes and base to facilitate construction. In this regard, stabilized groundwater levels at the site should be determined as part of the follow-up, site specific geotechnical investigation at the site. The need for and type of groundwater control measures can then be reviewed by the geotechnical engineer as part of the final design process.
- It is anticipated that the trench excavations for underground servicing would consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, some local flattening of side slopes may be required in some areas in looser soil zones or where significant water seepage is encountered. Conventional bedding thicknesses are anticipated for underground services founded within the native competent subsoils at the site. Additional bedding thicknesses may be required for services founded in wet sands, depending upon the excavation depths and success of the contractor's groundwater control measures, if required.
- The majority of the native subsoils above the local water table are generally near their estimated optimum water contents for compaction and should be suitable for reuse as trench backfill, provided they are free of significant amounts of topsoil, organics and other deleterious materials. Excavated subsoils from below the local water table would likely require some drying prior to placement.
- Complete removal of any existing septic systems, wells, old foundations, etc. would likely be required as part of the site redevelopment.
- Based on the subsoil conditions encountered, conventional asphaltic (flexible) pavement designs are considered to be appropriate for a proposed residential and/or commercial development at the site. Typical pavement designs are as follows:

TYPICAL COMMERCIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)	
		Truck Routes and Main Access Roads	Car Parking and Internal Access Roads
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	50
Granular Material (OPSS 1010)	Granular A Base	150	150
	Granular B Type I Subbase	400	300
		Prepared and Approved Subgrade	

TYPICAL RESIDENTIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)		
		Local Street	Collector Street	Major Collector
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40	40
	HL 8 Binder Course	50	65	90
Granular Material (OPSS 1010)	Granular A Base	150	150	150
	Granular B Type I Subbase	300	400	450
		Prepared and Approved Subgrade		

Prior to placing the granular subbase material, the exposed soil subgrade should be heavily proof-rolled in conjunction with inspection by qualified geotechnical personnel. Deleterious, organic, softened or loosened native subsoils or fills will require subexcavation and replacement with approved material (i.e. controlled fill), as directed by geotechnical personnel.

We trust that this report provides sufficient preliminary geotechnical engineering information to aid in the planning and preliminary design of the proposed residential and/or commercial development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

DRAFT

David B. Liu, P.Eng.
Geotechnical Engineer

DRAFT

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Senior Geotechnical Engineer, Associate

Enclosures: Abbreviations & Symbols
Record of Borehole Sheets 38 to 45
Figures 1 to 7
Appendix A – Important Information and Limitations of This Report

DL/DGG/tf
08-1186-0506 E-G REP 2008'04'23

LIST OF ABBREVIATIONS

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

I SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

III SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

II PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.).

Dynamic Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT):

An electronic cone penetrometer with a 60° conical tip and a projected end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
γ	unit weight

Note:

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

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (con't.)

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

(c) Hydraulic Properties

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

(d) Consolidation (one-dimensional)

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

(e) Shear Strength

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

Notes: 1. $\tau = c' + \sigma' \tan \phi'$

2. Shear strength = (Compressive strength)/2

PROJECT: 08-1186-0506E-G

RECORD OF BOREHOLE 38

SHEET 1 OF 1

LOCATION: SEE FIGURE

BORING DATE: April 7, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		BLOWS/0.3m												
									SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT						
									20	40	60	80		10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³			

Borehole open and dry
upon completion of
drilling, Apr. 7/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506E-G.GPJ_GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

PROJECT: 08-1186-0506E-G

RECORD OF BOREHOLE 39

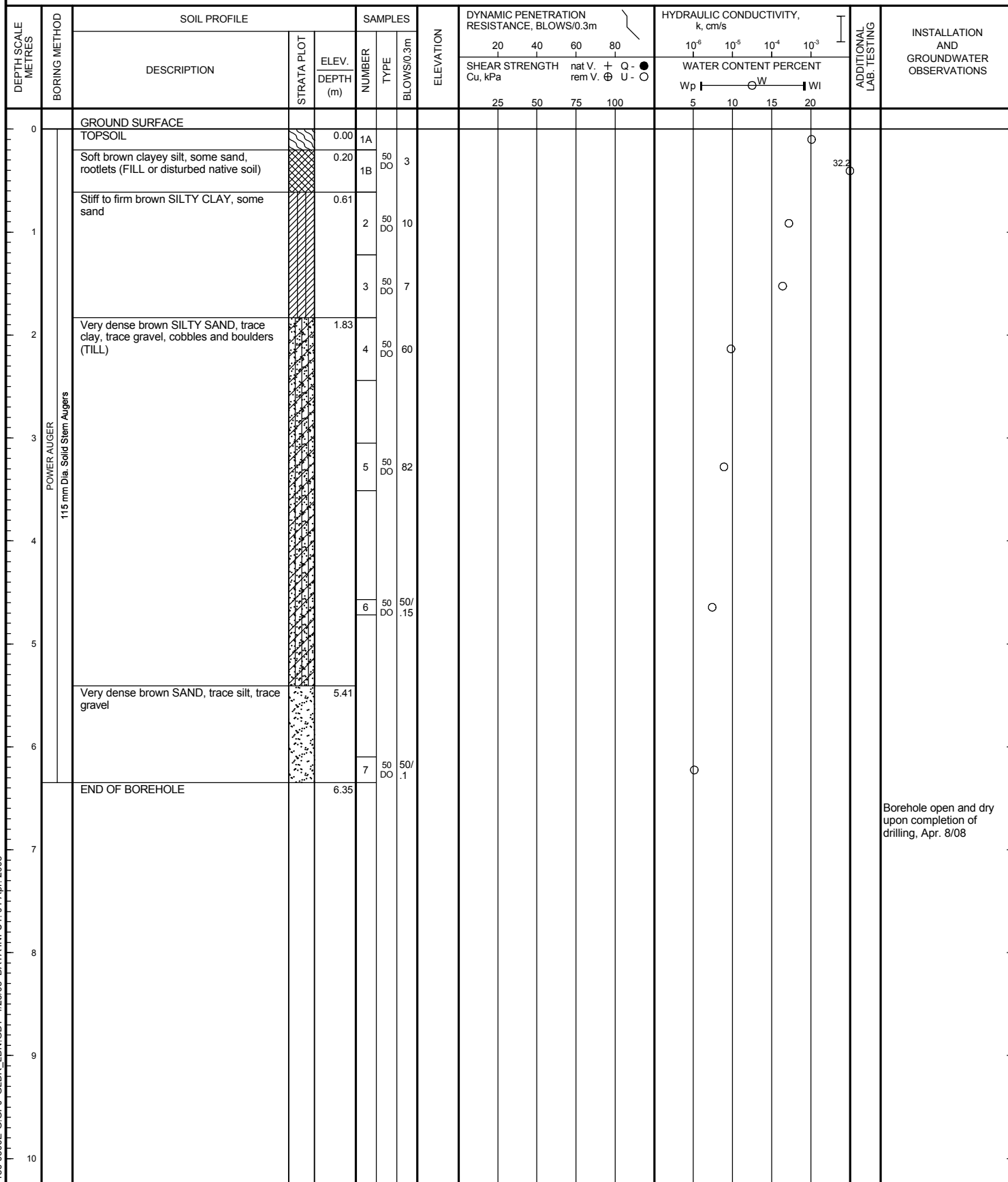
SHEET 1 OF 1

LOCATION: SEE FIGURE

BORING DATE: April 8, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm



DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506E-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

PROJECT: 08-1186-0506E-G

RECORD OF BOREHOLE 40

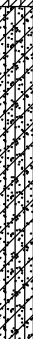
SHEET 1 OF 1

LOCATION: SEE FIGURE

BORING DATE: April 8, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS						
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		20		40		60		80		10 ⁻⁶				10 ⁻⁵		10 ⁻⁴		10 ⁻³	
								SHEAR STRENGTH		nat V.		+ rem V.		Q -		U -				Wp		W		Wi	
								Cu, kPa		rem V.		⊕		⊖		⊖									
								25	50	75	100					5	10	15	20						
0	POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE		0.00	1A																				
		TOPSOIL		0.20	1B	50 DO	3																		
		Loose brown sandy silt, some clay, trace gravel (FILL)		0.61	2	50 DO	10																		
1		Stiff to very stiff brown SILTY CLAY, some sand, trace gravel			3	50 DO	18																		
				1.83	4	50 DO	47																		
2		Dense to very dense SILTY SAND, trace clay, trace gravel, cobbles and boulders (TILL)			5	50 DO	80																		
3				4.04	6	50 DO	50/.13																		
4		Very dense brown SAND, trace silt			7	50 DO	50/.15																		
5																									
6																									
7		END OF BOREHOLE		6.40																					
8																									
9																									
10																									

Borehole caved to a depth of 5.5 m upon completion of drilling, Apr. 8/08

Borehole dry upon completion of drilling, Apr. 8/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506E-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 41

SHEET 1 OF 1

BORING DATE: April 8, 2008

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

[illegible]

LDN_BHS 08-1186-0506E-G-GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

PROJECT: 08-1186-0506E-G

RECORD OF BOREHOLE 42

SHEET 1 OF 1

LOCATION: SEE FIGURE

BORING DATE: April 8, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m						HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ Q - ⊕ U - ● ○		WATER CONTENT PERCENT					
														Wp ———— W ———— WI					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³				
								25	50	75	100		5	10	15	20			
0		GROUND SURFACE																	
	POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1B														
		Very loose to loose brown SANDY SILT, some clay, trace gravel, rootlets (TILL-LIKE)		0.18	1A	50 DO	2												
1																			
2		Compact brown SILTY SAND, trace clay, trace gravel (TILL)		1.83	4	50 DO	12												
3		Very dense brown SAND, trace silt, trace gravel		2.74															
4																			
5																			

MH

Borehole caved to a
depth of 5.8 m upon
completion of drilling,
Apr. 8/08Borehole dry upon
completion of drilling,
Apr. 8/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506E-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

PROJECT: 08-1186-0506E-G

RECORD OF BOREHOLE 43

SHEET 1 OF 1

LOCATION: SEE FIGURE

BORING DATE: April 8, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH Cu, kPa					WATER CONTENT PERCENT						
								20 40 60 80					10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³						
								nat V. + Q - rem V. ⊕ U - ○					Wp — W — WI						
							25	50	75	100		5	10	15	20				
0		GROUND SURFACE																	
	POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A											25.4			
		Very loose brown silty sand, trace to some clay, trace rootlets (FILL or disturbed native soil)		0.23	1B	50 DO	2									29.3			
		Compact brown SANDY SILT, trace clay, trace gravel (TILL-LIKE)		0.61	2	50 DO	11												
1		Very loose brown SILTY SAND, trace clay, trace gravel, cobbles (TILL-LIKE)		1.22	3	50 DO	2												
2		Compact to very dense brown SILTY SAND, some clay, trace gravel, cobbles and boulders (TILL)		1.83	4	50 DO	10												
						5	50 DO	37											
3																			
4																			
5					6	50 DO	90												
6																			
7		END OF BOREHOLE		6.55	7	50 DO	90												
8																			
9																			
10																			

▽

Borehole caved to a depth of 3.4 m upon completion of drilling, Apr. 8/08

Groundwater level in open portion of borehole at a depth of 0.6 m below ground surface, Apr. 8/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506E-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

Borehole caved to a depth of 3.4 m upon completion of drilling, Apr. 8/08

Groundwater level in open portion of borehole at a depth of 0.6 m below ground surface, Apr. 8/08

PROJECT: 08-1186-0506E-G

RECORD OF BOREHOLE 44

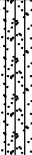
SHEET 1 OF 1

LOCATION: SEE FIGURE

BORING DATE: April 8, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS					
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		20		40		60		80		10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³								
								SHEAR STRENGTH Cu, kPa		nat V. + rem V. ⊕		Q - U - ●		WATER CONTENT PERCENT										
														Wp ———— W ———— WI										
							25	50	75	100					5	10	15	20						
0		GROUND SURFACE																						
	POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A																			
		Loose brown SILTY FINE SAND, rootlets, oxidization staining		0.23	1B	50 DO	4																	
		Firm brown SILTY CLAY, some sand		0.61																				
					2	50 DO	6																	
					3	50 DO	7																	
1																								
			Very dense brown SAND, trace silt, trace to some gravel, cobbles		1.83																			
		4				50 DO	80																	
		5				50 DO	50/ .15																	
2																								
3																								
4																								
5																								
6		Very dense brown SANDY SILT		5.49																				
7		END OF BOREHOLE		6.55																				
8																								
9																								
10																								

Borehole caved to a depth of 3.6 m upon completion of drilling, Apr. 8/08

Groundwater level in open portion of borehole at a depth of 3.5 m upon completion of drilling, Apr. 8/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506E-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

Borehole caved to a depth of 3.6 m upon completion of drilling, Apr. 8/08

Groundwater level in open portion of borehole at a depth of 3.5 m upon completion of drilling, Apr. 8/08

PROJECT: 08-1186-0506E-G

RECORD OF BOREHOLE 45

SHEET 1 OF 1

LOCATION: SEE FIGURE

BORING DATE: April 8, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS			
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		20		40		60		80		10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³						
								SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U -		Wp ——— W ——— WI						
								25 50		75 100		5 10 15 20										
0	POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																				
		TOPSOIL		0.00	1A												25.3					
		Loose to compact brown SANDY SILT, trace clay		0.23	1B	50 DO	5															
				2	50 DO	12																
1																						
		Compact brown SILTY FINE SAND		1.22	3	50 DO	22															
2		Dense to very dense brown SAND, trace silt		1.83	4	50 DO	35															
					5	50 DO	50/.15															
3																						
4																						
5																						
6		Very dense brown SILTY FINE SAND		5.56																		
7		END OF BOREHOLE		6.40																		
8																						
9																						
10																						

DEPTH SCALE

1 : 50



LOGGED: CR

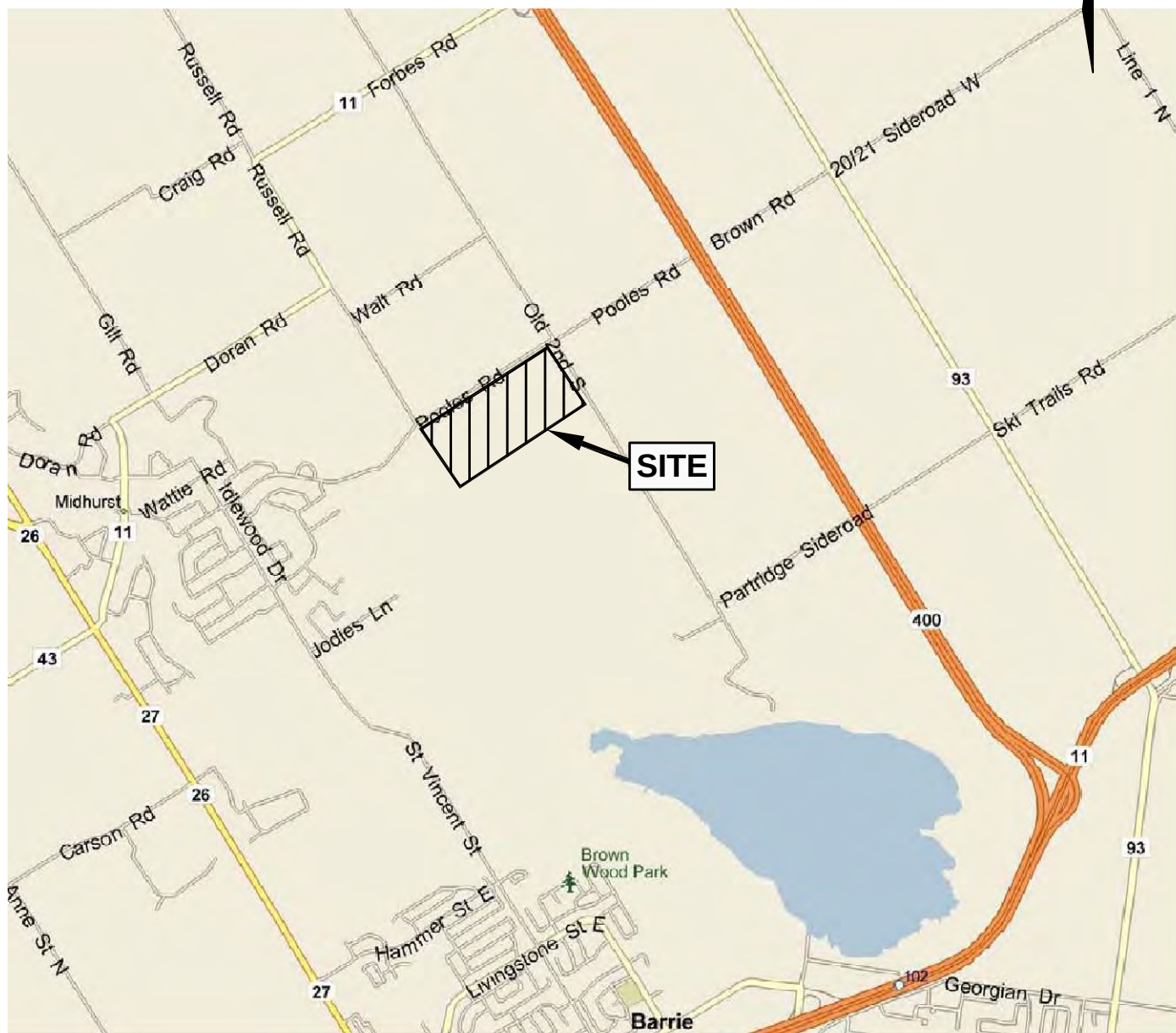
CHECKED:

LDN_BHS 08-1186-0506E-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: JT Apr. 2008

Borehole caved to a depth of 4.2 m upon completion of drilling, Apr. 8/08

Groundwater level in open portion of borehole at a depth of 4.1 m below ground surface, Apr. 8/08

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506E-002 -FIG 2008'03 Coutts - FIG 1 - KP.dwg Apr 18, 2008 - 12:05pm



Base map by Microsoft Streets & Trips 2006
Microsoft Corp. and/or its suppliers, 1988- 2005;
NAVTEQ, 2004; and TeleAtlas North America,
Inc., 2004

PROJECT		Preliminary Geotechnical Investigation Coutts Property, 2680 Old Second Road South Midhurst, Ontario			
TITLE		KEY PLAN			
 Whitby, Ontario		PROJECT No.08-1186-0506E-G		FILE No. 002	
		DESIGN		SCALE	AS SHOWN
		CADD	PJV	April 2008	REV.
		CHECK		FIGURE 1	
		REVIEW			

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506\Coutts\08-1186-0506E-001 -FIG 2008'03 Coutts - FIG 2.dwg Apr 18, 2008 - 12:05pm



NOT TO SCALE
ALL LOCATIONS ARE APPROXIMATE

LEGEND



BOREHOLE LOCATION IN PLAN

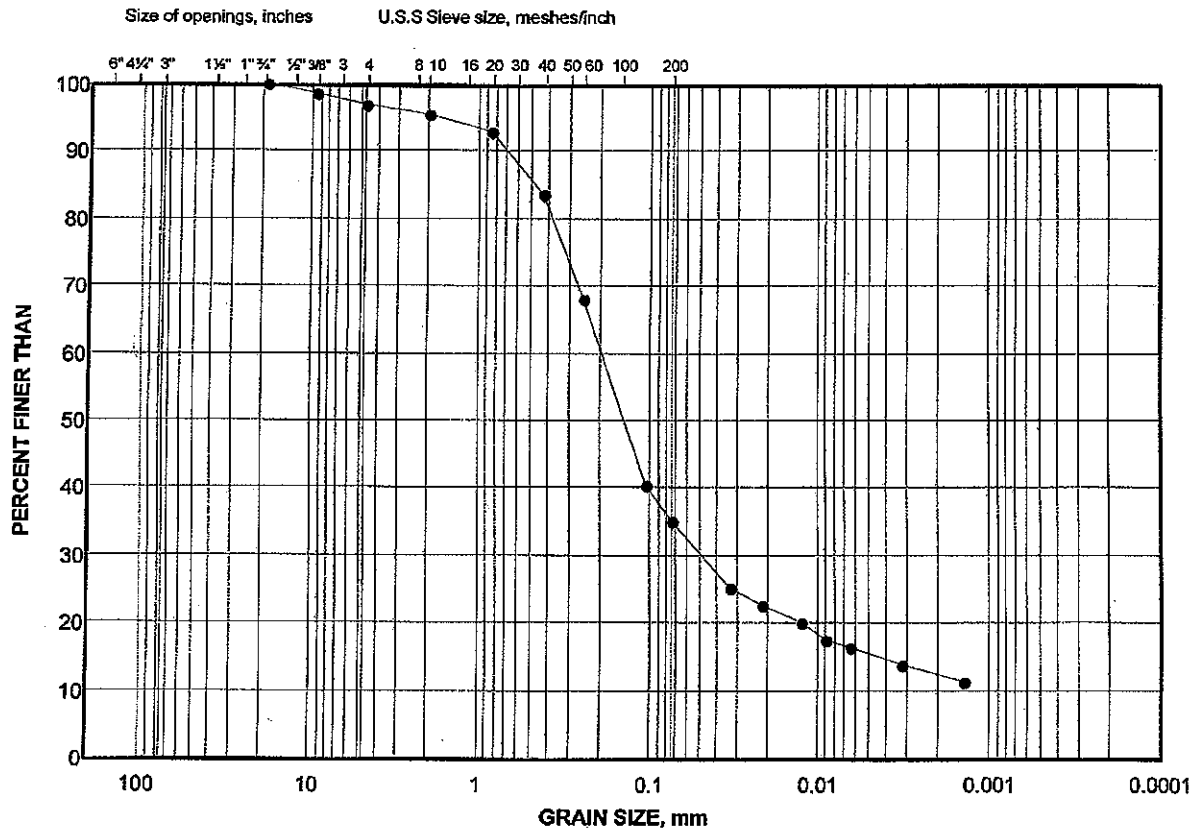


Aerial Photograph by Google Earth Pro 2007,
Image 2008 First Base Solutions.

PROJECT		Preliminary Geotechnical Investigation Coutts Property 2680 Old Second Road South Midhurst, Ontario			
TITLE		SITE LOCATION PLAN			
	PROJECT No.08-1186-0506E-G		FILE No.		001
	DESIGN		SCALE	AS SHOWN	REV.
	CADD	PJV	April 2008		
	CHECK				
	REVIEW				
FIGURE 2					

GRAIN SIZE DISTRIBUTION SILTY SAND TILL

FIGURE 3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	43	5	3.0 - 3.20

Project Number: 08-1186 0506E

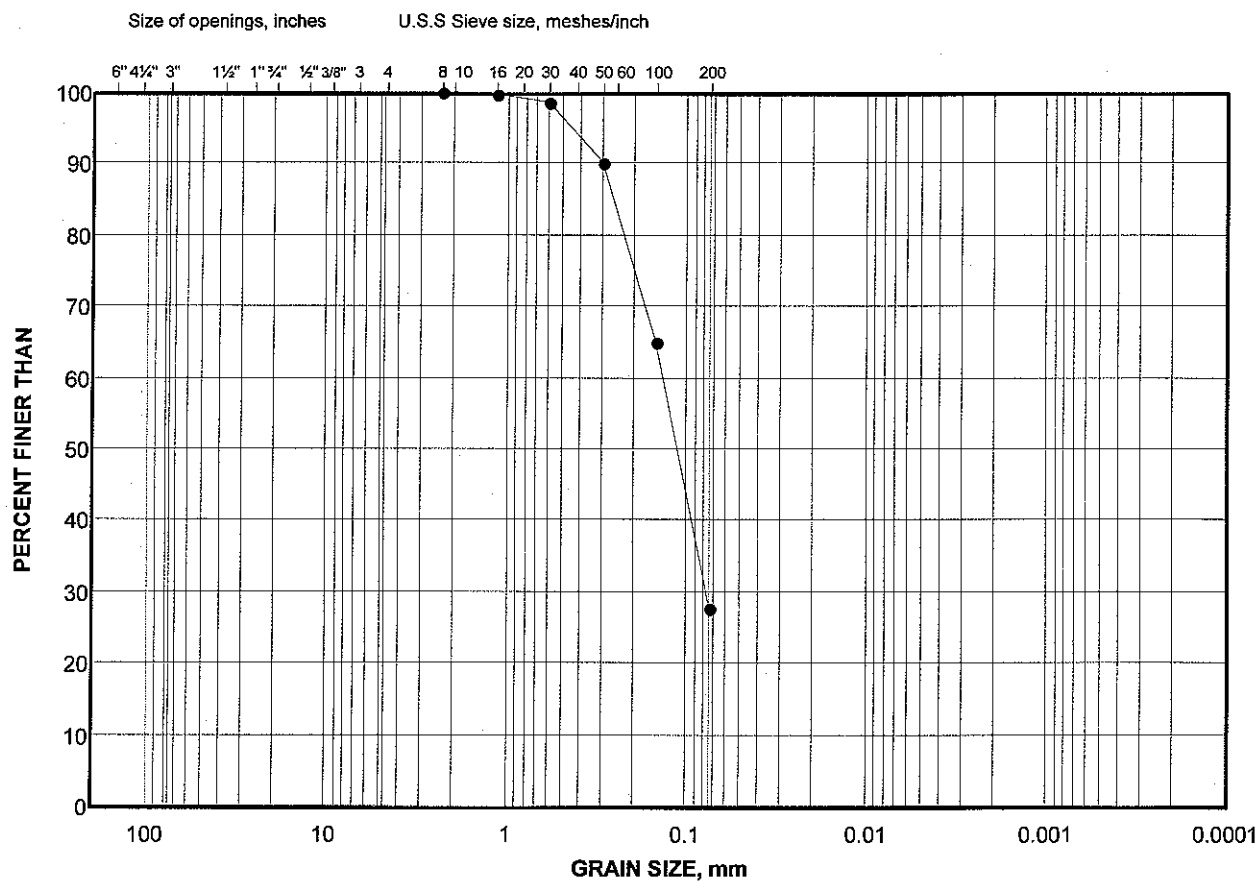
Checked By: *DA*

Golder Associates

Date: 18-Apr-08

GRAIN SIZE DISTRIBUTION SILTY FINE SAND

FIGURE 4



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	41	3	1.20 - 1.80

Project Number: 08-1186 0506E

Checked By: _____

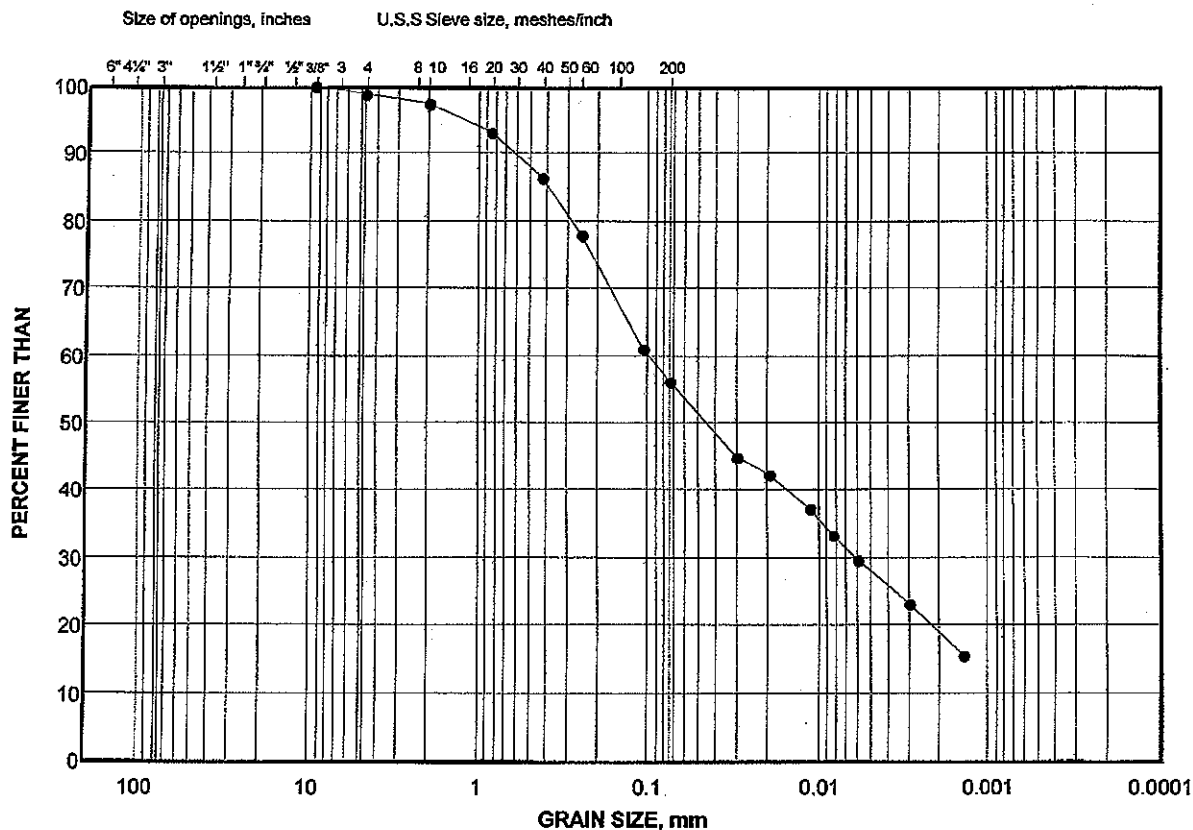
[Signature]

Golder Associates

Date: 21-Apr-08

GRAIN SIZE DISTRIBUTION SANDY SILT (Till-like)

FIGURE 5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	42	3	1.20 - 1.80

Project Number: 08-1186 0506E

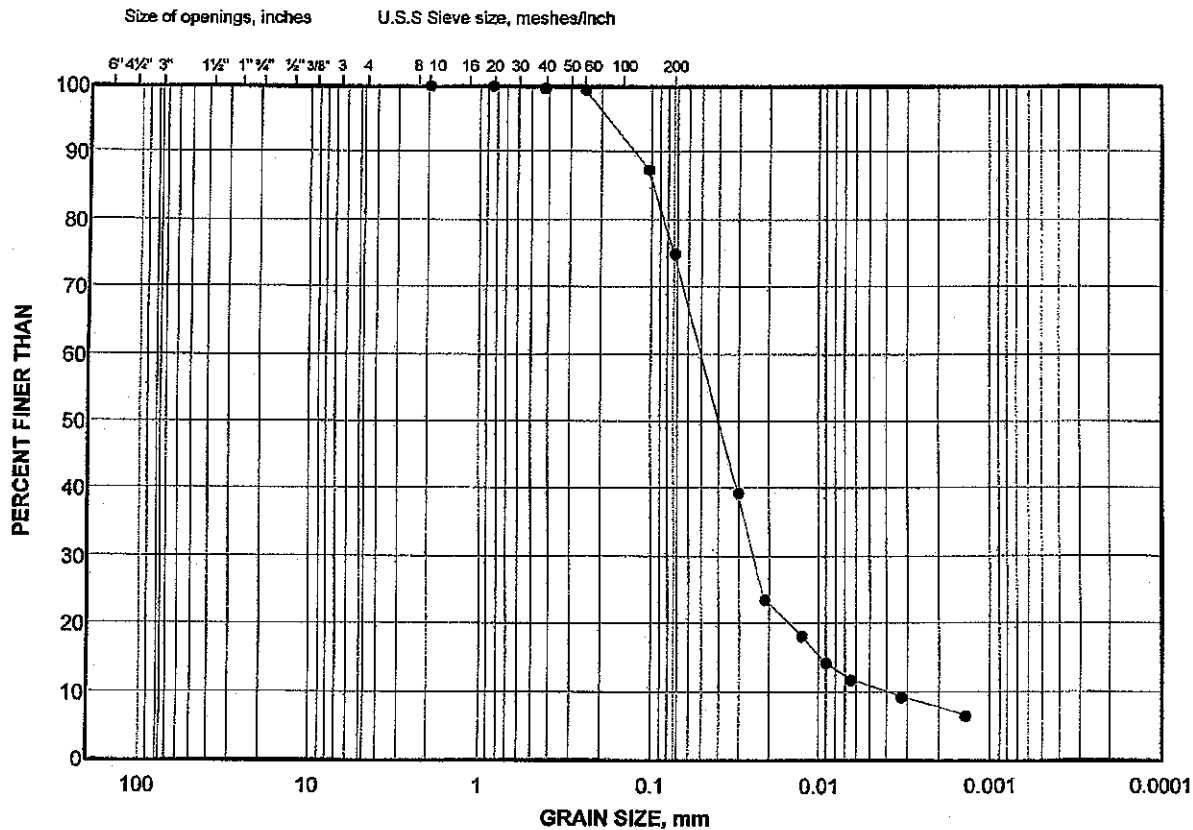
Checked By: _____

Golder Associates

Date: 18-Apr-08

GRAIN SIZE DISTRIBUTION SANDY SILT

FIGURE 6



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	45	2	0.60 - 1.20

Project Number: 08-1186 0506E

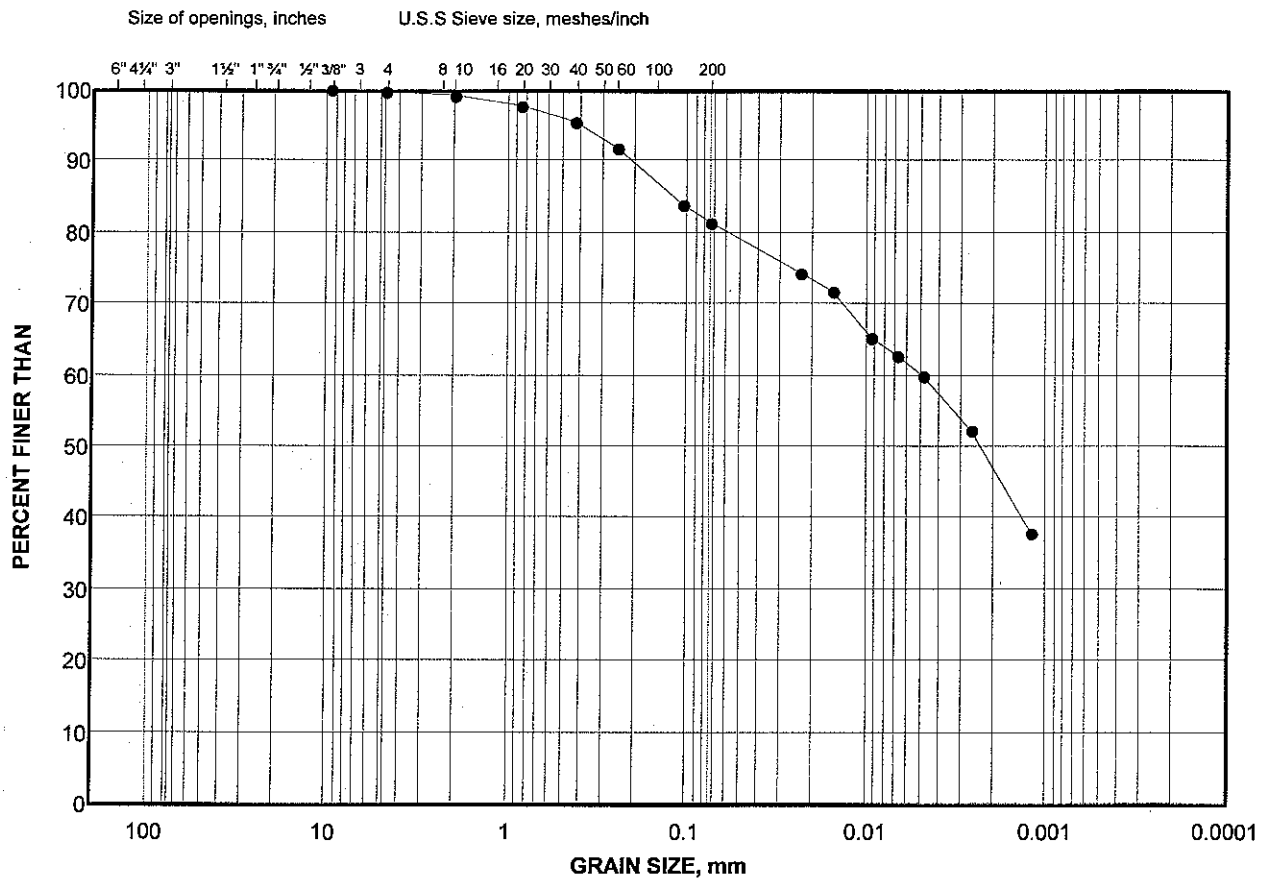
Checked By: DA

Golder Associates

Date: 18-Apr-08

GRAIN SIZE DISTRIBUTION SILTY CLAY

FIGURE 7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	39	2	0.60 - 1.20

Project Number: 08-1186 0506E

Checked By: _____

Golder Associates

Date: 21-Apr-08

Appendix A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing in Saskatchewan, subject to the time limits and physical constraints applicable to this report. No other warranty, express or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. ***No other party may use or rely on this report or any portion thereof without Golder's express written consent. Golder will consent to any reasonable request by the Client to approve the use of this report by other parties as Approved Users.*** The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media are susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use by any party of portions of the report without reference to the entire report.***

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (CONTINUED)

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgement, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction is necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

Golder Associates Ltd.

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Fax: (905) 723-2182



**DRAFT
REPORT ON**

**PRELIMINARY GEOTECHNICAL INVESTIGATION
JONES PROPERTY
MIDHURST, ONTARIO**

Submitted to:

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

Distribution:

- 1 Copy (Digital) - Geranium Corporation, Markham, Ontario
- 1 Copy - Golder Associates Ltd., Whitby, Ontario

April, 2008

08-1186-0506F(G)



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April 23, 2008

08-1186-0506F(G)

Midhurst Development Carson Road Inc.
c/o Geranium Corporation
3190 Steeles Avenue East, Suite 300
Markham, Ontario
L3R 1G9

Attention: Ms. Shauna Dudding, P.Eng.
Project Manager, Development Engineering

**RE: PRELIMINARY GEOTECHNICAL INVESTIGATION
JONES PROPERTY
MIDHURST, ONTARIO**

This report presents the results of a preliminary geotechnical investigation carried out at the above referenced site, as shown on the Key Plan, Figure 1. The purpose of the investigation was to determine the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of shallow boreholes. Based on our interpretation of the borehole data, this report provides preliminary geotechnical information for the planning of a proposed residential and/or commercial development at the site. Authorization to proceed with this investigation was provided by Ms. Shauna Dudding, P.Eng. of Geranium Corporation, in an email dated March 3, 2008.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder Associates Ltd. (Golder) should be given an opportunity to confirm that the preliminary recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report", included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. Further, the environmental aspects (i.e. Phase I ESA) at the site are being addressed concurrently by Golder (reported under separate cover).



SITE DESCRIPTION

The site is located on the west side of Old Second Road South, approximately 0.5 km south of Pooles Road West, in the Midhurst, Ontario. The site consists of an approximately 34.4 hectare (84.9 acre) parcel of agricultural land and woodland that is developed with an aircraft hangar (that is no longer in use) and a shed. A small drainage ditch crosses the eastern portion of the site. An irregular area of woodland is located in the western portion of the site. Adjacent land use consists of farmland to the north, followed by Pooles Road; Old Second Road South to the east; woodland to the west; and vacant land and woodland followed by a residence to the south.

PHYSIOGRAPHY

The site lies near the border of the physiographic regions of Southern Ontario known as the Simcoe Lowlands and Simcoe Uplands (Chapman and Putnam 1984). Physiographic mapping in the immediate vicinity of the site indicates glaciolacustrine deposits of sands, silt and clay, bordering on tills with predominantly sandy silt matrix (Map 2556, Quaternary Geology of Southern Ontario, Barnett, Cowan and Henry, 1991). This physiographic mapping is generally consistent with the results of the current investigation.

INVESTIGATION PROCEDURE

The field work for this preliminary investigation was carried out on April 9 to 11, 2008, during which time nine boreholes (Nos. 46 to 54) were advanced at the locations shown on the Location Plan, Figure 2. The boreholes were drilled using a track-mounted drillrig supplied and operated by Eastern Soil Investigation Limited, under our supervision. Standard penetration testing and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment. The shallow groundwater conditions were noted in the open boreholes during drilling and the boreholes were backfilled and sealed upon completion of drilling. All of the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective classification testing.

The field work for this investigation was directed by members of our engineering staff who also determined the borehole locations in the field, logged the boreholes and cared for the samples obtained. The as-drilled borehole locations and corresponding ground surface elevations were provided by RPE Surveying and are understood to be referenced to geodetic datum.

SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing, are shown in detail on the Record of Borehole sheets following the text of this report. Lists of abbreviations and symbols are provided to assist

in the interpretation of the borehole logs. The soils laboratory test results are shown on Figures 3 to 9 following the borehole logs. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this preliminary investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying 0.15 to 0.3 m of topsoil, the subsoil conditions predominantly consist of deposits of silty sand till and silty fine sand. Shallow discontinuous deposits of silty clay/clayey silt, till-like silty sand, silt and gravelly sand were also encountered in some of the boreholes. Shallow groundwater was encountered in seven of the nine boreholes, at depths ranging from 0.6 to 5.8 m below the existing ground surface.

TOPSOIL

Topsoil was encountered in all boreholes advanced at the site. The topsoil thickness encountered at the borehole locations ranged from 0.18 to 0.3 m, as summarized in the following table:

BOREHOLE	TOPSOIL THICKNESS (mm)
46	300
47	180
48	180
49	180
50	180
51	180
52	180
53	180
54	180*

* There is also a buried topsoil layer from depths of 1.22 to 1.42 m

Silty Sand Till

Silty sand till was encountered in Boreholes 46, 47 and 54. The silty sand till contains cobbles and boulders. Standard penetration tests carried out within the silty sand till gave N values ranging from 24 to 84 blows per 0.3 m, indicating a compact to very dense relative density. The natural water contents of the silty sand till samples ranged from 9 to 19 percent. One grain size distribution curve for a sample of the silty sand till, recovered from the 35 mm internal diameter split spoon sampler, is shown on Figure 3.

Silty Fine Sand

Deposits of silty fine sand were encountered underlying shallow fill or clayey silt or silt in Boreholes 48 to 52. Boreholes 48, 49, 51 and 52 were also terminated in the silty fine sand. Standard penetration tests carried out within the silty fine sand gave variable N values ranging from 4 to greater than 100 blows per 0.3 m, indicating a very loose to very dense relative density. The natural water contents of the silty fine sand samples were variably ranging from 3 to 23 percent. A grain size distribution curve for a sample of the silty fine sand is shown on Figure 4.

Gravelly Sand

A deposit of gravelly sand was encountered in Borehole 46, underlying the topsoil. Standard penetration tests carried out within the gravelly sand gave variable N values ranging from 7 to 57 blows per 0.3 m, indicating a loose to very dense relative density. The natural water contents of the gravelly sand samples ranged from 2 to 5 percent.

Clayey Silt Till

Clayey silt till was encountered in Boreholes 46, 53 and 54, underlying the silty clay, silt or silty sand tills. These boreholes were also terminated in clayey silt till. The clayey silt till contains cobbles and boulders. Standard penetration tests carried out within the clayey silt till gave N values ranging from 24 to 85 blows per 0.3 m, indicating a very stiff to hard consistency. The natural water contents of the clayey silt till samples ranged from 13 to 19 percent. A grain size distribution curve for a sample of the clayey silt till, recovered from the 35 mm internal diameter split spoon sampler, is shown on Figure 5. The liquid and plastic limits for a sample of the clayey silt till were 29 and 16 percent, respectively; indicating an inorganic clayey silt of low plasticity, as shown on the Plasticity Chart, Figure 9.

Silty Clay or Clayey Silt

Strata of silty clay or clayey silt were encountered in Boreholes 48 and 53, underlying the topsoil or shallow fill. Standard penetration tests carried out within the clayey soils gave N values ranging from 4 to 8 blows per 0.3 m, indicating a soft to stiff consistency. The natural water contents of the clayey soil samples ranged from 18 to 28 percent. A grain size distribution curve for a sample of the silty clay is shown on Figure 6. The liquid and plastic limits for a sample of the silty clay were 37 and 20 percent, respectively; indicating an inorganic clay of intermediate plasticity, as shown on the Plasticity Chart, Figure 9.

Silt

Deposits of silt were encountered in Boreholes 50, 51, 52 and 54, underlying the silty fine sand or silty sand till/till-like material. Borehole 50 was also terminated in the silt. Standard penetration tests carried out within the silt gave N values ranging from 12 to 85 blows per 0.3 m, indicating a

compact to very dense relative density. The natural water contents of the silt samples ranged from 9 to 29 percent. A grain size distribution curve for a sample of the silt is shown on Figure 7.

Till-like Silty Sand to Sandy Silt

Shallow strata of till-like silty sand to sandy silt were encountered in Boreholes 47 and 52, underlying the topsoil. Standard penetration tests carried out within the till-like materials gave N values ranging from 3 to 9 blows per 0.3 m, indicating a very loose to loose relative density. The natural water contents of the till-like samples ranged from 16 to 21 percent. A grain size distribution curve for a sample of the till-like soil is shown on Figure 8.

Fill

Shallow layers of fill consisting mainly of sandy silt to silty sand and sand were encountered in Boreholes 48, 49, 50, 51 and 54, underlying the topsoil. This material could represent disturbed native soil due to agricultural operations. Standard penetration tests carried out within the fill gave N values ranging from 2 to 8 blows per 0.3 m, indicating a very loose to loose relative density. The in-situ water contents of the fill samples ranged from 9 to 24 percent.

Shallow Groundwater

Shallow groundwater was encountered in Boreholes 47, 49, 50, 51, 52, 53 and 54 during drilling, at a depths ranging from 0.6 to 5.8 m below the existing ground surface. All other boreholes were found to be dry upon completion of drilling. It should be noted that these observations reflect the shallow groundwater conditions encountered in the boreholes during the time of the field investigation (early to mid April, 2008) and some seasonal fluctuations should be anticipated.

DISCUSSION

This section of the report provides preliminary geotechnical information based on our interpretation of the limited borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for planning and preliminary design purposes and is not sufficient for final design or construction purposes. Once the actual development plans and pertinent design details are available (e.g. road, lot and/or building layout, underground service locations/depths, etc.), the results of this preliminary investigation should be reviewed by the geotechnical engineer and an additional site specific investigation carried out, compatible with the final development plans for the site.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own

interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report and have not been investigated or addressed. However, as previously noted, Golder is providing concurrent Phase I ESA services for this site (reported under separate cover).

Preliminary Geotechnical Information

It is understood that consideration is being given to developing the site with a residential and/or commercial development. Based on the results of this preliminary investigation, the subsurface native soils encountered at the site are generally considered to be suitable for supporting the proposed development. The following preliminary geotechnical information is provided for the planning and preliminary design of residential houses or commercial buildings, underground services and paved roads at the site:

- Depending upon the final site grading scheme and proposed basement and/or at-grade floor slab elevations, the areas should be brought up to the underside of the footings and/or floor slabs, as required, using engineered fill. The materials proposed for use as engineered fill should be approved by qualified geotechnical personnel at the source, prior to hauling to the site. Most of the native soils at the site would be suitable for reuse as engineered fill. Imported materials meeting the requirements of OPSS Select Subgrade Material (SSM) would also be suitable for use as engineered fill. Details regarding placement and compaction requirements for engineered fill, if utilized at the site, can be provided once the actual development plans are available, as part of the final geotechnical recommendations for the project.
- The native subsoils at the site (underlying the fill or disturbed native soil) are considered to be suitable for supporting conventional residential houses (with basements) or single storey, slab-on-grade commercial buildings. A preliminary allowable bearing pressure in the range of 150 to 200 kPa may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed subsoils, at depths of approximately 0.8 to 2.7 m below the existing ground surface (or deeper as required for basements). It should be noted that the shallow, relatively loose till-like subsoils (vicinity of Boreholes 47 and 52) are generally not suitable for supporting houses/buildings. In addition, footings founded in the wet silt (vicinity of Boreholes 50, 51, 52 and 54) may require to use of lean concrete (placed as soon as practical) to help maintain the integrity of this material as a bearing stratum. Footings founded on approved engineered fill, if utilized at the site, may be designed using a preliminary allowable bearing pressure in the range of 100 to 150 kPa.
- The need for and type of foundation drainage system required (perimeter drains and/or underslab drains; damp-proofing or water-proofing) depends upon the proposed founding elevations, soil types in the area and actual stabilized groundwater levels. Based on the results of this preliminary investigation, it is anticipated that conventional foundation drainage (i.e. perimeter drains and damp-proofing) would be adequate at most locations.

However, basements founded in the wet sands below a depth of 4 m (vicinity of Boreholes 49 and 52) may require water-proofing. For floor slabs at or above exterior grades, foundation drainage would likely not be required. In any event, the need for and type of foundation drainage should be confirmed by the geotechnical engineer once the site grading plans are available, as part of final design process.

- Based on the results of this preliminary investigation, for shallow excavations for underground services up to about 4 m in depth, groundwater control during excavation can probably be handled, if required, by pumping from properly constructed and filtered sumps located at the base of the excavation. However, it should be noted that cohesionless sand and silt subsoils are present at this site. Excavations into these soils, where they are below the local water table (e.g. vicinity of Boreholes 49, 50, 51, 52 and 54), may require more positive dewatering measures, in addition to pumping from sumps, to maintain the stability of the trench side slopes and base to facilitate construction. In this regard, stabilized groundwater levels at the site should be determined as part of the follow-up, site specific geotechnical investigation at the site. The need for and type of groundwater control measures can then be reviewed by the geotechnical engineer as part of the final design process.
- It is anticipated that the trench excavations for underground servicing would consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical. However, some local flattening of side slopes may be required in some areas in looser soil zones or where significant water seepage is encountered. Conventional bedding thicknesses are anticipated for underground services founded within the native competent subsoils at the site. Additional bedding thicknesses may be required for services founded in wet sands or silt, depending upon the excavation depths and success of the contractor's groundwater control measures, if required.
- The majority of the native subsoils above the local water table are generally near their estimated optimum water contents for compaction and should be suitable for reuse as trench backfill, provided they are free of significant amounts of topsoil, organics and other deleterious materials. Excavated subsoils from below the local water table would likely require some drying prior to placement.
- Complete removal of any existing septic systems, wells, old foundations, etc. would likely be required as part of the site redevelopment.
- Based on the subsoil conditions encountered, conventional asphaltic (flexible) pavement designs are considered to be appropriate for a proposed residential and/or commercial development at the site. Typical pavement designs are as follows:

TYPICAL COMMERCIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)	
		Truck Routes and Main Access Roads	Car Parking and Internal Access Roads
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	65	50
Granular Material (OPSS 1010)	Granular A Base	150	150
	Granular B Type I Subbase	400	300
		Prepared and Approved Subgrade	

TYPICAL RESIDENTIAL DEVELOPMENT

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (mm)		
		Local Street	Collector Street	Major Collector
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40	40
	HL 8 Binder Course	50	65	90
Granular Material (OPSS 1010)	Granular A Base	150	150	150
	Granular B Type I Subbase	300	400	450
		Prepared and Approved Subgrade		

Prior to placing the granular subbase material, the exposed soil subgrade should be heavily proof-rolled in conjunction with inspection by qualified geotechnical personnel. Deleterious, organic, softened or loosened native subsoils or fills will require subexcavation and replacement with approved material (i.e. controlled fill), as directed by geotechnical personnel.

We trust that this report provides sufficient preliminary geotechnical engineering information to aid in the planning and preliminary design of the proposed residential and/or commercial development. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

DRAFT

David B. Liu, P.Eng.
Geotechnical Engineer

DRAFT

Doug G. Gorrill, P.Eng.
Senior Geotechnical Engineer, Associate

Enclosures: Abbreviations & Symbols
Record of Borehole Sheets 46 to 54
Figures 1 to 9
Appendix A – Important Information and Limitations of This Report

DL/DGG/tf
08-1186-0506 F-G REP 2008/04/23

LIST OF ABBREVIATIONS

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

I SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

III SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

II PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.).

Dynamic Penetration Resistance; N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT):

An electronic cone penetrometer with a 60° conical tip and a projected end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
γ	unit weight

Note:

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

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

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

(a) Index Properties (con't.)

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

(c) Hydraulic Properties

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

(d) Consolidation (one-dimensional)

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

(e) Shear Strength

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

Notes: 1. $\tau = c' + \sigma' \tan \phi'$

2. Shear strength = (Compressive strength)/2

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 46

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 9, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS						
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		20		40		60		80		10 ⁻⁶				10 ⁻⁵		10 ⁻⁴		10 ⁻³	
								SHEAR STRENGTH		nat V.		+ rem V.		Q -		U -				Wp		W		Wi	
								Cu, kPa		rem V.		⊕		⊖											
								25	50	75	100														
0		GROUND SURFACE																							
	POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A	50 DO	7																		
		Loose to very dense brown GRAVELLY SAND, trace to some silt, cobbles		0.30	1B																				
				2	50 DO	36																			
				3	50 DO	57																			
				4	50 DO	44																			
		Compact brown SILTY SAND, trace clay, some gravel, cobbles (TILL)		2.74																					
				5	50 DO	24																			
		Hard brown CLAYEY SILT, some sand, trace to some gravel, cobbles and boulders (TILL)		4.04																					
				6	50 DO	50																			
				7	50 DO	85																			
		END OF BOREHOLE		6.55																					
7																									
8																									
9																									
10																									

Borehole dry and open
upon completion of
drilling, Apr. 9/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/2008

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 47

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 9, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE													
								SHEAR STRENGTH Cu, kPa		nat V. + Q - rem V. ⊕ U -		WATER CONTENT PERCENT							
							20	40	60	80		10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³				
															</				

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/20/08

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 48

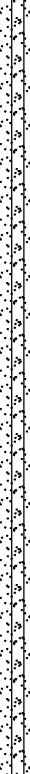
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 10, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS					
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	20		40		60		80		10 ⁻⁶		10 ⁻⁵				10 ⁻⁴		10 ⁻³		
							SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U -		Wp		W				WI				
									25	50	75	100													
0		GROUND SURFACE																							
	POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A																				
		Very loose brown sandy silt, trace clay, trace gravel and rootlets (Probably FILL or disturbed native soil)		0.18	1B	50 DO	3																		
		Firm brown CLAYEY SILT, some sand, rootlets		0.61	2	50 DO	6																		
1																									
		Very dense brown SILTY FINE SAND		1.22	3	50 DO	59																		
2					4	50 DO	80																		
3					5	50 DO	85																		

Borehole dry and open
upon completion of
drilling, Apr. 10/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/2008

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 49

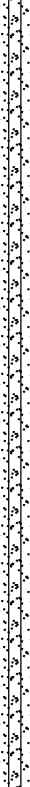
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 11, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS						
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		20		60		10 ⁻⁶		10 ⁻⁵				10 ⁻⁴		10 ⁻³			
								SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U -				Wp		W		Wi	
								25 50		75 100								10 20		30 40			
0		GROUND SURFACE																					
		TOPSOIL		0.00	1A																		
		Loose brown silty sand, trace clay, some gravel, cobbles (Possibly FILL or disturbed native soil)		0.18	1B	50 DO	6																
1					2	50 DO	8																
		Compact to very dense brown SILTY FINE SAND, occasional sandy silt seams		1.22																			
2							3	50 DO	19														
							4	50 DO	45														
3					5	50 DO	55																
4																							
5					6	50 DO	64																
6																							
7		END OF BOREHOLE		6.55	7	50 DO	80																
8																							
9																							
10																							

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/2008

Borehole caved to a depth of 5.5 m below ground surface upon completion of drilling, Apr. 11/08

Groundwater level in open portion of borehole at a depth of 5.3 m below ground surface upon completion of drilling, Apr. 11/08

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 50

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 9, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS				
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		20		60		80		10 ⁻⁶		10 ⁻⁵				10 ⁻⁴		10 ⁻³	
								SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U -		Wp				W		WI	
								25 50		75 100						10 20				30 40			
0		GROUND SURFACE																					
	POWER AUGER 115 mm Dia. Solid Stem Augers	TOPSOIL		0.00	1A																		
		Very loose to loose brown sand, some silt, some rootlets (Probably FILL or disturbed native soil)		0.18	1B	50 DO	3																
					2	50 DO	6																
1			Very loose to loose brown SILTY FINE SAND, trace rootlets		1.22	3	50 DO	4															
					4	50 DO	8																
2			Compact brown SILT, some sand and fine sand seams		2.74																		
3					5	50 DO	24																
4		Very dense brown SILTY FINE SAND		4.04																			
5				6	50 DO	60																	
6		Very dense brown SILT, trace to some fine sand and sand seams		5.56																			
7		END OF BOREHOLE		6.55																			
8																							
9																							
10																							

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/2008

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

Borehole caved to a depth of 5.8 m below ground surface upon completion of drilling, Apr. 9/08

Groundwater level in open portion of borehole at a depth of 5.2 m below ground surface upon completion of drilling, Apr. 9/08

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 51

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 9, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		20		40		60		80		10 ⁻⁶				10 ⁻⁵		10 ⁻⁴		10 ⁻³																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
								SHEAR STRENGTH Cu, kPa		nat V. rem V.		+ ⊕		Q - U		●				○		○		○		○																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
								25	50	75	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/2008

Borehole caved to a depth of 2.5 m below ground surface upon completion of drilling, Apr. 9/08

Groundwater level in open portion of borehole at a depth of 2.4 m below ground surface upon completion of drilling, Apr. 9/08

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 52

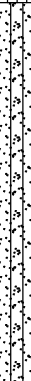
SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 9, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH					WATER CONTENT PERCENT							
								Cu, kPa		nat V. rem V.		+ Q - ⊕ U -								
								20	40	60	80									
							25	50	75	100										
0	POWER AUGER 115 mm Dia. Solid Stem Augers	GROUND SURFACE																		
		TOPSOIL		0.00	1A															
		Very loose to loose brown SILTY SAND, trace clay, trace gravel, rootlets (TILL-LIKE)		0.18	1B	50 DO	3													
					2	50 DO	7													
1				1.22	3	50 DO	12													
		Compact to very dense brown SILT, trace clay, some fine sand seams			4	50 DO	50													
2					5	50 DO	75													
3				4.04	6	50 DO	45													
4					7	50 DO	85													
5			Dense to very dense brown SILTY FINE SAND																	
6																				
7		END OF BOREHOLE		6.55																
8																				
9																				
10																				

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/2008

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

Borehole caved to a depth of 1.5 m below ground surface upon completion of drilling, Apr. 9/08

Groundwater level in open portion of borehole at a depth of 0.6 m below ground surface upon completion of drilling, Apr. 9/08

PROJECT: 08-1186-0506 F-G

RECORD OF BOREHOLE 53

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: April 10, 2008

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES		ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, k, cm/s					ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE		SHEAR STRENGTH Cu, kPa		nat V. + Q - rem V. ⊕ U - ⊙			WATER CONTENT PERCENT						
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³				
								25	50	75	100		10	20	30	40			
0		GROUND SURFACE																	
		TOPSOIL		0.00	1A														
		Soft to stiff brown SILTY CLAY, some sand		0.18	1B	50 DO	4										MH		
						2	50 DO	8											
1																			
		Hard brown to grey CLAYEY SILT, some sand, trace to some gravel, cobbles and boulders (TILL)		1.22		3	50 DO	42											
						4	50 DO	58											
						5	50 DO	56									MH		
						6	50 DO	42											
						7	50 DO	47											
		END OF BOREHOLE		6.55															
7																			
8																			
9																			
10																			

POWER AUGER
115 mm Dia. Solid Stem Augers

Groundwater level in open borehole at a depth of 5.8 m below ground surface upon completion of drilling, Apr. 10/08

DEPTH SCALE

1 : 50



LOGGED: CR

CHECKED:

LDN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04/2008

Groundwater level in open borehole at a depth of 5.8 m below ground surface upon completion of drilling, Apr. 10/08

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 54

SHEET 1 OF 1

BORING DATE: April 10, 2008

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

[illegible]

DN_BHS 08-1186-0506 F-G.GPJ GLDR_LDN.GDT 4/23/08 DATA INPUT: PH 04'2008

DEPTH SCALE

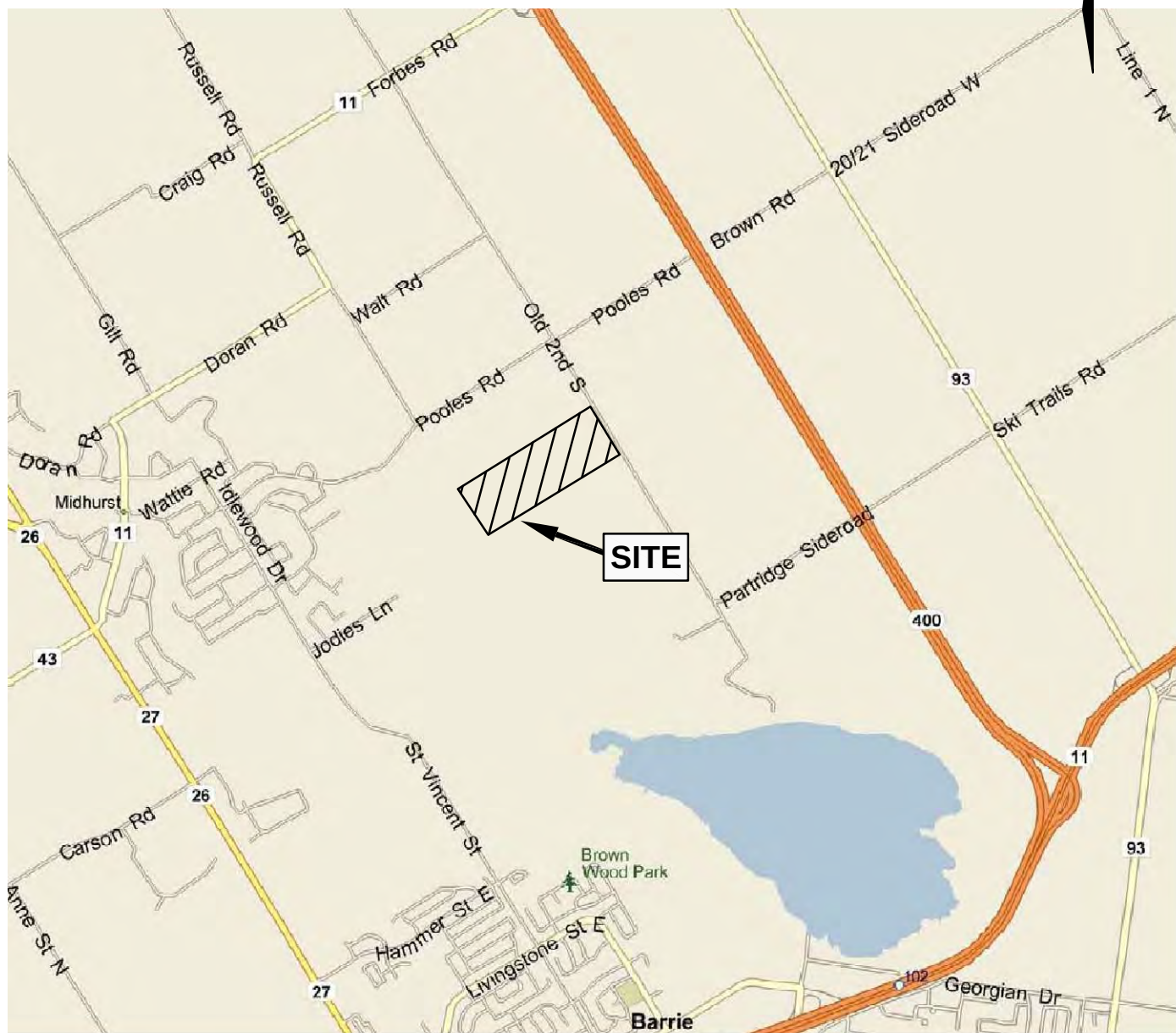
1 : 50



LOGGED: CR

CHECKED:

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506F-002 -FIG 2008\03 Jones - FIG 1- KP.dwg Apr 23, 2008 - 3:15pm



Base map by Microsoft Streets & Trips 2006
Microsoft Corp. and/or its suppliers, 1988- 2005;
NAVTEQ, 2004; and TeleAtlas North America,
Inc., 2004

0 km
(Approx.)

PROJECT		Preliminary Geotechnical Investigation Jones Property Lot 19, Concession 2 Vespra Midhurst, Ontario			
TITLE		KEY PLAN			
		PROJECT No.08-1186-0506F-G		FILE No. 002	
		DESIGN		SCALE	AS SHOWN
		CADD	PJV	April 2008	REV.
		CHECK		FIGURE 1	
		REVIEW			

Drawing file: N:\CAD\2008\1186 const. services\08-1186-0506\Jones\08-1186-0506F-001 -FIG 2008\03 Jones - FIG 2.dwg Apr 23, 2008 - 3:15pm



Aerial Photograph by Google Earth Pro 2007,
Image 2008 First Base Solutions.



NOT TO SCALE
ALL LOCATIONS ARE APPROXIMATE

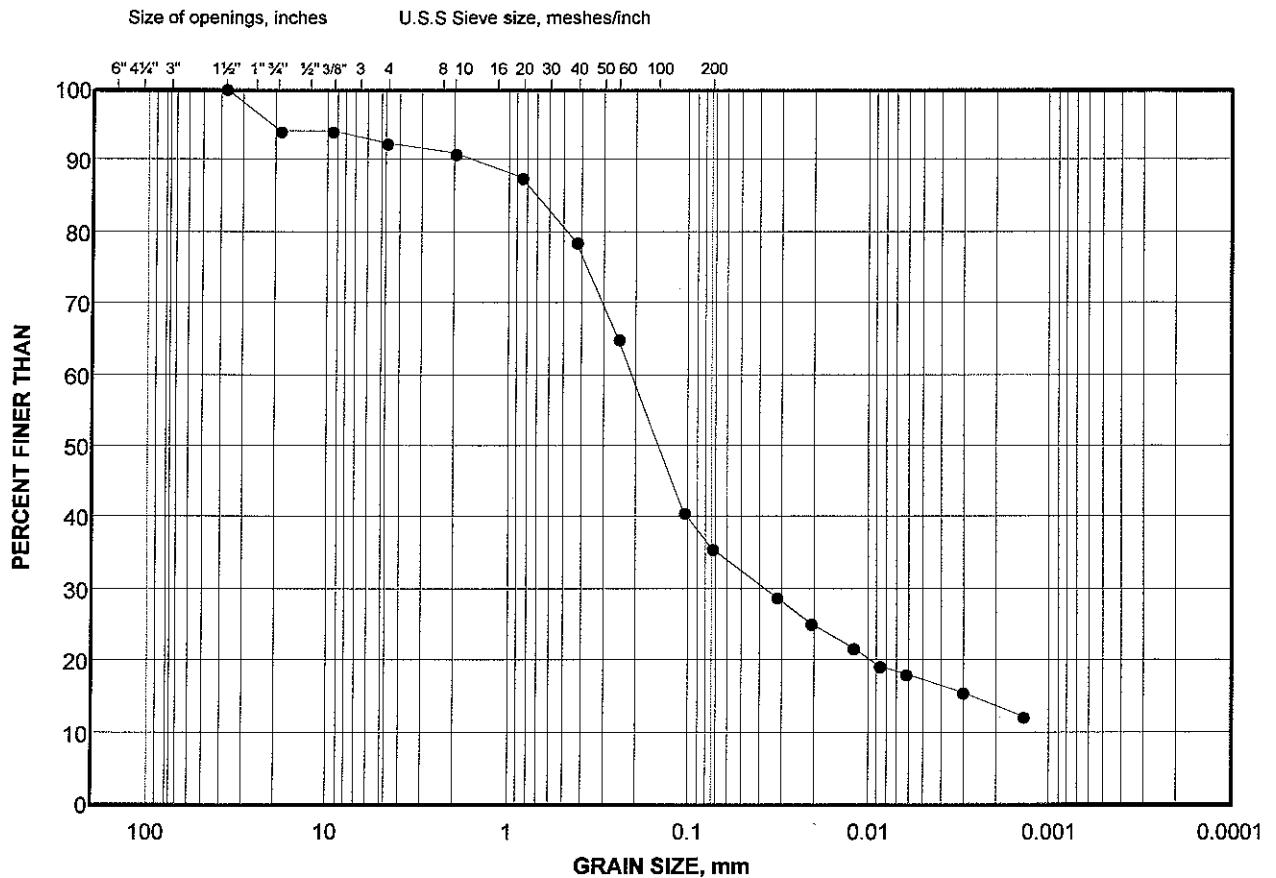
LEGEND

 BOREHOLE LOCATION IN PLAN

PROJECT		Preliminary Geotechnical Investigation Jones Property Lot 19, Concession 2 Vespra Midhurst, Ontario			
TITLE		LOCATION PLAN			
	PROJECT No.08-1186-0506F-G		FILE No.		001
	DESIGN		SCALE	AS SHOWN	REV.
	CADD	PJV	April 2008		
	CHECK				
	REVIEW				
FIGURE 2					

GRAIN SIZE DISTRIBUTION SILTY SAND TILL

FIGURE 3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	47	5	3.0 - 3.45

Project Number: 08-1186 0506F

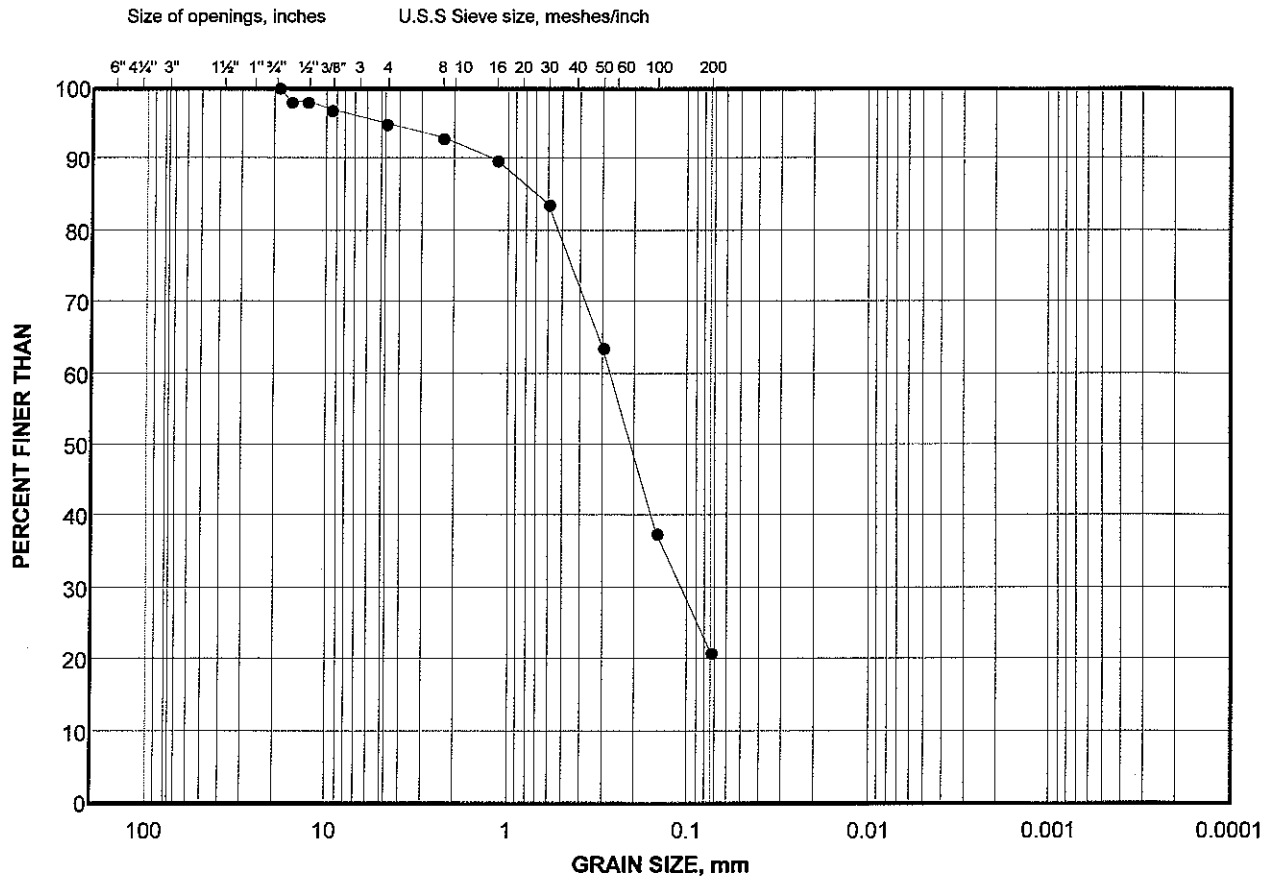
Checked By: _____

Golder Associates

Date: 22-Apr-08

GRAIN SIZE DISTRIBUTION SILTY FINE SAND

FIGURE 4



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	51	3	1.20 - 1.80

Project Number: 08-1186 0506F

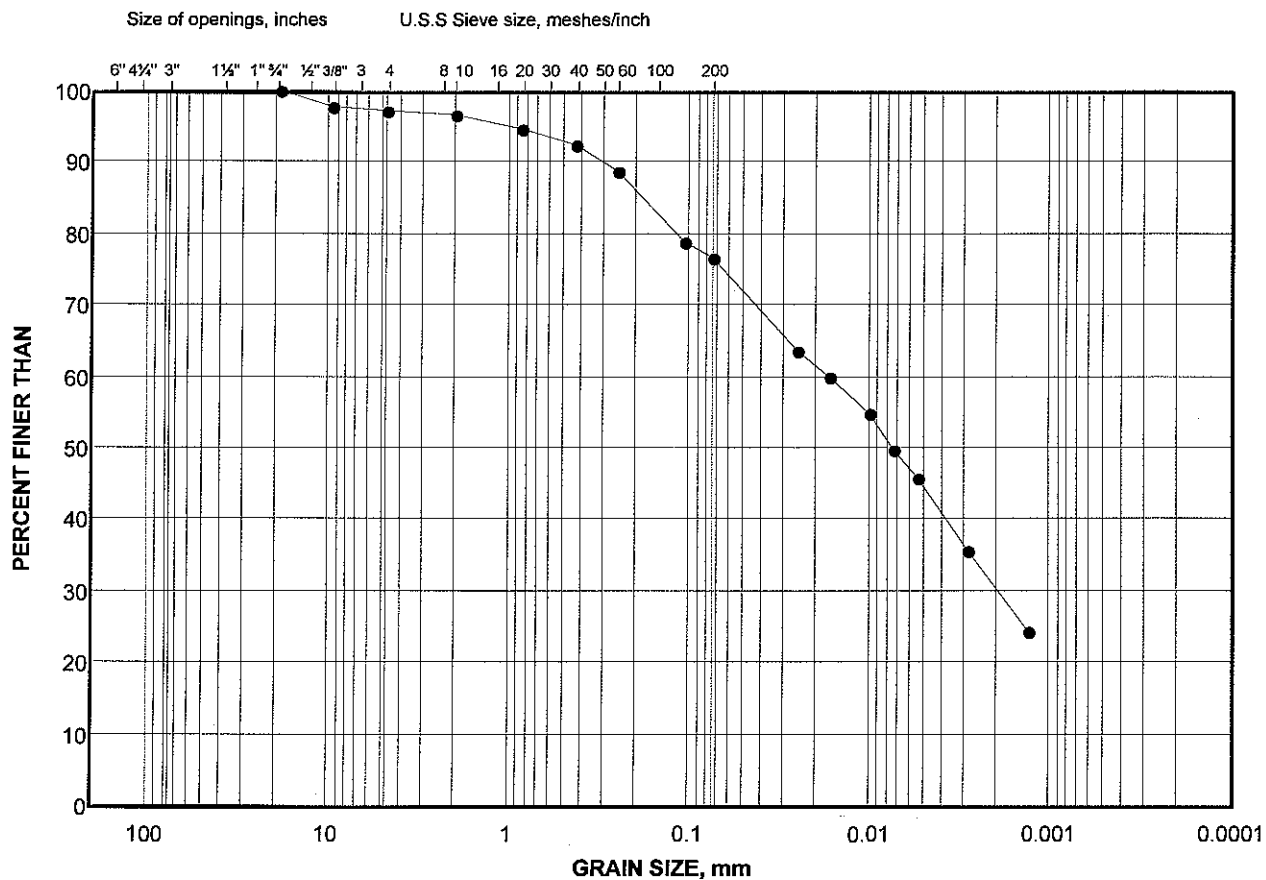
Checked By: DA

Golder Associates

Date: 22-Apr-08

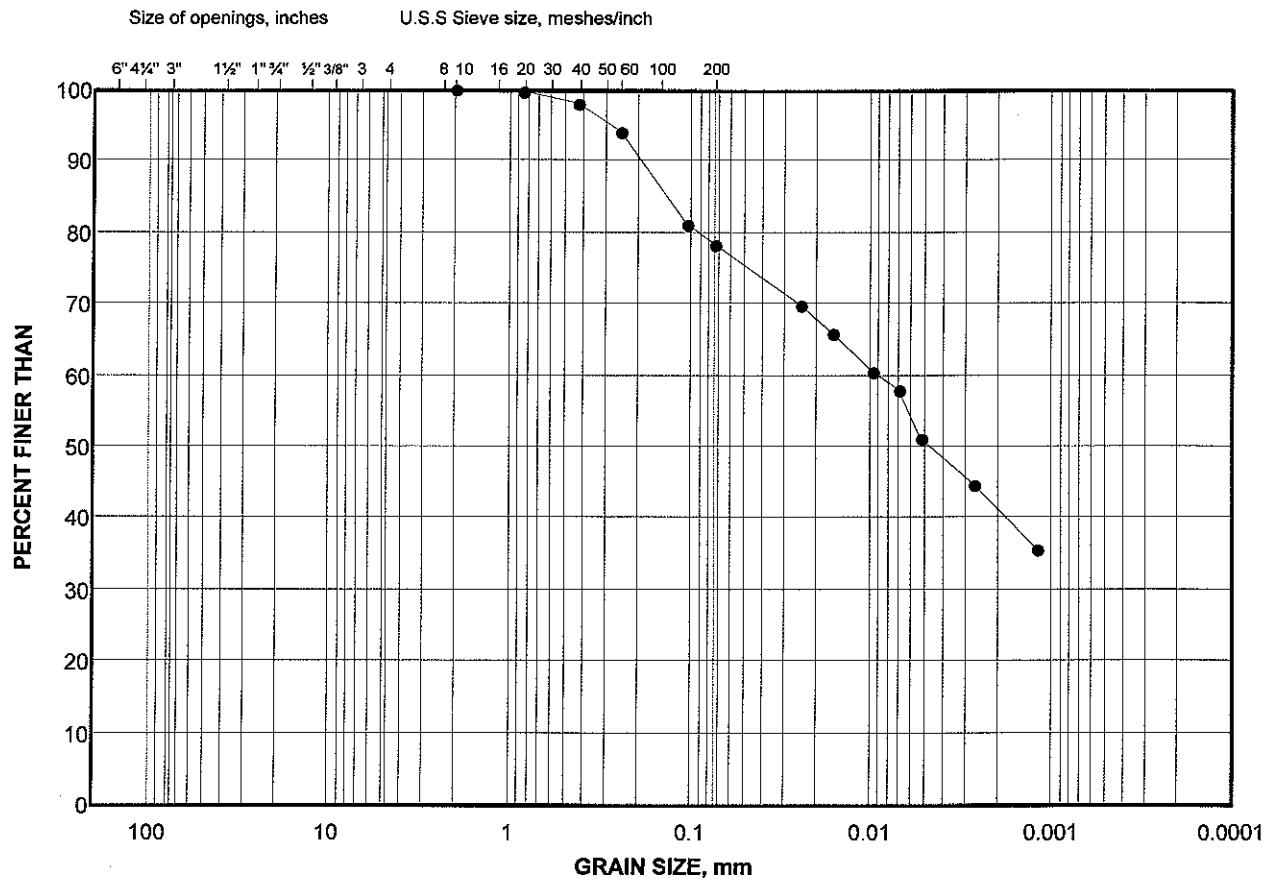
GRAIN SIZE DISTRIBUTION CLAYEY SILT TILL

FIGURE 5



GRAIN SIZE DISTRIBUTION SILTY CLAY

FIGURE 6



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	53	1B	0.20 - 0.60

Project Number: 08-1186 0506F

Checked By: DL

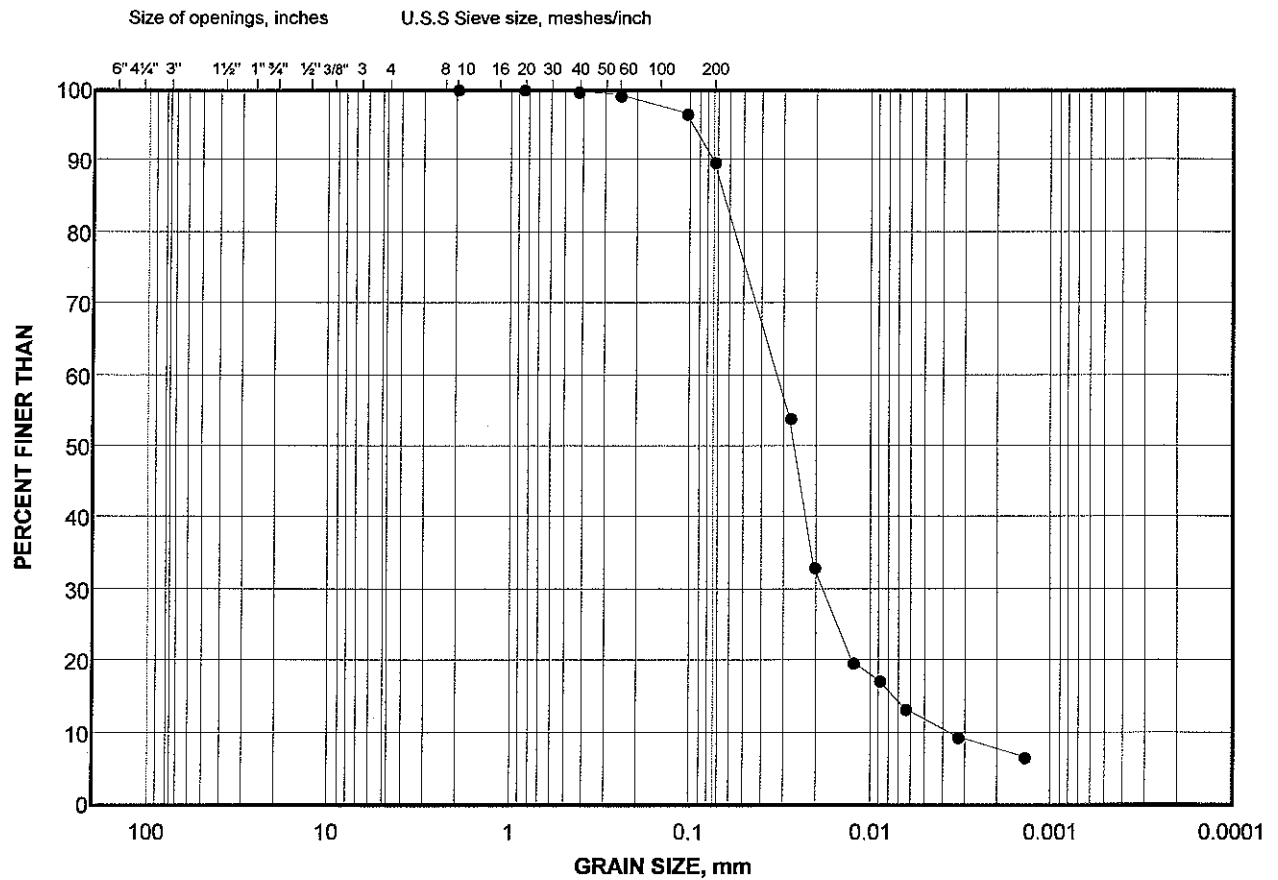
Golder Associates

Date: 22-Apr-08

GRAIN SIZE DISTRIBUTION

SILT

FIGURE 7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	52	3	1.20 - 1.80

Project Number: 08-1186 0506F

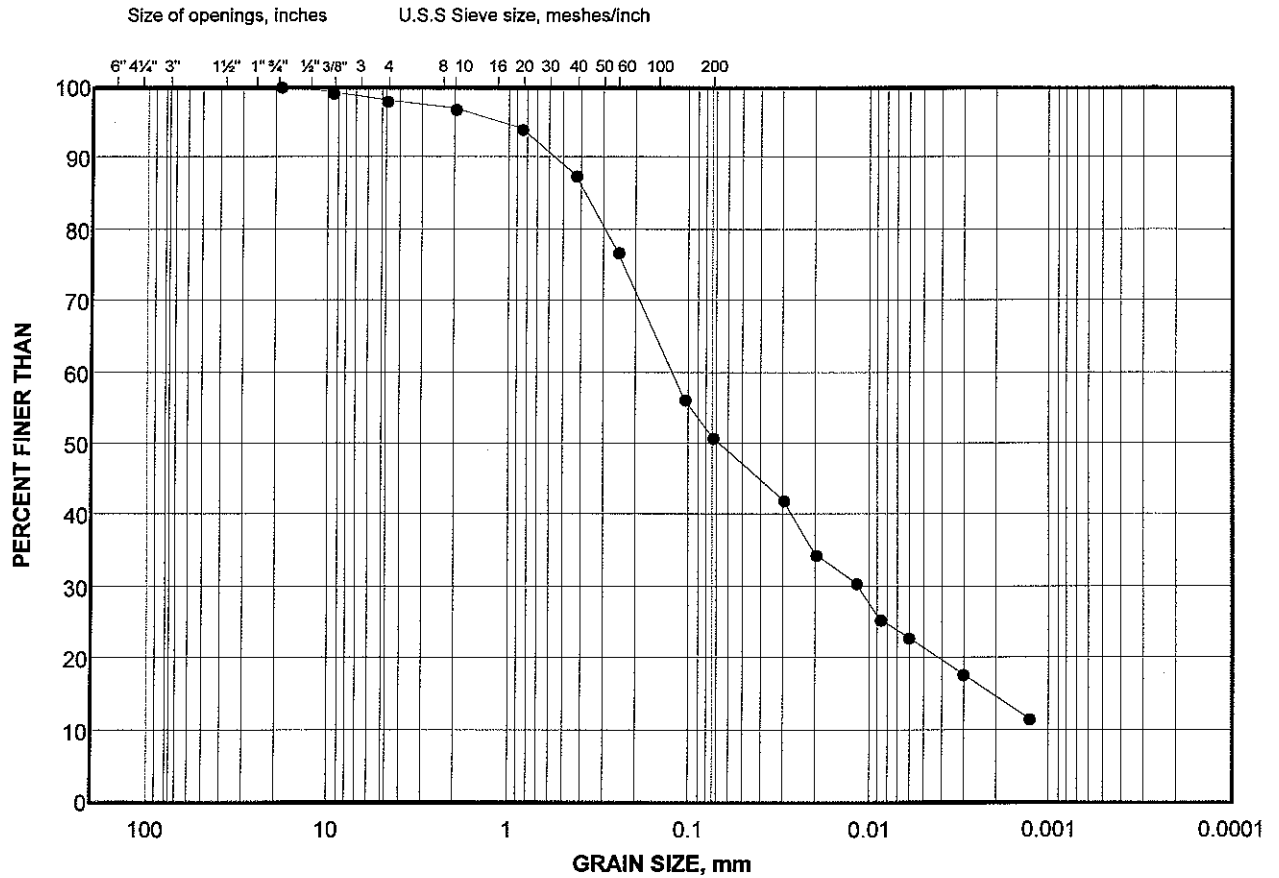
Checked By: 

Golder Associates

Date: 22-Apr-08

GRAIN SIZE DISTRIBUTION SILTY SAND (TILL-LIKE)

FIGURE 8



LEGEND

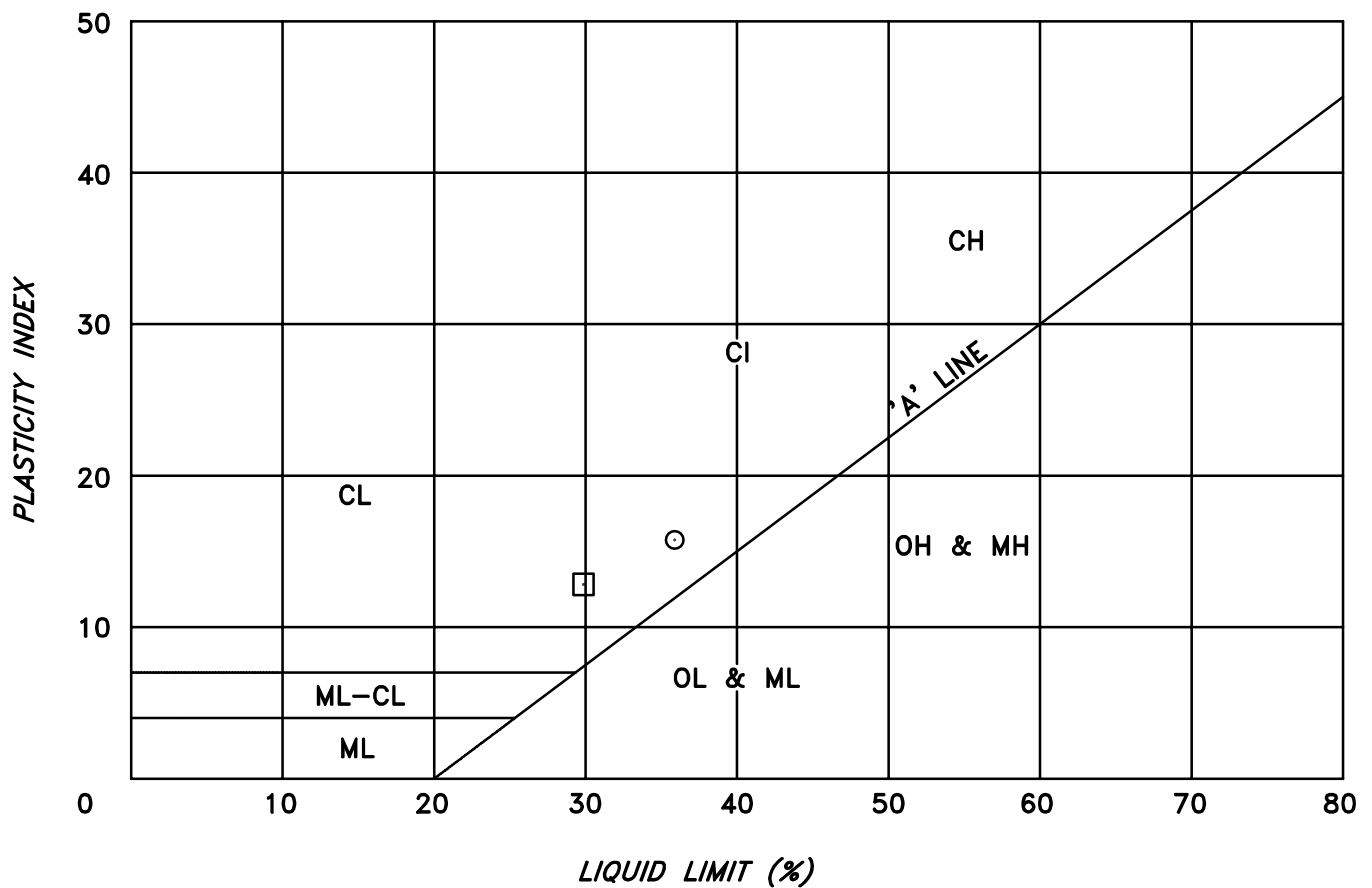
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	47	2	0.60 - 1.20

Project Number: 08-1186 0506F

Checked By: 

Golder Associates

Date: 22-Apr-08



SOIL TYPE		PLASTICITY	
C	Clay	L	Low
M	Silt	I	Intermediate
O	Organic	H	High

	BOREHOLE	SAMPLE	SAMPLE DESCRIPTION
○	53	1B	Silty Clay
□	53	5	Clayey Silt (TILL)



SCALE	AS SHOWN
DATE	04/18/08
DESIGN	
CADD	PJV
CHECK	
REVIEW	

TITLE

PLASTICITY CHART

FILE No. 004

PROJECT No. 08-186-0506F REV.

FIGURE 9

Appendix A

Important Information and Limitations of This Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing in Saskatchewan, subject to the time limits and physical constraints applicable to this report. No other warranty, express or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. ***No other party may use or rely on this report or any portion thereof without Golder's express written consent. Golder will consent to any reasonable request by the Client to approve the use of this report by other parties as Approved Users.*** The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media are susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use by any party of portions of the report without reference to the entire report.***

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (CONTINUED)

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgement, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction is necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

Water Copy

**CONSOLIDATED HYDROGEOLOGIC EVALUATION
PROPOSED RESIDENTIAL DEVELOPMENT
MIDHURST ROSE ALLIANCE
TOWNSHIP OF SPRINGWATER (VESPRA)**

1.0 INTRODUCTION

It is proposed to develop a residential subdivision on a 157.6 hectare parcel of land located in parts of Lots 11 and 12, Concession 3, and part of Lot 11, Concession 4, Township of Springwater (former Vespria). Figures 1 and 2 show the location of the proposed development.

It is proposed to service the subdivision with communal sub-surface treated sewage disposal systems, with the tile beds distributed throughout the property adjacent to various roadways, walking trails and paths. The subdivision will be supplied with water through an on-site communal water well system currently under development.

The majority of the site (152.5ha, referred to as the main parcel) is mainly bounded the block formed by Gill Road to the west, Doran Road to the south, Russell Road to the east and Craig Road to the north. A small portion of the development (5.11ha) extends to the west of Gill Road (referred to as the west parcel), to the south of the Road Allowance between Lots 10 and 11 (Craig Road).

The main parcel exhibits a generally flat relief which is interrupted by two northwest-trending, moderately incised, dry valleys in the far north-central and north-eastern portions of the site. The overall slope of the main parcel is towards the two valleys or to the north or northwest. The west parcel exhibits a hilly relief dominated by three northwest-trending, deeply incised, dry valleys. The main parcel is mostly cleared and is typically in active agricultural use, except for small forested areas in the north-central and northeastern portions of the site. The west parcel is mainly reforested. Lands surrounding the site are mainly in agricultural use or are undeveloped. Scattered rural residences are located along Gill Road and along Russell Road.

Although local National Topographic Series and Ontario Base Maps indicate that streams are situated in the base of some of the on-site valleys, the valleys have been observed to be dry on all site visits. Based on downgradient observation from Gill Road and extrapolation of the watertable surface (See Section 3.4.2), permanent streams are indicated to rise in the valleys near Gill Road approximately 1km to the northwest of the site.

Several general soil and shallow groundwater investigations were conducted over most parts of the site through the completion of thirty eight backhoe test pits during December 2004 and January 2006. Four deep test holes were drilled to the watertable surface during January, February and March 2008 to obtain information regarding the receiving aquifer. Eleven site-specific exploratory boreholes were completed in March 2008 to obtain subsurface information along proposed communal tile bed corridors. This

report provides a summary and consolidation of the various field investigations and soils analyses, details of communal sewage system disposal constraints, and the results of a development impact analysis following the guidelines of the Ministry of the Environment Reasonable Use Concept (RUC) as applicable to development utilizing communal sewage disposal systems.

2.0 **GEOLOGY AND HYDROGEOLOGY**

All subject lands are situated within the Simcoe Uplands physiographic region of southern Ontario, being separated from the Simcoe Lowlands by the Algonquin Bluff which is situated nearby to the north and northwest. The Uplands are characterized by a series of broad, rolling till plains (which were once islands in glacial Lake Algonquin) separated by steep-sided, flat-floored valleys. The Ontario Geological Survey "Surficial Geology of Southern Ontario" describes the upper soils over the site as sandy silt to silty sand glacial till with some older alluvial deposits of clay, silt, sand and gravel. The Soil Survey of Simcoe County describes the upper soils as primarily sandy loam belonging to the Vasey or Dundonald Soil Series, with some Tioga Soil Series loamy sand within the west parcel.

According to area water well records, the upper overburden consists of fine-grained deposits described as clay overlying a variable deposit consisting of sand to a gravelly clay. Where present, the granular deposits in the upper overburden appear to be dry, as indicated by a 19.5m deep well nearby to the southwest, reported as dry in gravel. Reported local wells are typically completed in an intermediate-depth granular deposit situated at a depth of about 55 to 60 metres below grade. Static water levels in these wells are very low, in the range of 40 metres below grade, consistent with the highland setting atop the Algonquin Bluff nearby to the northwest.

No local wells have fully penetrated the overburden and little local information is available regarding the lower overburden. However, according to the March 2004 document "Midhurst Secondary Plan - Settlement Capability and Servicing Option Study" prepared by Dixon Hydrogeology Limited, two deep aquifers (lower overburden), known to be capable of substantial yields in the Midhurst/Barrie corridor, may extend to the Gill Road Area north of Midhurst.

According to Ministry of the Environment Map 3135-7 "Bedrock Lithology and Topography, County of Simcoe, Southern Portion", the overburden is approximately 160 metres deep.

The bedrock beneath the site is described as limestone, dolostone and shale of the Middle Ordovician Simcoe Group of Rock.

Groundwater in viable quantities is obtained from granular formations within the overburden (i.e. sands and gravels) or from well fractured zones in the bedrock. According to local water well records, the vast majority of local wells are completed in an upper aquifer situated within intermediate-depth overburden granular deposits. The

Midhurst Settlement Capability and Servicing Option Study completed in 2004 suggests that one or two aquifers with high yield potential may be present in the lower overburden in the vicinity of Gill Road at the north end of Midhurst. These deep aquifers, identified as aquifers A3 and A4, are the target aquifers for the development's water supply, and good potential for the presence of the upper deep aquifer has been identified in a test hole at the northeastern corner of the site (see Section 6.0). The bedrock is not locally utilized as a source of water due to the likelihood of obtaining low yields of aesthetically poorer water and the high cost of drilling to the bedrock. Based on the geologic setting, shallow bored or dug wells will not be viable in the vicinity of the site.

3.0 SUBSURFACE INVESTIGATIONS

3.1 Test Pits:

Thirty eight test pits (numbered TP1 to TP21, TPN1 to TPN14 and TPW1 to W3) were excavated using backhoe equipment on December 8, 2004 and January 27, 2006. The soil profile was logged in each hole and representative soil samples were collected from each identified soil horizon for subsequent classification, analysis and storage. Figure 2 shows the approximate test pit locations. The following table provides a summary of the analytical results for selected, representative soil samples.

Table 1 : Summary of Test Pit Soil Analytical Data

Location/ Sample	Depth (m)	Grain-Size Distribution			"k" (cm/sec)	T-Time (min/cm)
		Clay %	Silt %	Sand %		
1/1	0.9	24	64	12	10^{-7}	>50
3/2	0.7	12	40	48	3×10^{-6}	40 to 45
5/3	0.7	4	39	57	3×10^{-5}	25 to 30
6/4	0.5	9	27	64	8×10^{-6}	35 to 40
8/5	0.6	30	65	5	10^{-7}	>50
10/6	0.6	trace	20	80	5×10^{-4}	12 to 15
12/7	1.0	10	35	55	9×10^{-6}	30 to 35
13/8	0.5	trace	26	74	1×10^{-4}	15 to 18
14/9	0.5	12	39	49	3×10^{-6}	40 to 45
15/10	0.6	9	33	58	1×10^{-5}	30 to 35
18/11	0.3	5	27	68	3×10^{-5}	25 to 30
19/12	0.5	4	36	60	2×10^{-5}	25 to 30

20/13	0.8	16	42	42	10^{-7}	>50
21/14	0.6	traces	33	67	5×10^{-5}	25 to 30
N1/15	1.3	0	8	92	6×10^{-3}	8 to 10
N4/16	1.0	3	29	68	5×10^{-5}	25 to 30
N5/17	0.6	3	18	79	3×10^{-4}	12 to 15
N7/18	1.0	12	40	48	4×10^{-6}	40 to 45
N8/19	0.6	10	48	42	5×10^{-8}	40 to 45
N9/20	0.5	3	37	60	4×10^{-5}	25 to 30
N13/21	1.1	8	31	61	1×10^{-5}	20 to 25
N14/22	0.5	22	52	26	10^{-7}	>50
W1/23	0.5	5	30	65	3×10^{-5}	30 to 35
W2/24	0.7	4	29	67	5×10^{-5}	25 to 30
W3/25	1.1	8	34	58	1×10^{-5}	30 to 35

Note: The above coefficients of permeability ("k" values) and T-times (percolation rates) are estimates based on field observation, laboratory grain-size analysis, experience with similar soils and guidelines of the Ontario Building Code.

Consistent with geologic mapping, the predominant soil type on-site is a silty sand glacial till. This soil exhibits a moderate permeability with a T-time in the range of 25 to 40 minutes per centimetre. A discontinuous, very compact to dense clayey silt was encountered mostly in test pits located in the northwestern portions of the site (TP1, TP3, TP8, TP20, TPN11, TPN12, TPN13 and TPN14), but was also found in a small area at the extreme eastern end of the site (TP14). The T-time of this soil is estimated to range between 40 minutes per centimetre to in excess of 50 minutes per centimetre in the vicinity due to high density and clay content.

3.2 Test Pit Shallow Groundwater Conditions:

No shallow groundwater or evidence of shallow groundwater (i.e. soil discolouration or mottling) was encountered in any of the thirty eight test pits, including Test Pit N10 which was located at the base of the north-central valley on the site. As discussed in Section 2.0, local well records indicate that static water levels in wells are in excess of 30 metres below grade and that a nearby well completed to a depth of 19.5m below grade was dry. As such, based on the highland setting atop the nearby Algonquin Bluff and local geology, seasonally elevated watertable conditions are not anticipated. The watertable surface will likely be in excess of 20 to 30 metres below grade.

It was noted on December 8, 2004 that in the vicinity of Test Pits N11 through N14, where the upper soils consist of lower-permeability materials, perched surface water was present. This condition is caused by the relatively low permeability of soils in this area is likely temporary following significant precipitation or snow melt.

3.3 Borehole Evaluation:

On March 20 and 21, 2008, eleven intermediate-depth (9.1m) exploratory boreholes (BH1 through BH11) were completed at regular intervals along the proposed subsurface sewage disposal corridors using a power auger machine equipped with hollow-stem, continuous flight augers operated by Canadian Soil Drilling. Soil samples were observed continuously using drilling cuttings and at 1.5m intervals using a standard split-spoon sampling apparatus over a drive length of 0.6m. Figure 3 shows the approximate borehole locations. As the boreholes, including the borehole for Monitoring Well 4 (see below), were completed to provide information in support of tile bed design, all samples from the 1.5m and 3.0m depth interval (6.0m depth at BH2) were subjected to grain-size analysis. The following table provides a summary of the borehole soil sample analytical results:

Table 2 : Summary of Borehole Soil Analytical Data

Location/ Sample	Depth (m)	Grain-Size Distribution			"k" (cm/sec)
		Clay %	Silt %	Sand %	
BH1/S26	1.5	8	29	63	5×10^{-5}
BH1/S27	3.0	7	31	62	8×10^{-5}
BH2/S28	1.5	23	47	30	1×10^{-8}
BH2/S29	6.0	0	8	82 (10% gravel)	6×10^{-3}
BH3/S30	1.5	6	30	64	8×10^{-5}
BH3/S31	3.0	35	58	7	10^{-7}
BH4/S32	1.5	14	36	50	7×10^{-8}
BH4/S33	3.0	6	35	59	6×10^{-5}
BH5/S34	1.5	9	44	47	5×10^{-6}
BH5/S35	3.0	12	28	60	3×10^{-5}
BH6/S36	1.5	13	32	55	1×10^{-5}
BH6/S37	3.0	0	3	97	3×10^{-3}
BH7/S38	1.5	0	16	84	2×10^{-3}

BH7/S39	3.0	2	38	60	1×10^{-4}
BH8/S40	1.5	16	41	43	3×10^{-6}
BH8/S41	3.0	24	42	34	1×10^{-6}
BH9/S42	1.5	23	49	28	1×10^{-6}
BH9/S43	3.0	0	8	92	6×10^{-3}
BH10/S44	1.5	9	32	59	4×10^{-5}
BH10/S45	3.0	32	56	12	10^{-7}
BH11/S46	1.5	7	57	36	1×10^{-5}
BH11/S47	3.0	0	51	49	2×10^{-5}
MW4/S48	1.5	0	3	97	1×10^{-2}
MW4/S49	3.0	6	31	63	6×10^{-5}

Note: The above coefficients of permeability ("k" values) are estimates based on field observation, laboratory grain-size analysis, experience with similar soils and guidelines of the Ontario Building Code.

The soil profiles encountered at the twelve boreholes were generally consistent with the test pit programs. The majority of boreholes encountered an upper silty sand till of varying consistency overlying a sand till at depth. Three areas of the site (the northwest corner, the southwest corner and the eastern/southeastern periphery) exhibited differing soil profiles:

- The upper clayey soils known to be present throughout the northwestern corner of the site were encountered at BH2, but were underlain at a relatively shallow depth (i.e. less than 2m) by the sand till. The upper clayey silt soils are indicated to be present within an area extending approximately 550m to the south, southeast and east from the intersection of Gill Road and Craig Road.
- The upper clayey silt soils were also encountered at the eastern and southeastern periphery of the site at BH8 (to 4.3m) and BH9 (to 1.5m), but were also underlain by the sand till. The driller's log for nearby MW2 also indicates a "brown clay" from grade to 3.1m, underlain by a "sand and gravel" (likely sand till).
- Moving westward from the eastern periphery of the site, at BH10 the clayey silt soil was found at depth, between 2.1 and 4.0m, but was underlain by sand till. At BH6, the clayey silt soil was found at depth (5.5m to the base of the borehole).

- At the southwestern corner of the site, BH3 encountered the clayey silt soil from 1.8m to 8.2m. The drillers log for nearby MW1 also noted a "grey clay" from 1.5m to 7.6m, indicating that this underlying clayey silt is likely contiguous within about 200 to 250m of the southwestern corner of the site. At both locations, the clayey silt was underlain by sand till.

Borehole logs and grain size curves are included in the appendix.

3.4 Watertable Evaluation:

3.4.1 Monitoring Wells:

In conjunction with the on-going deep aquifer test well drilling program (see Section 6.0), three small diameter monitoring wells (MW1, MW2 and MW3) were installed to below the watertable surface during January, February and March 2008 by Allan Wright Water Wells Inc. The monitors were completed as 3.6cm-diameter Schedule 40 PVC wells with 3m lengths of #10 slot PVC well screen (1.5m length on MW2) to depths of 44.8m (MW1 and MW3) and 48.2m below grade (MW2).

In conjunction with the above borehole investigation, a 28.8m deep monitoring well (MW4) was installed to a deep perched groundwater zone using a power auger machine equipped with hollow-stem, continuous flight augers operated by Canadian Soil Drilling. The well was equipped with a 5.1cm-diameter Schedule 40 PVC casing and a 3m length of #10 slot PVC well screen. Due to the limitations of drilling with hollow-stem augers, MW4 could not be installed beyond the perched groundwater zone and into the regional watertable.

An existing 15cm-diameter domestic well (currently out-of-service) is located on-site (MW5), approximately 160m north of MW1, and information from this well is incorporated into portions of this assessment.

Water well records, which contain well construction details and the geologic logs for wells MW1, MW2, MW3 and MW5, are included in the appendix. Well construction details and a visual log for MW4 is included in the appendix. The locations of the monitoring wells are shown on Figure 3.

3.4.2 Water Level Observations:

Water levels were observed in MW's 1 to 5 on March 24, 2008. Ground and casing elevation data were provided by C.T. Strongman Surveying Ltd. The following provides a summary of the water level information:

Well	Ground Elevation (m asl)	Water Level (m below grade)	Water Level Elevation (m asl)
MW1	285.23	39.71	245.52
MW2	289.01	40.00	249.01
MW3	287.05	39.30	247.75
MW4	282.43	23.68	258.75
MW5	283.10	37.58	245.52

As described in Section 3.2.1, MW4 was completed in an isolated zone of deep perched groundwater, as the water level in MW4 is about 10 to 13m higher than in the other monitors. The remaining four monitors are completed in the regional watertable.

Figure 3 shows the watertable surface equipotential lines and the inferred direction of groundwater flow in the upper aquifer, as interpreted from the March 24, 2008 water levels observed in MW1, MW2, MW3 and MW5. Groundwater in the upper aquifer is indicated to flow generally west-northwestward with a shallow gradient of approximately 3.5×10^{-3} . This interpreted direction of flow is consistent with local drainage patterns, which leads toward the Matheson Creek system.

3.4.3 Borehole Water Levels:

No groundwater was located within 9.1m of ground surface at all borehole locations, except at BH3 and BH6. Because of the underlying, relatively permeable sand till, the upper soils are typically well drained, and perched shallow watertable conditions are not present throughout most of the site.

However, small zones of isolated perched groundwater were identified at BH3 and at BH6, these being the boreholes where the clayey silt soils of significant thickness were found at depth. Shallow standpipes were set in BH3 and BH6 upon completion for subsequent water level observation. Water levels were observed in these two standpipes on March 24, 2008. Although shallow groundwater was encountered in BH3 above 1.5m during drilling, the standpipe was observed to be dry to a depth of 2.8m below grade, this despite the bentonite sealing of the borehole below the standpipe. The water level in BH6 was 2.07m below grade.

3.5 Groundwater Quality:

On March 24, 2008, samples of water were collected from MW1, MW2, MW3 and MW4 for background nitrate content analysis. The samples were collected using a Waterra inertial pump with a Hydrolift drive. Prior to sample collection, the wells were developed using the Waterra pump by pumping each well for approximately 60 minutes each at a rate of 3 to 4 litres per minute. MW2 and MW4 were incapable of a sustained yield of

3L/min, and were pumped dry three times and allowed to recover prior to sample collection. The standpipe set in BH6 was also sampled using the same procedures. The samples were collected in laboratory-supplied bottles, stored in an ice-packed cooler and submitted to Maxxam Analytics Inc. under chain of custody for nitrate content analysis. The following summarizes the analytical results:

Monitoring Well	Nitrate Content (mg/L as N)
MW1 (watertable)	4.4
MW2 (watertable)	<0.1
MW3 (watertable)	0.4
MW4 (deep perched groundwater)	11.0
BH6 (shallow perched groundwater)	4.0

Based on the inferred west-northwestward direction of groundwater flow in the upper aquifer, MW2 and MW3 are located at the upgradient end of the site, while MW1 is located near the downgradient end of the site. MW1, MW2 and MW3 all obtain water from the regional watertable aquifer. Being set in isolated perched groundwater zones, MW4 and BH6 will derive all water from direct on-site infiltration.

The nitrate content of the water from the five sampled boreholes is reflective of active agricultural practices on the site, in particular the application of agricultural fertilizers, with samples from the upgradient monitors containing little to no nitrate, and the downgradient sample containing 4.4mg/L nitrate. The shallow perched sample (BH6) contained 4.0mg/L nitrate, while the deep perched sample (MW4) contained 11mg/L nitrate. Given that the nitrate content of groundwater in the upper aquifer entering the site contains essentially no nitrate, with the withdrawal of agricultural practices on the site, the agriculturally-derived nitrate content of perched groundwaters and the upper aquifer will decline over time to low levels consistent with background levels.

A copy of the laboratory report is included in the appendix.

3.6 On-Site Stratigraphic Summary:

As described above, the test pit and borehole investigations indicated that at most locations, the upper soil profile consists of silty sand till overlying a sand till. Some clayey silt soils were found near surface in the northwestern and southeastern extremities of the site, but were also indicated to be underlain by the sand till. Of note in the context of sewage system function is the clayey silt soils encountered at depth at BH3, BH6 and MW1, where the base of the clayey silt soil is likely beyond the reasonable reach of excavation equipment.

Figures 4 and 5 are schematic cross-sections from southwest to northeast and northwest to southeast, each showing the geologic profile from grade to the upper portions of the watertable aquifer (approximately 50m total depth).

The cross-sections indicate that, with the above noted exceptions, the finer-grained upper soils are typically restricted to within the upper one or two metres of the soil

profile. The underlying sand till was indicated by the deeper monitoring well logs to be present down to an elevation of about 245m asl in the western half of the site, rising to above 270m asl in the eastern and southeastern portions of the site. The sand till is underlain by sands associated with the regional upper aquifer. A deep discontinuous sand/clay lens complex was identified in the eastern half of the site (i.e. at MW2 and MW3) at an elevation range of 245 to 250m asl, and likely supports the localized deep perched watertable at MW4.

As indicated in Section 3.4.2, the regional watertable slopes generally west-northwestward with a shallow gradient of approximately 3.5×10^{-3} , from a high of about 245m asl in the east down to a low of approximately 245m asl in the west. The regional aquifer is considered the ultimate receiving aquifer of all on-site sewage disposal.

4.0 **SEWAGE DISPOSAL CONSTRAINTS**

It is proposed to service the subdivision with communal sub-surface treated sewage disposal systems, with a cluster of tile beds surrounding the centrally-located sewage treatment plant (STP), with the balance of the tile beds distributed in a linear manner throughout the property adjacent to various roadways, walking trails and paths. It is understood that the linear tile beds (those not clustered around the STP) will be approximately 6m in width.

The regional watertable surface represents the ultimate receiving aquifer, and is situated beneath the entire development proposal at depth of more than 35m below grade. Although some sewage mounding will occur on the watertable surface, based on the sand deposits which form the upper aquifer, and the substantial unsaturated zone above the aquifer, any watertable mounding will be inconsequential to the operation of the tile beds.

Of primary concern to the operation of the tile beds is potential sewage mounding atop the native upper soils beneath the tile beds. In the interest of making the most efficient use of the areas tentatively allotted for sewage disposal, it is recommended that the underlying sand till be utilized as the target formation for the contact areas beneath the tile beds. The sand till offers the highest average permeability of the soils identified to be within reasonable reach of ground surface, and was found to be present within about 2m to 2.4m of ground surface in all areas except at BH3/MW1, BH6, BH8 and BH10.

To maximize the acceptable rate of sewage disposal per unit area beneath the tile beds, it is recommended that the upper silty sand till and upper clayey silt soils be removed to a depth of at least 2m beneath the tile bed corridors (so that the underlying sand till is exposed) and replaced with a clean sand fill with a coefficient of permeability in the range of 10^{-2} cm/sec (T-time 5 to 7 minutes per centimetre).

At BH3/MW1 and at BH6, the clayey silt soils were found at depth, and extended to 9m and beyond. Actual and potential perched watertable conditions were identified at these locations, this due to the presence of the low permeability underlying soils. Furthermore,

at BH8 the clayey silt soil extended to a depth of 4.3m. It is recommended that these locations not be utilized for tile bed disposal, as the potential for adverse sewage mounding atop the low permeability soil and perched watertable will be relatively high. Site specific boreholes are recommended to accurately determine the extent of the clayey silt soils beyond the above borehole locations, so that the installation of tile beds above clayey silt soil is avoided.

The following strip basin formula provides the sewage mounding potential atop the sand till beneath the linear tile bed corridors, assuming the above recommendation to use 2m of sand fill is followed.

$$H_{max} = W \times ((q/k_1) \times (q/k_2 - 1))^{0.5}$$

Where: H_{max} = maximum mound height
 W = basin width
 q = sewage infiltration rate (m/day)
 k_1 = conductivity of upper soil (sand fill)
 k_2 = conductivity of lower soil (underlying sand till)

Assuming a basin width of 6m, a sand fill conductivity of 1×10^{-2} cm/sec and a worst-case underlying sand till permeability of 2×10^{-5} cm/sec (as the linear basins traverse a variety of sand till conditions), the following mound heights are indicated above the base of the imported sand.

<u>Application Rate</u>	<u>Mound Height</u>
75 L/m ² /day	1.02m
60 L/m ² /day	0.79m
50 L/m ² /day	0.63m
40 L/m ² /day	0.47m

While mounding potential at application rates up to 75 L/m²/day appear viable, it should be noted that soils surrounding the linear sand fill will consist of native silty sand till and/or clayey silt soils. Because of the relatively lower permeability of these surrounding soils, and the resulting relative inability of the sewage mound to disperse laterally beyond the tile bed corridor, to conservatively maintain clearance between the tiles and the top of the sewage mound, it is recommended that the sewage application rate not exceed 50 L/m²/day. This recommendation assumes that there will be at least 1.5m of imported sand fill between the bases of the tile beds and the exposed sand till, and that the sewage will be subject to tertiary treatment prior to subsurface disposal.

A cluster of tile beds is also proposed in a generally square-shaped area surrounding the STP. According to the most recent concept plan, the tile bed cluster is situated within an area of dimensions approximately 245m x 225m. The above linear basin calculation assumed the worst-case sand till permeability, as the linear corridors will traverse a variety of sand till conditions. Several test pits and boreholes are located in the vicinity of the central tile bed cluster, these being test pits 7, 8, 19, 19, 20, N7 and

N9, as well as Boreholes 2, 4 and 5. Soil analyses and soil profiles in the vicinity of the tile bed cluster suggest that at depths beyond 2.1 to 2.4m below grade, the bulk permeability of the underlying sand till is approximately an order of magnitude higher (averaging 1×10^{-4} cm/sec) than the worst-case permeability assumed for the above linear basin analysis. Assuming a conservative local sand till permeability of 8×10^{-6} cm/sec, and a loading rate of 50L/m²/day (or 5cm/day), the "q/k₂" value in the above mounding equation will be less than 1. As such, the mounding equation will indicate essentially no potential for mounding of treated sewage atop the sand till beneath the tile bed cluster, this based on the known soils data from test pits and boreholes in the close vicinity of the tile bed cluster.

Qualitatively, the underlying sand till in the vicinity of the STP exhibits a typical interpreted "T-time" in the range of 30 to 35 minutes per centimetre. A treated sewage loading rate of 5cm/day in the tile bed cluster is well within the interpreted "T-time" for this soil type.

Accordingly, subject to the proper extraction of the upper silts and clays, thereby exposing the more permeable underlying sand till, the cluster of tile beds surrounding the STP, as well as the linear tile basins throughout the site are viable using a maximum loading rate of 50L/m²/day. The full replacement of the upper silts/clays with clean sand fill beneath all of the tile beds to a depth of 2.1 to 2.4m is essential. Alternate dosing of beds, if an available option, is an appropriate conservative operational measure.

All tile bed excavations must be supervised by a qualified person to ensure that the sand till deposit, or a contiguous deposit of better permeability is exposed by the excavation.

5.0 REASONABLE USE ASSESSMENT

The Ministry of the Environment (MOE) Reasonable Use Concept (RUC) is applicable to the assessment of impact of large sewage disposal systems (i.e. >10,000 litres per day design capacity), which would include the proposed communal system on the site. MOE Guideline B-7 and Procedure B-7-1 outline details of the Ministry's RUC. The critical groundwater contaminant in the context of the RUC is nitrate. The effect of the RUC is to require the nitrate content of groundwater at the downgradient property line not to exceed 25% of the difference between background and the Ontario Drinking Water Standard (10 mg/L).

As described in Section 3.5, the background nitrate content of the receiving aquifer entering the site is <0.1mg/L to 0.4mg/L. On-site agricultural practices, which will cease upon development of the lands, has increased the on-site nitrate levels to slightly in excess of 4mg/L. With the low identified background nitrate content of groundwater entering the site (0.4mg/L), the nitrate content of groundwater at the downgradient property boundary can be increased to 2.8mg/L under the RUC.

To calculate the potential impact of the proposed communal sewage system on the

nitrate content of groundwater at the downgradient property line, a dilution model utilizing the volume of infiltrating precipitation within the possible mixing zone downgradient of communal tile bed corridors, plus the volume of sewage is proposed. Recent opinion from the Ministry of the Environment has indicated that groundwater flow within the receiving aquifer cannot be included in the RUC dilution model, and guidance in the November 2007 draft MOE "Design Guidelines for Sewage Works" supports this opinion.

Section 22 of the November 2007 draft Design Guidelines for Sewage Works suggests the use of a standard infiltration rate of 250mm/year for dilution purposes, which recognizes the ability of finer-grained soils to provide attenuative mechanisms not available in high permeability sand deposits. Based on the indicated freely-draining soils throughout most of the property and the relatively flat relief of much of the site, with a regional water surplus of approximately 341mm/year (see appendix), such an infiltration rate is warranted.

As described in Section 3.4.2, groundwater flow in the receiving aquifer is west-northwestward. Based on the most recent site plans, two general sewage disposal corridors are proposed, with the corridors situated southwest to northeast, one spanning the central portion of the site and the other spanning the northwestern half of the site. It is recommended that the current site plan be consulted for accurate locations of the proposed tile bed corridors. Based on a west-northwestward direction of groundwater flow, approximately 51ha of on-site lands are available for dilution directly downgradient of all on-site tile beds. Accordingly, 1.28×10^8 litres of water will join the receiving aquifer on-site downgradient of the tile beds.

It is understood from the project engineer (Totten Sims Hubicki Associates) that the design sewage flow for the STP serving the "neighbourhood" is approximately $2,376 \text{ m}^3/\text{day}$.

To determine the degree of treatment required to achieve a nitrate content of 2.8mg/L at the downgradient property line, the following mass balance approach is proposed:

Nitrate sources:

Sewage: $8.67 \times 10^8 \text{ L/year}$ at nitrate concentration " C_s "

Dilution Sources:

Sewage	$8.67 \times 10^8 \text{ L/year}$
Infiltration:	$1.28 \times 10^8 \text{ L/year}$
Total:	$9.95 \times 10^8 \text{ L/year}$

The required degree of treatment can be determined using the mass-balance formula:

$$\text{Impact} = \text{Nitrate sources} \div \text{Dilution sources}$$

Therefore:

$$2.8\text{mg/L} = (8.67 \times 10^8 \text{L/year} \times C_s) \div 9.95 \times 10^8 \text{L/year}$$

$$C_s = 3.21\text{mg/L}$$

Therefore, based on the assumptions outlined above, the sewage treatment system serving the proposed development will be required to reduce the nitrate content of sewage to 3.21mg/L or lower to meet the requirements Ministry of the Environment's Reasonable Use Concept.

It should be noted that groundwater flow within the receiving aquifer will be substantial, based on the indicated depth and extent of the upper aquifer. However, as noted above, recent opinion from the Ministry of the Environment has indicated that this dilution source is no longer permitted for use as part of RUC calculations. The actual impact of sewage at the downgradient property line will be less than calculated.

As described above, the closest surface water body to the site is estimated to be approximately 1km to the northwest. This distance is more than sufficient to provide adequate attenuative mechanisms in the subsurface so that adverse impacts to surface waters (phosphorous in particular) do not occur in the long term.

6.0 STATUS OF WATER SUPPLY DEVELOPMENT

The development of an on-site water supply is currently underway. Three deep test holes (at the locations of MW1, MW2 and MW3) were completed to the known base elevation of target aquifers A3 or A4 during January, February and March 2008 by Allan Wright Water Wells Inc. Copies of the water well records are included in the appendix.

Test Hole 1, located at MW1, was completed to a depth of 146.4m (elevation 139m asl), and encountered probable aquifer A3 at a depth of about 101m (elevation 184m asl). However, the A3 formation was determined to be excessively silty at TH1, with the only possible viable formation being about 6.1m thick, an insufficient section to support a high-yield municipal well.

Test Hole 2, located at MW2, was completed to a depth of 158m (elevation 131m asl), and encountered probable aquifer A3 at a depth of 103.6m (elevation 185.4m asl). Aquifer A3 was identified to be approximately 31m thick at Test Hole 2, but was again mainly somewhat silty, with the most viable portions of the formation (i.e. coarser than medium sands) identified in two separate horizons, each only about 5 to 6 metres thick. Of interest at TH2 was the indicated thickness of aquifer A2, which is the upper aquifer most commonly utilized by local domestic wells. The most viable portion of aquifer A2 was found to extend over a length of about 41metres, from a depth of 48.8m (elevation 240m asl) to a depth of 89.9m (elevation 199m asl). Aquifer A2 is not the preferred source, as it may introduce a risk of off-site interference potential, and the downgradient upper portion of aquifer A2 is the probable eventual receiving aquifer for on-site sewage.

As such, TH2 was not completed as a test well at this time.

Test Hole 3, located at MW3, was completed to a depth of 131m (elevation 156.5m), and encountered probable aquifer A3 at a depth of 100.6m (elevation 187m). The most viable portion of the aquifer was found to be approximately 20m thick, and was selected for the development of a large-diameter test well. The construction of the test well is currently under way, and has been specified with a large-diameter 15.2m long Johnson Screens Hi-Flow 304 Stainless well screen with a transmitting capacity of approximately 48L/sec. Aquifer A3 is well known to be capable of such yields to the north and south, however formal testing is required to confirm actual long-term safe yields.

Depending on the outcome of the test well, an additional well(s) will be required for the development to either supplement the supply and/or to provide backup/alternate sources. Subject to the results of testing, additional development of aquifer A3 may be viable in the northern portion of the site. Alternatively, development of the lower portion of Aquifer A2 may be possible at TH2. Aquifer A2 may be a viable source at TH2 as it is a relatively remote location, with the closest off-site wells being approximately 200 to 300m distant. TH2 is also located about 550m upgradient of the closest proposed on-site tile bed corridor, thereby minimizing the possibility that the well's capture zone might extend to the on-site tile beds. Based on the identified formation at TH2, a well screen similar to that specified at the test well at TH3 appears viable (i.e. >40L/sec transmitting capacity). However, aquifer A2 is not as well known for high yield wells in the area, and a test well would be required to confirm long-term yield potential at the TH2 location.

7.0 **CONCLUSIONS AND RECOMMENDATIONS**

1. The predominant upper soil type on the site is a silty sand glacial till. Small areas of surficial, dense clayey silt were identified within the northwest, southwest and southeastern extremities of the main site.
2. The regional watertable surface was identified to be in excess of 37m below grade, and is inferred to flow in a west-northwestward direction. The regional watertable surface is considered as the receiving aquifer for sewage disposal purposes.
3. The nitrate content of groundwater in the receiving aquifer entering the site is low, at between <0.1 to 0.4mg/L.
4. Fully in-ground sewage tile beds are likely to be viable over much of the site. It is recommended that to achieve the most efficiency of the tile bed areas, the underlying sand till be exposed beneath the tile bed corridors, and the excavations backfilled with imported sand. In most areas, this should be possible within 2m to 2.4m of land surface, but slightly greater in some areas. However, two small areas identified in Section 4.0 of this report should be avoided for tile bed installation due to deep clayey silt deposits, and additional boreholes are recommended to accurately delineate the local areal extent of these low

permeability deposits.

5. Sewage mounding potential atop the watertable surface will be inconsequential, based on the depth to the regional watertable and the sand deposit of the upper aquifer.
6. Due to sewage mounding potential atop the exposed sand till, the treated sewage application rate beneath the all tile beds should not exceed 50L/m²/day.
7. Under the current Ministry of the Environment Reasonable Use Concept, a tertiary sewage treatment facility will be required to reduce the nitrate content of sewage to 3.21mg/L or lower for the indicated design sewage flow of 2,376m³/day.
8. The construction of a large-diameter well to be completed in deep Aquifer A3, and equipped with a large-diameter well screen with a transmitting capability of approximately 48L/sec., is currently underway. Aquifer A3 is well known to be capable of such yields, however formal testing of the test well, once completed, is required to confirm long-term safe yield. A second test drilling site, located at the southeast corner of the site has also indicated high yield potential.

8.0 **STATEMENT OF LIMITATIONS**

This report was prepared solely to provide conclusions regarding the general suitability of soil and groundwater conditions for sewage disposal and the density of development allowable under current Ministry of the Environment Reasonable Use Concept, and the current status of water supply development. No conclusions should be drawn from this report regarding the viability of residential development on the subject parcel of land as it relates to any other factors (e.g. demonstrated water supply, drainage, slope stability, load-bearing engineering, biology, etc...).

IAN D. WILSON ASSOCIATES LIMITED

draft

Geoffrey Rether, P.Geo.

June 18, 2008

TEST PIT LOGS**Completed January 27, 2006****TEST PIT DEPTH (m) MATERIALS**

TP1	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 0.6	dark brown, lightly compact, dry silty SAND with traces of clay
	0.6 - 1.8	brown, very compact, dry clayey SILT with some fine sand
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 1 - 0.9m Clay - 24% Silt - 64% Sand - 12%	

TP2	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 0.8	red-brown, lightly compact, dry silty SAND with traces of clay
	0.8 - 1.7	brown, compact, dry silty SAND with traces of clay (till)
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions	

TP3	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.7	brown, compact, dry SILT AND SAND with some clay (till)
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 2 - 0.7m Clay - 12% Silt - 40% Sand - 48%	

TEST PIT LOGS**Completed January 27, 2006****TEST PIT DEPTH (m) MATERIALS**

TP4 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 1.7 brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions

TP5 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 1.7 brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 3 - 0.7m
Clay - 4%
Silt - 39%
Sand - 57%

TP6 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.6 grey-brown, lightly compact, dry silty SAND with traces of clay (till)
 0.6 - 1.5 brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 4 - 0.5m
Clay - 9%
Silt - 27%
Sand - 64%

TEST PIT LOGS**Completed January 27, 2006**

TEST PIT DEPTH (m) MATERIALS

TP7	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.7	grey-brown, very compact, dry silty SAND with some clay (till)
• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions		
TP8	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 0.9	grey, dense, dry clayey silt with traces of fine sand
	0.9 - 1.7	brown, compact, dry silty SAND with traces of clay (till)
• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 1 - 0.6m Clay - 30% Silt - 65% Sand - 5%		
TP9	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.0	grey-brown, compact, dry silty SAND with traces of clay (till)
	1.0 - 1.7	grey-brown, lightly compact, dry silty SAND with traces of clay (till)
• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions		

TEST PIT LOGS**Completed January 27, 2006****TEST PIT DEPTH (m) MATERIALS**

TP10 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 1.0 brown, compact, dry silty SAND
 1.0 - 1.7 grey-brown, loose, dry SAND

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 2 - 0.6m
Clay - 0%
Silt - 20%
Sand - 80%

TP11 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 1.7 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions

TP12 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.6 grey-brown, lightly compact, dry silty SAND with traces of clay (till)
 0.6 - 1.8 light brown, compact, dry silty SAND with some clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 3 - 1.0m
Clay - 10%
Silt - 35%
Sand - 55%

TEST PIT LOGS**Completed January 27, 2006****TEST PIT DEPTH (m) MATERIALS**

TP13

0 - 0.2

dark brown cultivated TOPSOIL

0.2 - 0.6

red-brown, lightly compact, dry silty SAND

0.6 - 1.5

grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 4 - 0.5m

Clay - 0%

Silt - 26%

Sand - 74%

TP14

0 - 0.3

dark brown cultivated TOPSOIL

0.3 - 0.9

grey-brown, very compact, dry silty SAND with some clay (till)

0.9 - 1.5

brown, very compact, dry silty SAND with some clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 5 - 0.6m

Clay - 12%

Silt - 39%

Sand - 49%

TP15

0 - 0.3

dark brown cultivated TOPSOIL

0.3 - 1.7

brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 5 - 0.6m

Clay - 9%

Silt - 33%

Sand - 58%

TEST PIT LOGS**Completed January 27, 2006****TEST PIT DEPTH (m) MATERIALS**

TP16 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 1.0 brown, compact, dry silty SAND with traces of clay (till)
 1.0 - 1.5 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions

TP17 0 - 0.2 dark brown cultivated TOPSOIL
 0.2 - 0.8 brown, compact, dry silty SAND with traces of clay (till)
 0.8 - 1.5 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions

TP18 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.5 red-brown, lightly compact, dry silty SAND with traces of clay
 0.5 - 1.7 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 6 - 0.3m
 Clay - 5%
 Silt - 27%
 Sand - 68%

TEST PIT LOGS**Completed January 27, 2006****TEST PIT DEPTH (m) MATERIALS**

TP19	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 0.7	brown, lightly compact, dry silty SAND with traces of clay
	0.7 - 1.7	grey-brown, compact, dry silty SAND with some clay, some stones (till)
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 7 - 0.5m Clay - 4% Silt - 36% Sand - 60%	

TP20	0 - 0.2	dark brown cultivated TOPSOIL
	0.2 - 1.65	brown, dense, dry SILT AND SAND with some clay
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 8 - 0.8m Clay - 16% Silt - 42% Sand - 42%	

TP21	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.0	brown, compact, dry silty SAND
	1.0 - 1.7	grey, compact, dry silty SAND with some clay (till)
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 9 - 0.6m Clay - 0% Silt - 3 Sand - 67%	

TEST PIT LOGS**Completed December 8, 2004****TEST PIT DEPTH (m) MATERIALS**

TPN1	0 - 0.2	dark brown cultivated TOPSOIL
	0.2 - 1.1	dark brown to grey-brown, lightly compact, dry silty SAND with traces of clay
	1.1 - 1.8	light brown to grey-brown, loose, dry SAND with traces of silt
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 1 - 1.3m - Clay - 0% - Silt - 8% - Sand - 92%	
TPN2	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.2	brown, very compact, dry SILT AND SAND with some clay
	1.2 - 1.9	grey-brown, compact, dry silty SAND with traces of clay (till)
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions	
TPN3	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.8	grey-brown, compact, dry silty SAND with traces of clay (till)
	1.8 - 2.0	light grey, compact to very compact, dry SILT with traces of clay
	• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions	

TEST PIT LOGS**Completed December 8, 2004****TEST PIT DEPTH (m) MATERIALS**

TPN4 0 - 0.2 dark brown cultivated TOPSOIL
 0.2 - 1.7 grey-brown, compact, dry silty SAND with traces of clay (till)
 1.7 - 2.0 red-brown, loose, dry SAND

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 2 - 1.0m
 Clay - 3%
 Silt - 29%
 Sand - 68%

TPN5 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.9 dark grey-brown, lightly compact, dry stony, silty SAND with traces of clay (till)
 0.9 - 2.0 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 3 - 0.6m
 Clay - 3%
 Silt - 18%
 Sand - 79%

TPN6 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.9 grey-brown, compact, dry silty SAND with traces of clay (till)
 0.9 - 2.0 light grey, very compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions

TEST PIT LOGS**Completed December 8, 2004****TEST PIT DEPTH (m) MATERIALS**

TPN7	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.7	grey-brown, very compact to dense, dry SILT and SAND with some clay (till)
		• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions (perched surface water in vicinity) • Sample 4 - 1.0m - Clay - 12% - Silt - 40% - Sand - 48%

TPN8	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 1.2	dark red-brown, very compact, dry SILT and SAND with some clay (till)
	1.2 - 2.2	grey-brown, compact, dry silty SAND with traces of clay (till)
		• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 5 - 0.6m - Clay - 10% - Silt - 48% - Sand - 42%

TEST PIT LOGS**Completed December 8, 2004****TEST PIT DEPTH (m) MATERIALS**

TPN9 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.7 red-brown, compact, dry silty fine SAND with traces of clay
 0.7 - 2.3 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 6 - 0.5m
 Clay - 3%
 Silt - 37%
 Sand - 60%

TPN10 0 - 0.1 dark brown TOPSOIL
 0.1 - 1.2 brown, compact, dry SILT
 1.2 - 2.7 red-brown, compact, dry silty fine SAND with traces of clay

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions

TPN11 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 1.3 red-brown, compact to very compact, dry sandy, clayey SILT
 1.3 - 2.3 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions

TEST PIT LOGS**Completed December 8, 2004****TEST PIT DEPTH (m) MATERIALS**

TPN12 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 1.5 red-brown, very compact to dense, dry sandy, clayey SILT
 1.5 - 2.1 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions (perched surface water in vicinity)

TPN13 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.7 red-brown, compact to very compact, dry sandy, clayey SILT
 0.7 - 1.5 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions (perched surface water in vicinity)
- Sample 7 - 1.1m
 Clay - 8%
 Silt - 31%
 Sand - 61%

TPN14 0 - 0.3 dark brown cultivated TOPSOIL
 0.3 - 0.9 red-brown, compact to very compact, dry sandy, clayey SILT
 0.9 - 1.5 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 7 - 0.5m
 Clay - 22%
 Silt - 52%
 Sand - 26%

TEST PIT LOGS**Completed December 8, 2004****TEST PIT DEPTH (m) MATERIALS**

TPW1 0 - 0.2 dark brown TOPSOIL
 0.2 - 0.9 dark brown to red-brown, loose, dry silty fine SAND with traces of clay
 0.9 - 1.8 grey-brown, dense, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 1 - 0.5m
 Clay - 5%
 Silt - 30%
 Sand - 65%

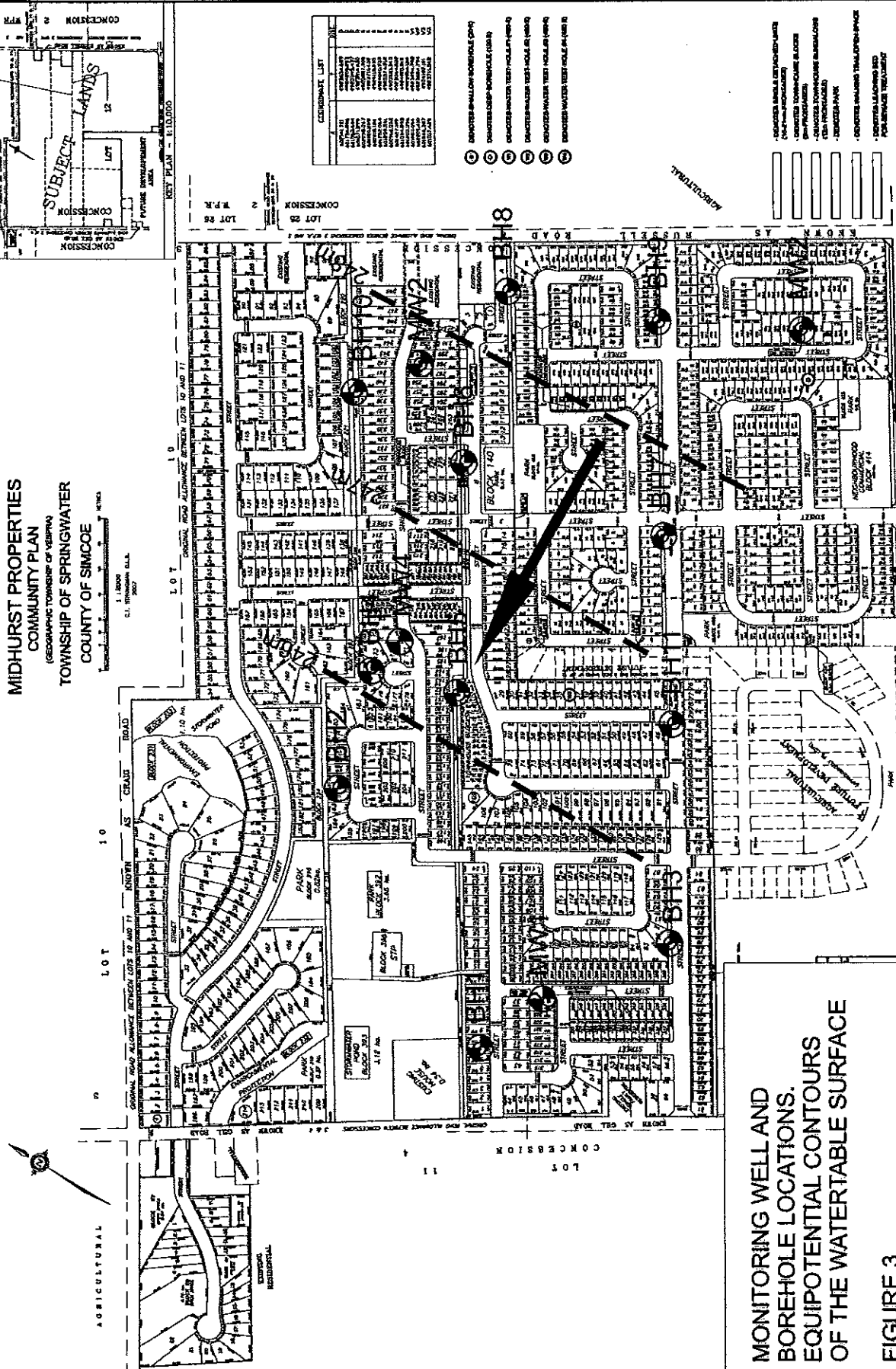
TPW2 0 - 0.3 dark brown TOPSOIL
 0.3 - 1.0 brown, compact, dry silty SAND with traces of clay (till)
 1.0 - 1.7 grey-brown, compact, dry silty SAND with traces of clay (till)

- Test Pit stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 2 - 0.7m
 Clay - 4%
 Silt - 29%
 Sand - 58%

TEST PIT LOGS**Completed December 8, 2004****TEST PIT DEPTH (m) MATERIALS**

TPW3	0 - 0.2	dark brown TOPSOIL
	0.2 - 0.9	grey-brown, compact, dry silty SAND with traces of clay (till)
	0.9 - 1.7	grey, compact, dry silty SAND with traces of clay (till)
• Test Pit stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 3 - 1.1m - Clay - 8% - Silt - 34% - Sand - 58%		

**MIDHURST PROPERTIES
COMMUNITY PLAN**
(GEOGRAPHIC TOWNSHIP OF VESPERIN)
TOWNSHIP OF SPRINGWATER
COUNTY OF SIMCOE



**MONITORING WELL AND
BOREHOLE LOCATIONS.
EQUIPOTENTIAL CONTOURS
OF THE WATERTABLE SURFACE**

FIGURE 3

LEGEND

- MONITORING WELL AND BOREHOLE LOCATIONS
- EQUIPOTENTIAL CONTOURS OF THE WATERTABLE SURFACE
- AGRICULTURAL VACANT LANDS
- CONCESSION
- LOT
- STREET
- PARK
- WATER
- ROAD
- RAILROAD
- UTILITY
- INDUSTRIAL
- RESIDENTIAL
- COMMERCIAL
- AGRICULTURAL

CROSS-SECTION LIST

SECTION	DESCRIPTION
1	SECTION 1
2	SECTION 2
3	SECTION 3
4	SECTION 4
5	SECTION 5
6	SECTION 6
7	SECTION 7
8	SECTION 8
9	SECTION 9
10	SECTION 10
11	SECTION 11
12	SECTION 12
13	SECTION 13
14	SECTION 14
15	SECTION 15
16	SECTION 16
17	SECTION 17
18	SECTION 18
19	SECTION 19
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22	SECTION 22
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94	SECTION 94
95	SECTION 95
96	SECTION 96
97	SECTION 97
98	SECTION 98
99	SECTION 99
100	SECTION 100

C.T. SPRINGWATER SURVEYING LTD.
1000 SHEPPARD AVENUE EAST
SUITE 100
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FAX: (416) 291-1112
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ORILLIA - ONTARIO

LEGEND

- MONITORING WELL AND BOREHOLE LOCATIONS
- EQUIPOTENTIAL CONTOURS OF THE WATERTABLE SURFACE
- AGRICULTURAL VACANT LANDS
- CONCESSION
- LOT
- STREET
- PARK
- WATER
- ROAD
- RAILROAD
- UTILITY
- INDUSTRIAL
- RESIDENTIAL
- COMMERCIAL
- AGRICULTURAL

FIGURE 3

VISUAL BOREHOLE LOGS**Completed March 20 and 21, 2008****BOREHOLE DEPTH (m) MATERIALS**

BH3
(March 20)

0 - 0.3	dark brown cultivated TOPSOIL
0.3 - 1.8	brown, soft, damp silty SAND TILL with traces of clay
1.8 - 8.2	brown, soft, dry clayey SILT with traces of sand
8.2 - 9.6	grey-brown, lightly compact, dry silty SAND TILL with traces of clay

- Borehole stable and wet upon completion
- 5.1cm-diameter PVC monitor installed, with a 1.5m length of #10 slot screen set from 0.9 to 2.4m, Bentonite plug installed below the pipe.
- Perched groundwater noted above clayey silt above 2.4m.
- Sample 30 - 1.5m
Clay - 6%
Silt - 30%
Sand - 64%
- Sample 31 - 3.0m
Clay - 35%
Silt - 58%
Sand - 7%

BH4
(March 20)

0 - 0.3	dark brown cultivated TOPSOIL
0.3 - 1.8	brown, compact, dry SILT AND SAND with some clay
1.8 - 3.1	grey-brown, lightly compact, dry silty SAND TILL with traces of clay

- Borehole stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 32 - 1.5m
Clay - 14% Silt - 36%
Sand - 50%
- Sample 33 - 3.0m
Clay - 6%
Silt - 35%
Sand - 59%

VISUAL BOREHOLE LOGS**Completed March 20 and 21, 2008****BOREHOLE DEPTH (m) MATERIALS**

BH5 0 - 0.3 dark brown cultivated TOPSOIL
(March 20) 0.3 - 2.4 brown, compact, dry SILT and SAND with traces of clay
 2.4 - 9.6 grey, compact, dry silty SAND till with some clay

- Borehole stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 34 - 1.5m
Clay - 9%
Silt - 44%
Sand - 47%
- Sample 35 - 3.0m
Clay - 12%
Silt - 28%
Sand - 60%

BH6 0 - 0.3 dark brown cultivated TOPSOIL
(March 21) 0.3 - 2.3 brown, compact, dry to wet silty SAND TILL with some clay
 2.3 - 5.5 brown, loose, wet SAND with traces of silt
 5.5 - 8.4 brown, compact, dry clayey SILT with traces of sand
 8.4 boulder refusal

- Borehole unstable and wet upon completion
- 5.1cm-diameter PVC monitor installed, with a 1.5m length of #10 slot screen set from 2.4 to 4.0m, Bentonite plug installed below the pipe.
- Perched groundwater noted above clayey silt above 5.5m.
- Sample 36 - 1.5m
Clay - 13%
Silt - 32%
Sand - 55%
- Sample 37 - 3.0m
Clay - 0%
Silt - 3%
Sand - 97%

VISUAL BOREHOLE LOGS

Completed March 20 and 21, 2008

BOREHOLE DEPTH (m) MATERIALS

BH7 (March 21)	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 2.1	red-brown, loose, dry fine SAND with some silt
	2.1 - 9.6	grey, compact, dry silty SAND till with traces of clay
	• Borehole stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 38 - 1.5m Clay - 0% Silt - 16% Sand - 84% • Sample 39 - 3.0m Clay - 2% Silt - 38% Sand - 60%	
BH8 (March 21)	0 - 0.3	dark brown cultivated TOPSOIL
	0.3 - 4.3	brown, soft, dry SILT AND SAND with some clay
	4.3 - 8.5	grey, compact, dry sandy SILT till with some clay
	8.5 - 9.6	light brown, compact, dry silty SAND till with traces of clay
	• Borehole stable and dry upon completion • No evidence of emergent groundwater or seasonally elevated watertable conditions • Sample 40 - 1.5m Clay - 16% Silt - 41% Sand - 43% • Sample 41 - 3.0m Clay - 24% Silt - 42% Sand - 34%	

VISUAL BOREHOLE LOGS**Completed March 20 and 21, 2008****BOREHOLE DEPTH (m) MATERIALS**

BH9 0 - 0.3 dark brown cultivated TOPSOIL
(March 21) 0.3 - 1.5 brown, compact, dry SILT with some sand and clay
 1.5 - 4.8 brown, lightly compact, dry SAND TILL with some silt
 4.8 - 9.6 grey, compact, dry silty SAND till with traces of clay

- Borehole stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 42 - 1.5m
Clay - 23%
Silt - 49%
Sand - 28%
- Sample 43 - 3.0m
Clay - 0%
Silt - 8%
Sand - 92%

BH10 0 - 0.3 dark brown cultivated TOPSOIL
(March 21) 0.3 - 2.1 brown, compact, dry silty SAND with traces of clay
 2.1 - 4.0 brown, lightly compact, clayey SILT with some fine sand
 4.0 - 6.4 grey, compact, dry silty SAND till with traces of clay
 6.4 - 9.6 brown, loose, dry SAND TILL with some silt

- Borehole stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 44 - 1.5m
Clay - 9%
Silt - 32%
Sand - 59%
- Sample 45 - 3.0m
Clay - 32%
Silt - 56%
Sand - 12%

VISUAL BOREHOLE LOGS**Completed March 20 and 21, 2008****BOREHOLE DEPTH (m) MATERIALS**

BH11	0 - 0.3	dark brown cultivated TOPSOIL
(March 21)	0.3 - 0.8	brown, soft, dry silty fine SAND
	0.8 - 2.1	brown, loose, dry sandy SILT with traces of clay
	2.1 - 5.2	brown, loose, dry SILT AND SAND
	5.2 - 7.6	grey, compact, dry silty SAND till with traces of clay
	7.6	rock refusal

- Borehole stable and dry upon completion
- No evidence of emergent groundwater or seasonally elevated watertable conditions
- Sample 46 - 1.5m
Clay - 7%
Silt - 57%
Sand - 36%
- Sample 47 - 3.0m
Clay - 0%
Silt - 51%
Sand - 49%

VISUAL BOREHOLE LOGS**Completed March 5, 20 and 21, 2008****BOREHOLE DEPTH (m) MATERIALS**

MW4	0 - 0.3	dark brown cultivated TOPSOIL
(March 5)	0.3 - 3.2	light brown, compact, dry SAND TILL with traces of silt
	3.2 - 22.9	grey, compact, dry silty SAND TILL with traces of clay
	22.9 - 28.7	brown, loose, wet SAND with some silt
• Borehole mainly stable and dry, base unstable and wet upon completion • 5.1cm-diameter PVC monitor installed, with a 3.0m length of #10 slot screen set from 25.7 to 28.7m. • Water level March 24, 2008 - 23.71m below grade. • Sample 48 - 1.5m Clay - 0% Silt - 3% Sand - 97% • Sample 49 - 3.0m Clay - 6% Silt - 31% Sand - 63%		

For MW1, MW2 and MW3 - See water well records prepared by Allan Wright Water Wells

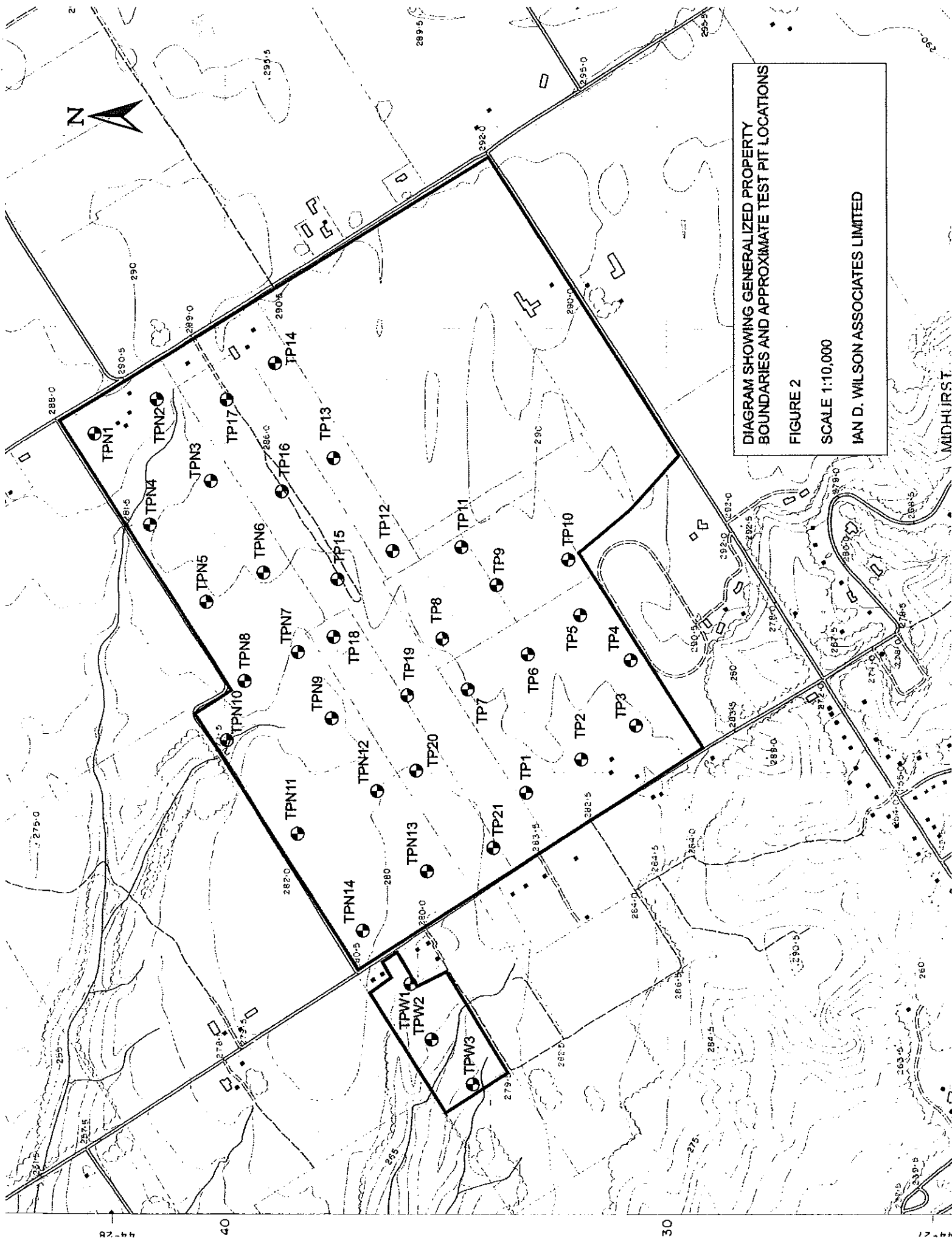


DIAGRAM SHOWING GENERALIZED PROPERTY
BOUNDARIES AND APPROXIMATE TEST PIT LOCATIONS

FIGURE 2

SCALE 1:10,000

IAN D. WILSON ASSOCIATES LIMITED