



City of London

Boler Mountain Land Status Report

Prepared by North-South Environmental Inc.

In collaboration with Parish Geomorphic and R.J. Burnside Ltd

November 2012

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CITY OF LONDON

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Boler Mountain Land Status Report
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1.0 INTRODUCTION

1.1 Project Goals and Objectives

Boler Mountain is an important natural and recreation area within the City of London. Lands associated with Boler Mountain are currently identified as Environmental Review Lands on Schedule A and as Potential ESA on Schedule B-1 (maps 4 and 7) of the Official Plan. These designations are implemented through the Open Space and Environmental Review Zones through Zoning By-Law 2-1 (see Figure 1).

The purpose of a Subject Lands Status Report is to assess the ecological features and functions of unevaluated vegetation patches generally identified as Environmental Review Lands in order to determine their significance, to assign appropriate management zones, to assess natural and human-generated disturbances, and to identify management needs. The City of London retained North-South Environmental Inc. in 2011 to complete a Subject Lands Status Report for the Boler Mountain property and adjacent city owned and privately owned lands

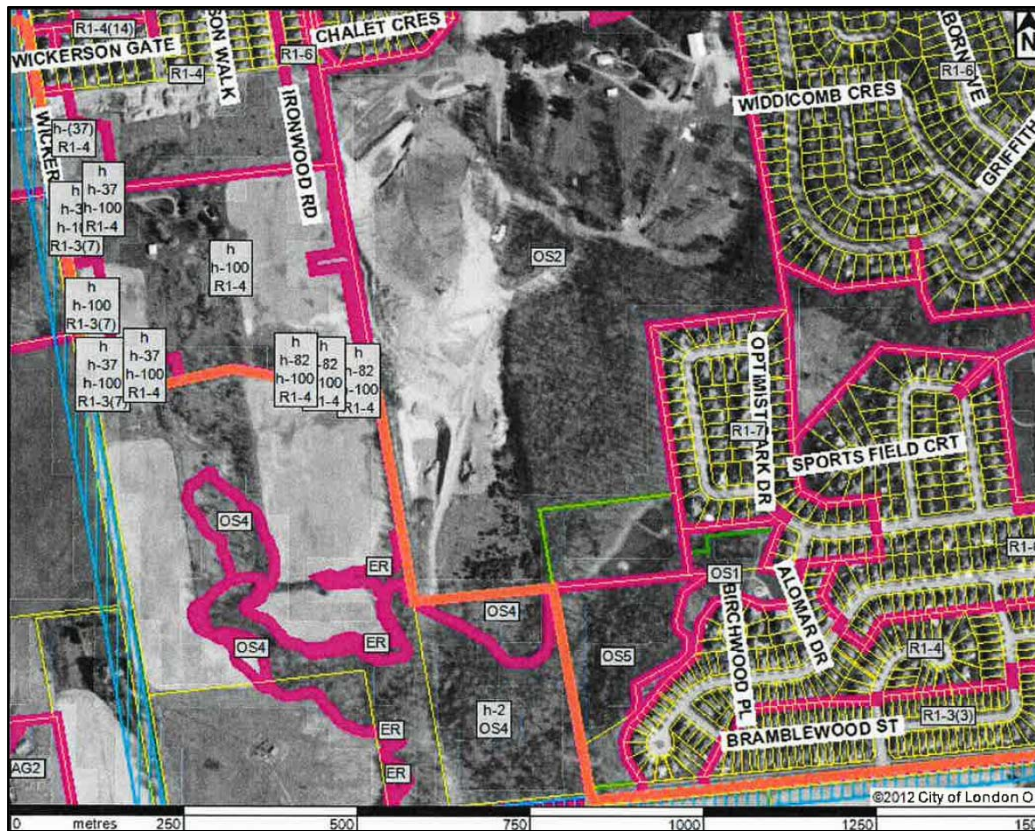
Other planning and development initiatives are occurring within and around Boler Mountain and these have been considered in the Subject Land Status Report. The recreation facility known as Boler Mountain has initiated a new strategic fifteen year business planning program in order to revisit the potential for the future development of Boler Mountain as a community recreational resource. To complete this planning work Boler Mountain is working with the City to carry out the required environmental studies. The City of London has identified a conceptual pathway alignment through the Boler Mountain lands to complete a linked system in Byron as part of the City's walking and cycling pathway system. And future development west of Boler Mountain requires a stormwater management facility adjacent to the Environmental Review lands.

Objectives of the Land Status report are to provide a preliminary assessment of the natural features on the subject lands and to evaluate the significance of the lands designated Environmental Review on Schedule A according to criteria set out in Section 15.4 of the Lands Status Report Guidelines for specific components of the Natural Heritage System. The purpose of a Lands Status Report is to provide the necessary technical information to enable the appropriate land use designation of the subject Environmental Review Lands.

The purpose of this report is to provide the necessary technical information to support the appropriate designation of the subject Environmental Review Lands and to apply the City's new Planning and Design Standards for Trails in Environmentally Significant Areas (London 2012). The scope of field work and analysis completed was comprehensive and included a complete inventory of birds and plants, Ecological Land Classification, fish habitat assessment, rapid geomorphic survey of watercourses, and mapping of existing uses including formal and informal trails. Based on an analysis of data collected through fieldwork observations, recommendations have been made regarding the ESA boundary, ESA management zones, present and future trail management, access roads, ecological restoration, and the possible construction of a stormwater management pond.



Figure 1. City of London Zoning for Boler Mountain Study Area.



1.2 Study Tasks

The following tasks were undertaken in order to complete the Subject Lands Status Report:

1. **Information gathering:** all relevant data and report information were obtained and incorporated into the data set used to assess the Environmental Review lands;
2. **Field investigations:** field investigation and data collection following the City of London Data Collection Standards for Natural Areas was completed;
3. **Assessment of significance:** an assessment of the significance of the ecological features and functions of the Environmental Review lands was completed, and the City of London's Environmentally Significant Areas (ESA) Criteria and Boundary Delineation Guidelines were applied to the Boler Mountain study area.
4. **Boundary delineation and mapping:** the boundary of the natural features was accurately delineated and clearly mapped.
5. **Assignment of designations:** appropriate designation of the Environmental Review lands was determined, including a recommended ESA boundary based on the City of London Guidelines Documents for Environmentally Significant Areas Identification, Evaluation and Boundary Delineation (London 1997) and management zones based on the City of London draft Planning and Design Standards for Trails in Environmentally Significant Areas (London 2012).
6. **Documentation and reporting:** a Subject Lands Status Report has been prepared to document the findings of the study, application of evaluation criteria and guidelines, mapping, and recommendations regarding appropriate designation of the subject lands.



2.0 STUDY AREA

The study area was identified at the outset with City Staff to look at natural areas north of Southdale Road West and west of Wickerson Road. The study area is indicated of Figure 2. The study area for this Lands Status Report includes the Boler Mountain property and adjacent lands, including portions of the Dingman Creek ESA. The Lower Dingman Corridor ESA is located to the south and west of the study area. Lower Dingman Corridor is adjacent to the Dingman Creek west of Lambeth. It contains a Provincially Significant Wetland complex, very diverse assemblage of natural communities and species and provides an important linkage function.

3.0 DATA COLLECTION AND ANALYSIS METHODS

3.1 Field Inventory Program

The following table (Table 1) provides details on the field inventory program including the periods when field work was conducted for each species group. For all taxa, locations of significant species were recorded with a hand-held GPS receiver (Garmin-76CSx, generally accurate to within a few metres), and/or recorded on an aerial photograph (if the location could not be reached, for example for birds heard in areas where access was not permitted).

In addition to targeted species inventories and wildlife habitat assessment, additional field work was conducted to record information relevant to the development of appropriate zones for a Land Status Report including:

- Confirmation of existing ELC Vegetation Type through a field assessment of the dominant species present within each vegetation polygon.
- Confirmation of existing ELC vegetation polygons and the Dingman Creek ESA boundary through a field assessment of:
 - the boundaries between vegetation polygons;
 - the boundaries between areas of vegetation and areas of development; and
 - areas of successional vegetation and/or restoration/naturalization.
- Mapping of the existing formal and informal trails present.
- Detailed documentation of human impacts recording the type, extent and location within the study area. To ensure an accurate record of disturbances was captured, a disturbance data sheet was used, photographic records were made and locations were recorded using a handheld GPS device and manually on orthoimagery.

Table 1. Field survey dates (2011 and 2012) and primary purpose of field visit.

Species Group	Sampling Periods and Primary Purpose
Mammals	• March-August – incidental surveys conducted during all site visits
Breeding Birds	• July 1 st and July 12 th 2011, and May 24 th 2012 to record calls/sightings for breeding birds
Fish	• August 18 th , 2011 site walk for aquatic habitat assessment



Species Group	Sampling Periods and Primary Purpose
Reptiles	<ul style="list-style-type: none"> April-August – incidental surveys conducted during all site visits
Amphibians - salamanders	<ul style="list-style-type: none"> March 13th 2012 survey conducted for breeding habitat in ponds May-August – incidental surveys for upland habitat (under logs) during all site visits
Amphibians – frogs	<ul style="list-style-type: none"> April 23rd 2012 – early spring surveys for breeding habitat in ponds May 15th 2012 – mid-spring surveys for breeding habitat in ponds incidental surveys (during breeding bird and spring flora inventories) for bullfrogs
Flora Inventory	<ul style="list-style-type: none"> April 23rd and May 15th 2012 – surveys of all sites to record spring ephemerals August 3rd and 4th, 2011 – one survey of all sites during peak growing season to collect floral species lists and complete Ecological Land Classification vegetation community mapping
Butterflies	<ul style="list-style-type: none"> July-August – incidental surveys conducted during all site visits
Dragonflies & Damselflies	<ul style="list-style-type: none"> July-August – incidental surveys conducted during all site visits

3.2 Ecological Land Classification Methods

Vegetation communities were classified using standard ELC methods developed by the Ontario Ministry of Natural Resources (OMNR) for southern Ontario (Lee *et al.* 1998). Physical characteristics, stand descriptions and dominant species were recorded. Remarks on natural disturbances (*e.g.*, evidence of flooding) and significant wildlife habitat were made and threats from human-made disturbances (*e.g.*, tracks and trails) were noted if encountered. Assessment of recreation and resource management issues was also considered. Information on soils was collected with a Dutch auger.

Terminology used to describe each of the vegetation communities in Section 4.1 below is based on ELC sampling protocols that collect information on four vegetation layers in each community. Some layers may not be present within a vegetation community sampled. The four layers are:

1. **Canopy:** The canopy consists of tall vegetation which reaches the light first; typically composed of tall trees (in a forest community).
2. **Sub-canopy:** The sub-canopy includes vegetation growing just under the canopy: vegetation that receives filtered sunlight through the canopy; typically composed of trees and tall shrubs (in a forest community).
3. **Understory:** The understory is the vegetation growing below the sub-canopy; typically composed of both tall and low-growing shrubs.
4. **Ground:** The ground layer is the layer of vegetation which is closest to, and covering, the ground; typically composed of herbaceous vegetation.



3.3 Vegetation Data Collection Methods

An inventory of spring ephemerals (those plants that flower just as soils thaw and then die back before summer) was completed on April 23rd and May 15th, 2012. Full inventories of trees, shrubs, ground flora and soil sampling were completed on August 3 and 4. Floral lists were recorded for each vegetation community polygon, and relative abundances of each plant species were recorded for each layer.

Global Positioning System (GPS) points were recorded for the locations of provincially and regionally significant species, as well as significant wildlife habitat, such as vernal pools. The GPS units used are accurate to 2-3 m. In instances where GPS readings were not accurate (*e.g.*, under a closed canopy within a forest), approximate locations of rare species were mapped on an aerial photograph. The abundance and distribution of each significant flora species was recorded (for example, whether it was widespread or scattered, or localized to one or two clumps). Surveys were conducted to ensure locations of flora (and fauna) were accurate and fully documented.

The Natural Heritage Information Centre (NHIC) database was queried to determine the locations of previously recorded rare and significant species in the vicinity of the study area. These species were recorded and referenced prior to completing fieldwork. Regional and local rarity statuses for vascular plants were reviewed prior to completing fieldwork as well. Vascular plant rarity in southwestern Ontario is based on Oldham 1993, and in Middlesex County is based on Bowles 2005. Table 2 presents a summary of rare species records from NHIC recorded in the last 20 years.

Table 2. Summary of rare species records from NHIC

Scientific Name	Common Name	G-rank	S-rank	COSEWIC	SARO	Last Observed Date
<i>Taxidea taxus</i>	American Badger	G5	S2	END	END	07/06/2009
<i>Argia tibialis</i>	Blue-tipped Dancer	G5	S3			28/06/2000
<i>Cornus florida</i>	Eastern Flowering Dogwood	G5	S2?	END	END	22/05/1992

Small collections of plants were made if a species was difficult to identify (for example, sedges and grasses). However, species considered Species at Risk (SAR) or potential SAR were not collected. Instead, photographs were taken for later identification and verification.

3.4 Fauna Surveys

3.4.1 Breeding Bird Survey Methods

Breeding bird surveys were conducted at Boler Mountain in 2011 and 2012, spanning three dates: 1st July and 12th July, 2011 and May 24th, 2012. These survey periods encompassed the later portion of the breeding bird survey window in 2011 and the early portion of the breeding bird survey window in 2012 (as defined by the Canadian Wildlife Service Forest Bird Monitoring Program). Due to the date the study commenced, surveys during the earlier period



recommended for breeding bird surveys (May 24th to June 10th) were not conducted in 2011. Follow-up breeding bird surveys were completed on May 24th in 2012. All visits were conducted in fair weather with little wind, as recommended by CWS protocols.

NSE conducted limited fauna surveys within the southern portion of the Boler Mountain property in 2004 as part of the London Woodlands study (North-South Environmental 2009).

Surveys were focused on obtaining evidence of at least possible breeding for bird species, but higher levels of breeding evidence were sought wherever possible. Breeding status was assessed as follows (Ontario Breeding Bird Atlas 2001):

“Possible breeding” is indicated by the presence of a singing male in suitable habitat or the presence of a bird in suitable breeding habitat.

“Probable breeding” is defined as an observation of any of the following: (1) a pair in breeding season in suitable habitat, (2) permanent territory presumed through registration of territorial song on at least two days, a week or more apart, at the same place or (3) courtship or display between a male and a female or two males, including courtship feeding or copulation; visiting probable nest site; agitated behaviour or anxiety calls of an adult; brood patch on an adult female or cloacal protuberance on an adult male; nest building or excavation of a nest hole.

“Confirmed breeding” is defined (Ontario Breeding Bird Atlas 2001) as observation of any of the following: (1) a distraction display or injury feigning; (2) used nest or egg shell found (occupied or laid within the period of the study); (3) recently fledged young or downy young, including young incapable of sustained flight; (4) adults entering or leaving nest site in circumstances indicating occupied nest (e.g., adult carrying fecal sac; adult carrying food for young), or (5) nest containing eggs, or nest with young seen or heard.

3.4.2 Amphibian Survey Methods

Site surveys were conducted in the early spring (March 13, April 23, May 8 and 15, 2012), a time conducive to detecting forest amphibian breeding (e.g., mole salamanders such as Spotted Salamander, and frogs such as Spring Peeper, Wood Frog and Gray Treefrog). Frog surveys were conducted between dusk and approximately midnight, on nights with little wind and mild temperatures, as recommended by Canadian Wildlife Survey protocols. Amphibian abundance was estimated using call codes developed by the Canadian Wildlife Service for the Ontario Marsh Monitoring Program (CWS 2008). Abundance codes are as follows:

Code 1: individuals can be counted; calls not simultaneous

Code 2: calls distinguishable, some simultaneous calling

Code 3: full chorus; calls continuous and overlapping

Mole salamander surveys were conducted by searching for breeding salamanders in suitable pools during the earliest spring visit (March 13). Ponds were subsequently searched during daylight hours for egg masses.



3.4.3 *Incidental Wildlife Observations*

During all vegetation surveys, logs and fallen debris were over-turned to determine if animals that inhabit rotting logs such as Eastern Red-backed Salamander (as well as snakes) were present at the site. Records of animals for which presence was determined from signs, tracks, and scat were also recorded during all visits.

3.5 **Fluvial Geomorphic Assessment**

During the site visit (August 2010), the entire study reach was walked and Rapid Assessments (Rapid Geomorphic Assessment and Rapid Stream Assessment Technique) completed. A Rapid Geomorphic Assessment documents observed indicators of channel instability (MOE, 1999). Observations are quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel widening and planimetric adjustment. The index produces values that indicate whether the channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40) or adjusting (score >0.41).

An RSAT (Rapid Stream Assessment Technique) provides a broader view of the system by also considering the ecological functioning of the stream (Galli, 1996). Observations include instream habitat, water quality, riparian conditions, and biological indicators. Additionally, the RSAT approach includes semi-quantitative measures of bankfull channel dimensions, type of substrate, vegetative cover, and channel disturbance. RSAT scores rank the channel as maintaining a low (<20), moderate (20-35) or high (>35) degree of stream health.

3.6 **Data Analysis and Mapping**

Data were entered into a Microsoft Access database and species lists and observation records were compiled. Community descriptions were summarized and an appropriate ELC description was assigned to each vegetation community. Floristic Quality Index (FQI) (Oldham *et al.* 1995), Native Mean Coefficient of Conservatism (Native Mean C), and percentages of native and non-native species composition were calculated for each vegetation community. FQI, a measure of both habitat conservatism and species richness and thus an indicator of vegetation quality, is the average CC divided by the square root of the number of plant species in the community (Oldham *et al.* 1995). CC is a measure of a plant's specificity of habitat requirements, with a coefficient of 0 indicating a plant tolerant of a wide range of conditions and 10 indicating a plant that has the most specific habitat requirements. Mean CC is thus a measure of the habitat requirements of a plant community. For example, remnant patches of natural habitat in urban areas in Ontario, such as the City of London, typically have FQIs in the 15-30 range. FQIs of 40-45 are fairly high for agricultural landscapes. A mean C under 40 indicates that the site is primarily vegetated with adaptable species that can withstand a variety of habitat changes. Areas with high coefficients (higher than 4) are likely to be more sensitive to disturbance, for example, a change in water regime, influx of non-native species or canopy disturbance.

Species lists were screened for provincial, regional and local significance. Provincial floral and faunal rarity was based on rankings provided by the NHIC (identified as S1-S3) or species identified as endangered, threatened or special concern by COSEWIC1 and/or COSSARO2.

1 Nationally rare species are designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and are subject to the Federal Species at Risk Act.



Regional floral rarity is based on listings provided by Oldham (1993), and local floral rarity is based on listings provided by Bowles (2005).

Regional faunal significance was determined using Priority Landbird Species in Ontario Bird Conservation Region (BCR) 13 identified by Ontario Partners in Flight (Ontario Partners in Flight 2005), which identified priority species based on the following priority categories:

- continental concern;
- regional concern;
- continental stewardship;
- regional stewardship;
- at risk – Canada;
- at risk – Ontario; and
- Management Interest.

In this case, BCR 13 is considered the region. Fauna area-sensitivity was based on species reported as area-sensitive in the Ministry of Natural Resources Significant Wildlife Habitat Technical Guide Appendix C (OMNR 2000).

Delineated natural area boundaries and vegetation community boundaries were digitized to create shape files (in GIS NAD83, UTM zone 17). Figure 2 shows the vegetation community and natural area boundaries overlaying an aerial photograph base. Following the digitization exercise, trails, management issues and significant species were mapped.

² Provincially rare species are designated by the Committee on the Status of Species at Risk in Ontario (COSSARO) and are subject to the Ontario Endangered Species Act.



4.0 RESULTS OF NATURAL HERITAGE INVENTORY

4.1 Ecological Land Classification

Nineteen vegetation communities are present within the study area including a variety of forest, wetland, and cultural communities. Each of these communities is shown on Figure 2 and they are described below, the floral and faunal species recorded in each community is provided in Appendix 1 and 2 respectively.

4.1.1 Forested Vegetation Communities

Dry-Fresh Deciduous Forest Ecosite (FOD4)

This deciduous forest is located on valley slopes in the central portion of the study area, leading down to the laneway which bisects the site. The canopy is dominated by Bitternut Hickory (*Carya cordiformis*), White Ash (*Fraxinus americana*), Sugar Maple (*Acer saccharum*), and Black Walnut (*Juglans nigra*). The eastern half of this community is more heavily dominated by hickory, and the western half is more heavily dominated by Black Walnut. The canopy layer is between 10-25 m in height and covers greater than 60% of the community. The sub-canopy is dominated by Bitternut Hickory, White Ash, Basswood (*Tilia americana*) and Black Walnut. This layer is between 2-10 m in height and covers between 25-35% of the community. The understory consists of Hawthorn (*Crataegus spp.*), European Buckthorn (*Rhamnus cathartica*), Riverbank Grape (*Vitis riparia*) and Choke Cherry (*Prunus virginiana*). This layer is between 1-2 m in height and covers between 10-25% of the community. The ground layer is dominated by Enchanter's Nightshade (*Circaea lutetiana*), Yellow Avens (*Geum aleppicum*), and Jack-in-the-Pulpit (*Arisaema triphyllum*). This layer is between 0.5-1 m in height and covers greater than 60% of the community. Large patches of silt were located with this community which appears to have eroded from the adjacent agricultural field. Bike trails are present throughout the eastern half of this community.

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

This deciduous forest is located on valley slopes centrally within the study area as well as along the eastern and southwestern sides of the study area. Sugar Maple dominates the canopy with a lesser abundance of Shagbark Hickory (*Carya ovata*) and the rare occurrence of White Oak (*Quercus alba*), Black Cherry (*Prunus serotina*), and Red Oak (*Quercus rubra*). The canopy is 10-25 m in height and these trees cover greater than 60% of the forest community. The sub-canopy is also dominated by Sugar Maple with a lesser abundance of Hop Hornbeam (*Ostrya virginiana*), White Ash, and Shagbark Hickory. This layer is 2-10 m in height and covers greater than 60% of the community. The understory vegetation is 1-2 m in height and covers greater than 60% of the community. Sugar Maple also dominates the understory layer with an occasional occurrence of European Buckthorn (*Rhamnus cathartica*), and a lesser abundance of Hawthorn species (*Crataegus sp.*). The ground layer is completely vegetated (>60% cover of species 0.2-0.5 m in height) mainly dominated by Sugar Maple with a lesser abundance of Running Strawberry Bush (*Euonymus obovata*), Poison Ivy (*Rhus rhydbergii*), Herb Robert (*Geranium robertianum*), Garlic Mustard (*Alliaria petiolata*), Jack-in-the-pulpit, and Mayapple (*Podophyllum peltatum*).



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

This deciduous forest is located on rolling upland, south of the ski hill as well as at the southern edge of the study area. Sugar Maple dominates the canopy with a lesser abundance of Red Oak, Shagbark Hickory, Black Cherry, White Ash, and the rare occurrence of White Oak. The canopy is 10-25 m in height and these trees cover greater than 60% of the forest community. The sub-canopy is also dominated by Sugar Maple with a lesser abundance of Hop Hornbeam, Shagbark Hickory, American Beech (*Fagus grandifolia*), and Black Cherry. Associate sub-canopy species that are rare in occurrence include Red Maple (*Acer rubrum*), Basswood (*Tilia americana*), and White Ash. This layer is 2-10 m in height and covers greater than 60% of the community. The understory vegetation is 1-2 m in height and covers greater than 60% of the community. Such understory vegetation includes: Sugar Maple, White Ash, Choke Cherry (*Prunus virginiana*), Riverbank Grape (*Vitis riparia*), Tartarian Honeysuckle (*Lonicera tatarica*). The ground layer is densely vegetated (>60% cover of species <0.2 m in height) with a variety of species such as: Enchanter's Nightshade, Sugar Maple, Maple-leafed Viburnum (*Viburnum acerifolium*), Choke Cherry, Southern Arrow-wood (*Viburnum recognitum*), False Solomon's Seal (*Maianthemum racemosum*), and White Baneberry (*Actaea pachypoda*).

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

This deciduous forest is located on valley slopes along the southern and southeastern side of the study area. Sugar Maple dominates the canopy with a lesser abundance of White Ash and the occasional Basswood and American Beech. The canopy is 10-25 m in height and these trees cover greater than 60% of the forest community. The sub-canopy is also dominated by Sugar Maple with a lesser abundance of White Ash, Hop Hornbeam, and Sweet Cherry (*Prunus avium*). Associate sub-canopy species that are rare in occurrence include Horse Chestnut (*Aesculus hippocastanum*), Black Cherry, Red Oak, American Beech, and European Buckthorn. This layer is 2-10 m in height and covers greater than 60% of the community. The understory vegetation is 1-2 m in height and covers 35-60% of the community. Such understory vegetation includes: Sugar Maple, Green Ash (*Fraxinus pennsylvanica*), White Ash, and Horse Chestnut. The ground layer is moderately vegetated (between 35-60% cover of species 0.2-0.5 m in height) with a variety of species such as: Garlic Mustard, Jack-in-the-pulpit, Lady Fern (*Athyrium filix-femina*), and Wild Crane's-bill (*Geranium maculatum*).

Fresh – Moist Sugar Maple – Black Maple Deciduous Forest Type (FOD6-2)

This community is listed as a Vulnerable (S3?) vegetation community by the Natural Heritage Information Centre (NHIC). According to NHIC, S3 communities are vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation. This deciduous forest is located on valley slopes along the southeastern side of the study area. Sugar Maple dominates the canopy with a lesser abundance of Black Maple, White Ash, Hop Hornbeam, and Shagbark Hickory. The canopy is 10-25 m in height and these trees cover greater than 60% of the forest community. The sub-canopy has a similar distribution of species abundances also with the occasional American Beech and the rare occurrences of European Buckthorn, Red Maple, Witch Hazel (*Hamamelis virginiana*), and Black Cherry. This layer is 2-10 m in height and covers greater than 60% of the community. The understory vegetation is 1-2 m in height and covers 35-60% of the community. Such understory vegetation includes: Sugar Maple, Shagbark Hickory, and American Beech. The ground layer is completely vegetated (>60% cover of species 0.2-0.5 m in



height) with a variety of species such as: White Trillium (*Trillium grandiflorum*), Winged Burning Bush (*Euonymus alata*), Mayapple, Running Strawberry Bush (*Euonymus obovatus*), Herb Robert (*Geranium robertianum*), Jack-in-the-pulpit, Kidney-leaved Buttercup (*Ranunculus abortivus*), and Virginia Strawberry (*Fragaria virginiana*).

Fresh-Moist Black Walnut Lowland Deciduous Forest / Mineral Cultural Woodland Ecosite (FOD7-4 / CUW1)

This community is located along moist slopes leading down to the stream which passes through the western portion of the site. The canopy is dominated by Black Walnut, which appears to have been planted in evenly spaced distances throughout the community. Bitternut Hickory, Green Ash and Black Cherry are also present in the canopy, but to a much lesser extent. The canopy is between 10-25 m in height, and covers approximately 60% of the community. Some areas are much more open than others and would more accurately be described as cultural woodland than forest. The sub-canopy consists of Black Walnut, Basswood, Green Ash and Bitternut Hickory. This layer is between 2-10 m in height, and covers between 25-35% of the community. The understory is dominated by European Buckthorn and Virginia Creeper, with occasional Riverbank Grape and Gray Dogwood (*Cornus foemina* ssp. *racemosa*). The understory was very dense in place and was predominantly covered by European Buckthorn. This layer is between 1-2 m in height and covers between 25-35% of the community. The ground layer consists of Garlic Mustard, Virginia Knotweed (*Polygonum virginianum*), Enchanter's Nightshade and Canada Goldenrod. This layer is between 0.5-1 m in height and covers greater than 60% of the community. Tree cutting was observed within the eastern half of this community, and numerous trails were noted throughout this community.

Fresh-Moist Oak-Maple-Hickory Deciduous Forest Ecosite (FOD9)

This community is located at the base of a slope at the south edge of the site. A super-canopy of Red Oak and White Oak towers over a canopy dominated by Bitternut Hickory, Shagbark Hickory, Black Maple, and Black Cherry. The canopy is 10-25 m in height and covers greater than 60% of the forest community. The sub-canopy is dominated by Bitternut Hickory, Hop Hornbeam, White Ash, and Blue Beech (*Carpinus caroliniana*). This layer is 2-10 m in height and these covers between 35-60% of the community. The understory vegetation is 1-2 m in height and covers between 10-25% of the community. Understory vegetation includes Choke Cherry (*Prunus virginiana*), European Buckthorn, Manitoba Maple (*Acer negundo*), and High-bush Cranberry (*Viburnum trilobum*). The ground layer is densely vegetated (>60% cover of species 0.2-0.5 m in height), including Running Strawberry-bush (*Euonymus obovata*), Enchanter's Nightshade, False Solomon's Seal, and Wild Crane's-bill.

Dry-Fresh Poplar Mixed Forest Type / Scotch Pine Coniferous Plantation Type (FOM5-2 / CUP3-3)

The mixed forest/cultural plantation is located on tableland at the north end of the study area. Scotch Pine (*Pinus sylvestris*), Trembling Aspen (*Populus tremuloides*), Black Walnut, Black Cherry, and Red Oak. The canopy is 10-25 m in height and these trees cover 35-60% of the forest community. The sub-canopy is also dominated by European Buckthorn, Black Walnut and Sugar Maple. This layer is 2-10 m in height and covers greater than 60% of the community. The understory vegetation is 1-2 m in height and covers greater than 60% of the community. Such understory vegetation includes: European Buckthorn, Choke Cherry, Tartarian



Honeysuckle, Sugar Maple and Staghorn Sumac (*Rhus typhina*). The ground layer is densely vegetated (>60% cover of species 0.2-0.5 m in height) with a variety of species such as: Enchanter's Nightshade (*Circaea lutetiana*), Poison Ivy, False Solomon's Seal, Riverbank Grape, Garlic Mustard, and Herb Robert.

4.1.2 Wetland Vegetation Communities

Cattail Mineral Shallow Marsh Type (MAS2-1)

This community is located in the northwest corner of the site along an intermittent watercourse that drains to the south. The canopy of this community is dominated by Narrow-leaved Cattail (*Typha angustifolia*), which is between 1-2 m in height and covers 35-60% of the community. The understory consists of Swamp Milkweed (*Asclepias incarnata*), Spotted Joe-pye Weed (*Eupatorium maculatum* ssp. *maculatum*), Dark Green Bulrush (*Scirpus atrovirens*), and Purple Loosetrife (*Lythrum salicaria*). This layer is between 0.5-1 m in height and covers greater than 60% of the community. The ground layer consists of American Bugleweed (*Lycopus americanus*) and Canada Clearweed (*Pilea pumila*). This layer is between 0.2-0.5 m in height and covers between 10-25% of the community. A few small pools of standing water were still present within this community in August.

Green Ash Mineral Deciduous Swamp Type / Forb Mineral Meadow Marsh Type (SWD2-2 / MAM2-10)

This vegetation community complex is located along the watercourse located in the western portion of the site. The canopy of this community is dominated by Green Ash, Hybrid Willow (*Salix x rubens*), and Black Walnut. This layer is between 10-25 m in height and covers greater than 60% of the community. The sub-canopy consists of Green Ash and Manitoba Maple, and is between 2-10 m in height and covers between 25-35% of the community. The understory consists of willow (*Salix* spp.), Gray Dogwood, Manitoba Maple and Green Ash saplings. This layer is between 1-2 m in height and covers between 25-35% of the community. Portions of this community are heavily dominated by Gray Dogwood. The ground layer consists of Spotted Joe-pye Weed, Spotted Jewelweed (*Impatiens capensis*), Rice Cutgrass (*Leersia oryzoides*), Panicked Aster (*Symphotrichum lanceolatum*), and Reed Canary Grass (*Phalaris arundinacea*). This layer ranges in height between 0.5-1 m and covers greater than 60% of the community.

4.1.3 Cultural Vegetation Communities

Hedgerow / Mineral Cultural Woodland Ecosite (H / CUW1)

This community is located near the northwest corner of the site, near the farm laneway and existing barn structure. This community consists of a hedgerow which has expanded to the north (away from the laneway which is located to the south of the hedgerow), forming a hedgerow and cultural woodland complex. The canopy of this community is dominated by Trembling Aspen, Green Ash, Manitoba Maple and Sweet Cherry (*Prunus avium*) which are between 10-25 m in height and cover between 35-60% of the community. The sub-canopy consists of Trembling Aspen, Green Ash and Manitoba Maple which are between 2-10 m in height and cover between 25-35% of the community. The understory is dominated by Manitoba Maple saplings, European Buckthorn, Common Lilac (*Syringa vulgaris*), and Tartarian Honeysuckle (*Lonicera tatarica*). This layer is between 1-2 m in height and covers between 35-60% of the community. The



ground layer consists of dense mats of Riverbank Grape, Canada Goldenrod, and Trumpet Creeper (*Campsis radicans*) (which was planted in the hedgerow). This layer is between 0.5-1 m in height and covers greater than 60% of the community.

Mineral Cultural Meadow Ecosite / Mineral Cultural Savannah Ecosite (CUM1 / CUS1)

This vegetation community is located on tablelands surrounding the watercourse which runs through the western portion of the site. The sparse canopy consists of young Black Walnut and Trembling Aspen with some hawthorn shrubs. This layer is between 2-10 m in height and covers between 10-25% of the community. The ground layer consists of Canada Goldenrod, Birds-foot Trefoil (*Lotus corniculatus*), Wild Carrot (*Daucus carota*), and Meadow Timothy (*Phleum pratense*). This layer is between 0.5-1 m in height and covers greater than 60% of the community. This vegetation community appears to have regenerated from previous agricultural uses.

Mineral Cultural Thicket Ecosite (CUT1)

This vegetation community is located in the central portion of the site, south of the Ski Hill Development Area (refer to Figure 2). The canopy is dominated by European Buckthorn, with some hawthorn, Riverbank Grape, and Gray Dogwood. This layer is between 1-2 m in height and covers between 25-35% of the community. The ground layer is dominated by cultural meadow species, such as Canada Goldenrod, Short-fringe Starthistle (*Centaurea nigra*), Field Basil (*Clinopodium vulgare*), and Birds-foot Trefoil. This layer is between 0.5-1 m in height and covers greater than 60% of the community. Several bike trails are present in this community.

Coniferous Plantation (CUP3)

A young coniferous plantation is located in the central portion of the site, south of the Ski Hill Development Area (refer to Figure 2). The canopy of this community is dominated by young White Pine (*Pinus strobus*) which is between 2-10 m in height and covers between 35-60% of the community. The understory is dominated by European Buckthorn and hawthorn, which are between 1-2 m in height and cover between 25-35% of the community. The ground layer consists of cultural meadow species, such as Short-fringe Starthistle, Canada Goldenrod, Birds-foot Trefoil and Panicked Aster. This layer is between 0.5-1 m in height and covers greater than 60% of the community.

Scotch Pine Coniferous Plantation Type (CUP3-3)

This plantation type is located to the east of the ski hill. This small community consists of rows of Scotch Pine trees which have been planted. These trees are 10-25 m in height and cover greater than 60% of the community. There is no sub-canopy or understory. The ground layer is routinely mowed.

Mineral Cultural Meadow Ecosite / Mineral Cultural Thicket Ecosite (CUM1 / CUT1)

This vegetation community is located along Southdale Road West at the southern edge of the site, and extends from the hedgerow into the agricultural field. This canopy of this community is dominated by Staghorn Sumac (*Rhus typhina*). This layer is between 1-2 m in height and covers between 35-60% of the community. The ground layer consists of cultural meadow species, such as Canada Goldenrod, Birds-foot Trefoil, Awnless Brome (*Bromus inermis*), and Canada Thistle



(*Cirsium arvense*). This layer is between 0.5-1 m in height and covers greater than 60% of the community.

Mineral Cultural Meadow Ecosite (CUM1)

This cultural meadow community is located around the edge of a storm water management pond, as well as to the south of the ski hill development area and a small community is located at the south end of the study area, adjacent to Southdale Road. The canopy (*i.e.* trees >10m in height) is open (<10% cover) with the rare occurrence of trees such as Eastern Cottonwood (*Populus deltoides*), Basswood, Freeman's Maple (*Acer x freemanii*), Sugar Maple, and Green Ash. Sub-canopy trees (2-10m in height) were also sparse (25-35% cover) and includes species such as Sandbar Willow (*Salix exigua*), Beaked Willow (*Salix bebbiana*), and European Buckthorn. The understory vegetation is 1-2 m in height and covers greater than 60% of the community. Such understory vegetation includes: Canada Goldenrod (*Solidago canadensis*), Flat-top Fragrant-goldenrod (*Euthamia graminifolia*), Orchard Grass (*Dactylis glomerata*), Meadow Timothy (*Phleum pratense*), Wild Carrot (*Daucus carota*), and Riverbank Grape. The ground layer is completely vegetated (>60% cover of species 0.2-0.5 m in height) with a variety of species such as: Great Ragweed (*Ambrosia trifida*), English Plantain (*Plantago lanceolata*), Colt's Foot (*Tussilago farfara*), and Panicked Aster.

Mineral Cultural Woodland/Savannah Ecosite (CUW1/CUS1)

This cultural woodland/savannah is located along a hedgerow located between residential housing and a recreational park at the east end of the study area. This area is highly disturbed, and has high edge-to-interior ratio. The canopy layer is 10-25 meter in height and is mostly open (35-60% cover) mainly consisting of Manitoba Maple, White Ash, and Norway Maple (*Acer platanoides*) with a lesser abundance of Black Walnut, and Black Spruce (*Pinus nigra*). The sub-canopy mainly consists of Manitoba Maple (*Acer negundo*), and White Ash with a lesser abundance of Black Walnut. This layer is 2-10 m in height and covers 35-60% of the community. The understory vegetation is 1-2 m in height and covers 10-25% of the community. Eastern White Cedar (*Thuja occidentalis*) is the dominant species in this layer with a lesser abundance of Forsythia (*Forsythia europaea*) and European Buckthorn. The ground layer is sparsely vegetated (1-10% cover of species <0.2 m in height) including species such as Common Mullein (*Actium minus*) Wild Carrot, Canada Goldenrod, Bittersweet Nightshade (*Solanum dulcamara*), Herb Robert, and Yellow Wood Sorrel (*Oxalis stricta*).

Mineral Cultural Woodland Ecosite (CUW1)

Cultural woodland is located on tableland and valley slopes at the north and south ends of the study area. The canopy layer is 10-25 meter in height and is mostly open (35-60% cover) consisting of Shagbark Hickory, White Ash, and Sugar Maple. The sub-canopy is dominated by Hawthorn species (*Crataegus sp.*), European Buckthorn, and a lesser abundance of Shagbark Hickory, Sugar Maple, Basswood, and Black Cherry. This layer is 2-10 m in height and covers greater than 60% of the community. The understory vegetation is 0.5-1 m in height and covers 35-60% of the community. Hawthorn species and European Buckthorn also dominate this layer. The ground layer is densely vegetated (>60% cover of species <0.2 m in height) with a variety of species such as Pennsylvania Sedge (*Carex pennsylvanica*), European Buckthorn, Poison Ivy, Wild Crane's Bill, Field Basil (*Clinopodium vulgare*), Heal-all (*Prunella vulgaris*), and Virginia Strawberry.



Hedgerow (H)

Hedgerow communities are found in numerous locations on the Boler Mountain ski hill, as well as one long hedgerow located to the west and southwest of the ski hill development area. These hedgerow communities vary in species composition, but are too small to be considered individually. The canopy layer of these communities is 10-25 meters in height with greater than 60% cover mainly consisting of Sugar Maple, Shagbark Hickory, Black Cherry, Basswood, Red Oak, White Oak, with a lesser abundance of Hop Hornbeam, Black Walnut, and White Ash. Some of the hedgerows have canopy trees of lower floristic quality including: Black Locust (*Robinia pseudo-acacia*), Manitoba Maple, with a lesser abundance of Scotch Pine (*Pinus sylvatica*). The sub-canopy consists mainly of Hop Hornbeam, Shagbark Hickory, Sugar Maple, and Manitoba Maple. This layer is 2-10 m in height with greater than 60% cover. The understory vegetation is 1-2 meters in height with greater than 60% cover and includes species such as Witch Hazel, European Buckthorn, Tartarian Honeysuckle, and Riverbank Grape. The ground layer is densely vegetated with greater than 60% cover at a height of 0.2-0.5 m. This layer is partly comprised of Pennsylvania Sedge (*Carex pennsylvanica*), Blue-stemmed Goldenrod (*Solidago caesia*), Smooth Brome (*Bromus inermis*), Riverbank Grape, Canada Mayflower (*Maianthemum canadense*), and Bladder Campion (*Silene vulgaris*).



Figure 2. Boler Mountain Ecological Land Classification, Significant Features and Environmental Concerns



4.1.4 Significant Vegetation Communities

According to provincial listings provided by the Natural Heritage Information Centre (NHIC), provincially significant vegetation communities do not occur at Boler Mountain. The NHIC assigns “subnational” (provincial) ranks (SRANKS) for species and vegetation communities in Ontario. These SRANKS parallel the global and national ranks, and also range from S1 (critically imperiled in Ontario) to S5 (secure in Ontario). SRANKS are not formal designations and do not confer any protection; however, SRANKS are used by COSSARO and other groups to set conservation priorities.

4.2 Flora

A total of 342 species of vascular plants were documented at Boler Mountain (Appendix 1). Twelve of those species were identified only to genus and were not included in the analysis. Consequently, the total number of species used for analysis was 330, and of these 230 (70%) species are considered native, and 100 (30%) species are considered non-native. The proportion of native plants present within this urban natural area is quite similar to the flora of Ontario as a whole, which has approximately 73% native plant species (Kaiser 1983).

The Floristic Quality Analysis in Table 3 summarizes the quality of the plant communities on the site, based on the ‘conservatism’ of the native plants found within them. Each plant species has been assigned a Coefficient of Conservatism (CC), a number between 1 and 10, that represents the degree of tolerance to disturbance and the specialized habitat requirements that a plant species requires to persist (Swink and Wilhelm 1979). Plant species that can live in a wide variety of habitats, including disturbed habitats, have low CC values, and include species such as Kentucky Bluegrass, Canada Goldenrod, and Red Raspberry (*Rubus idaeus ssp. strigosus*). Species that grow in a narrow range of habitat conditions are considered to be highly conservative and thus have high CC values. Examples of plant species in the study area with higher CC values include Male Fern (*Dryopteris felix-mas*), Canada Wild Onion (*Allium canadense*) and Poke Milkweed (*Asclepias exaltata*). The mean CC of a community, termed the ‘Native Mean C’, averages all CC scores for the natural species present and is used to calculate the Floristic Quality Index (FQI) of a habitat. FQI is calculated by summing the CC for all native plant species divided by the square root of the total number of native species present within a community ($FQI = \sum CC / \sqrt{N}$).

Table 3 summarizes the characteristics and quality of the plant communities found in the Boler Mountain study area based on the conservatism and origin of the plants found within them.



Table 3. Floristics of Boler Mountain. Vegetation communities have been grouped based on ELC community series (e.g., FOD).

Ecosite	Number of Plant Species				FQI	Native Mean C
	Native	Non-Native	Unknown	Total		
FOD	145	37	9	191	55.82	4.64
FOD/CUW	38	19	1	58	19.69	3.19
FOM/CUP	37	22	1	60	22.59	3.71
MAS	32	14	1	47	17.50	3.09
SWD/MAM	26	4	0	30	15.89	3.12
CUM	50	32	3	85	22.83	3.23
CUM/CUT	3	9	0	12	0.87	0.50
CUM/CUS	31	20	1	52	13.18	2.37
CUT	14	9	2	25	6.62	1.77
CUW	48	21	4	73	24.02	3.47
CUW/CUS	14	20	0	34	11.22	3.00
CUP	28	22	1	51	14.50	2.74
H	69	37	1	107	30.37	3.66
H/CUW	25	18	0	43	11.52	2.30

Overall, FQIs reported from vegetation communities at Boler Mountain are in line with what is expected from a natural area located in an urbanizing/urbanized setting, with the deciduous forest communities reporting a higher-than-average FQI (55.82). For example, FQIs generally range from 10 to 30 in urban areas such as the City of Mississauga (NSE 2010). Other vegetation communities were quite small in comparison to the deciduous forest communities, with higher levels of disturbance and comparatively fewer native species. With respect to the cultural communities, the percentages of non-native species were generally much higher than native or natural vegetation communities. This could be due to the fact that the remainder of the vegetation communities have either been highly influenced by past land use histories, or are highly fragmented resulting in a high proportion of non-native and habitat-generalist floral species.

4.2.1 Significant Flora

Species lists were screened for provincial, regional and local significance. Provincial floral rarity was based on rankings provided by the NHIC (identified as S1-S3) or species identified as



endangered, threatened or special concern by COSEWIC³ and/or COSSARO⁴. Regional floral rarity is based on listings for Southwestern Ontario provided by Oldham (1993). Local floral rarity is based on listings for Middlesex County provided by Bowles (2005).

Two provincially rare floral species were noted at the site (Table 4). Butternut (*Juglans cinerea*), which is a nationally and provincially endangered (S3?) species, was noted at the edge of the Sugar Maple Deciduous Forest Type (FOD5-1) north of Southdale Road West, near the hay field and Cultural Woodland community in the southwest corner of the site (Figure 2). One tree was located, which showed abundant evidence of Butternut Canker, a disease responsible for the widespread decline of this species across its range in North America. Numerous sooty cankers and crown dieback were noted on the trunk and branches. Butternut nuts or seedlings were not noted in the understory in the vicinity of this tree. Hybrid Cress (*Cardamine x maxima*) was located in the Sugar Maple Deciduous Forest Type (FOD5-1). Two additional provincially rare species: Honey Locust (*Gleditsia triacanthos*) (S2) was found within the study area, but was planted in a restoration area; and Trumpet Creeper (*Campsis radicans*) was located in a hedgerow near an abandoned homestead near the western edge of the study area. This population is presumed to have been planted, given the cultural context of its location.

A total of two regionally rare floral species were noted at the site (Table 4): Narrow-panicked Rush (*Juncus brevicaudatus*), and Smooth Blackberry (*Rubus canadensis*). Narrow-panicked Rush was located in the cultural meadow community, and Smooth Blackberry was located at the edge of the Sugar Maple Deciduous Forest Type (FOD5-1) and cultural woodland communities. Fragrant Sumac (*Rhus aromatica*) and Northern Mountain-ash (*Sorbus decora*), which are also considered regionally rare (*i.e.*, rare in southwestern Ontario), were located within a restoration area and appeared to have been planted.

Seven locally rare floral species in Middlesex County were noted at the site (Table 4): Ground Juniper (*Juniperus communis*), Creeping Spike-rush (*Eleocharis smalii*), Richardson's Pondweed (*Potamogeton richardsonii*), Smooth Blackberry, Early Buttercup (*Ranunculus fascicularis*), Carolina Spring-beauty (*Claytonia caroliniana*), and Wood Germander (*Teucrium canadense* ssp. *canadense*). Ground Juniper (R1) was located in the Cultural Woodland/Cultural Savannah (CUW/CUS) community, Creeping Spike-rush (R3) was located in the cultural meadow community, Richardson's Pondweed (R2) was located in the stormwater management pond at the eastern edge of the site, Smooth Blackberry (R2) was noted at the edge of the Sugar Maple Deciduous Forest Type (FOD5-1) and cultural woodland communities, Early Buttercup (R3) was noted in the Sugar Maple Deciduous Forest Type (FOD5-1), Carolina Spring-beauty (R3) was also noted in the Sugar Maple Deciduous Forest Type (FOD5-1), and Wood Germander (R4) was located in the Cattail Mineral Shallow Marsh (MAS2-1) community.

³ Nationally rare species are designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and are subject to the Federal Species at Risk Act.

⁴ Provincially rare species are designated by the Committee on the Status of Species at Risk in Ontario (COSSARO) and are subject to the Ontario Endangered Species Act.



Table 4. Naturally occurring provincially, regionally, and locally rare plant species within the Boler Mountain study area.

Scientific Name	Common Name	S Rank*	COSEWIC/ COSSARO	SW Ont	Middlesex
<i>Cardamine x maxima</i>	Hybrid Cress	S3		Yes	
<i>Claytonia caroliniana</i>	Carolina Spring-beauty	S5			R3
<i>Eleocharis smallii</i>	Creeping Spike-rush	S5			R3
<i>Juglans cinerea</i>	Butternut	S3?	END		
<i>Juncus brevicaudatus</i>	Narrow-panicled Rush	S5		Yes	
<i>Juniperus communis</i>	Ground Juniper	S5			R1
<i>Potamogeton richardsonii</i>	Richardson's Pondweed	S5			R2
<i>Ranunculus fascicularis</i>	Early Buttercup	S4			R3
<i>Rubus canadensis</i>	Smooth Blackberry	S4?		Yes	R2
<i>Teucrium canadense ssp. canadense</i>	Wood Germander	S5?			R4

* Provincial (or Subnational) “S-Ranks” are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities.. The NHIC evaluates provincial S-Ranks on a continual basis and produces updated lists at least annually. Species with an S-Rank that is uncertain include a question mark, e.g. S3?

4.3 Fauna

A total of 71 wildlife species were noted within the Boler Mountain site in 2011 and 2012: 51 bird species, including 49 breeding bird species, one reptile species (Eastern Gartersnake), six amphibian species (all frogs and toads), six mammal species, two dragonfly species, and five butterfly species.

4.3.1 Amphibians

Five species of amphibians were noted within the Boler Mountain site: American Bullfrog, American Toad, Gray Treefrog, Green Frog, Northern Leopard Frog. Spring Peeper, the only forest-dependent amphibian noted, was heard in breeding choruses just outside the site. Bullfrog and Green Frog were both noted within the storm pond on the southeastern part of the site, which contains permanent water necessary for these species to breed. Permanent water also occurs in the central portion of the shallow marsh located in the western portion of the site. Green Frog and Northern Leopard Frog were observed in this pond. American Toad was noted in non-breeding habitat within the forest and cultural meadow on the western portion of the site. Pools within the western tributary contained abundant American Toad tadpoles (observed on May 15, 2012). Gray Treefrog were heard calling from two locations in permanent ponds: in the small cattail marsh along the west tributary (3 individuals) and along the tributary that extends from



the cattail marsh (2 individuals). Spring Peepers were heard vocalizing in two locations, both just outside the site. Spring Peeper was heard calling from a small dug pond within the residential neighbourhood north of Optimist Park Drive (2 individuals). A large population (Code 3) of Spring Peepers was also heard calling from the deciduous forest located west of Wickerson Road. Mole salamanders were not located on the site.

Very few suitable pools where amphibians could breed were noted within the site. There was evidence of a few shallow vernal pools within the tributary on the west side of the site where vernal pool-dependent species could breed; however, these pools were not surrounded by forest, which forest-dependent amphibians need for summer and winter habitat, and were part of a flow-through system which is less suitable for breeding. The only significant area of standing water was the storm pond in the southeast corner of the site, and it contained only American Bullfrog and Green Frog, both species that breed in permanent water. This pond is deep enough to contain fish, and is thus likely unsuitable for breeding woodland amphibians, which are highly susceptible to predation from both fish and predatory frogs such as Green Frog and American Bullfrog. Vernal pools suitable to support breeding of significant numbers of woodland frogs and salamanders (i.e., fishless pools that persist until mid-summer) did not occur within forested areas on the site.

During all vegetation surveys, logs and fallen debris were over-turned to determine if Eastern Red-backed Salamander is present at the site. No observations of this species (or other species that depend on terrestrial habitat for part of their life cycle such as Eastern Newts) were noted.

Significant Amphibian Species

American Bullfrog, noted in the stormwater pond on the southeast corner of the site, is considered an area-sensitive species by the Ontario Ministry of Natural Resources (OMNR). This species is generally present only in large marshes with abundant vegetation near permanent water, and is not common in urban habitats. Breeding habitat for American Bullfrog in meadow marsh and shallow marsh communities is also considered Significant Wildlife Habitat by OMNR. However as Significant Wildlife Habitat is only identified for natural habitat, the stormwater management pond where American Bullfrog is present would not qualify for assessment as Significant Wildlife Habitat.

4.3.2 Reptiles

The only reptile species noted was Eastern Gartersnake. Snakes are cryptic, particularly in July when the main surveys were conducted. It is likely that other species of forest snake are found within the Boler Mountain site, such as Dekay's Brownsnake and Red-bellied Snake, and it is also possible that Eastern Milksnake could be found in successional vegetation on the western part of the site.

4.3.3 Birds

Forty-nine breeding bird species (two confirmed breeders, eighteen probable breeders, and twenty-nine possible breeders) were noted within the Boler Mountain site (Appendix 2). The following species were noted in 2004 surveys completed as part of the London Woodlands



Study: American Goldfinch, Downy Woodpecker, Eastern Wood-Pewee, Hairy Woodpecker and Red-eyed Vireo. All were noted in 2011 and 2012 surveys as well. Most of the birds seen were adaptable species characteristic of a variety of habitats in Ontario, such as American Goldfinch, American Robin, Black-capped Chickadee, Northern Cardinal, Song Sparrow and Indigo Bunting. Several species that are specific to forest habitats were also noted, for example Great Crested Flycatcher, Red-eyed Vireo, Eastern Wood-Pewee and Wood Thrush. The latter is generally dependent on larger wooded areas than are usually found in urban landscapes (though it is not considered area-sensitive) and is not common in urban habitat, though it can be found in larger forests in Toronto and Mississauga. Scarlet Tanager, an area-sensitive forest breeding species, was noted at the site as a possible breeder in May, 2012 but was not noted in later surveys. Other area-sensitive species at the lower end of the spectrum of area-sensitivity and more tolerant of urban habitats were noted on the site: Cooper's Hawk, Hairy Woodpecker, White-breasted Nuthatch, Blue-gray Gnatcatcher, Pine Warbler, and Savannah Sparrow. Many species dependent on successional habitats were noted as well, including Gray Catbird, Field Sparrow, Cedar Waxwing and Eastern Kingbird. The only wetland-dependent species noted were Common Yellowthroat (near the storm pond and along the western tributary), Warbling Vireo and Red-winged Blackbird. Seven cavity-nesting species were noted. Eastern Meadowlark, an area-sensitive species of open habitats and a Threatened species in Ontario, was noted on adjacent farmland to the west and south of study area in both 2011 and 2012. This species was not noted within the study area itself.

Significant Breeding Bird Species and Bird Species of Conservation Priority

Boler Mountain ESA provides habitat for 23 birds of conservation priority. Most of these bird species are not rare per se, but are considered a conservation priority because of their dependence on specific habitats or the fact that southern Ontario supports a significant portion of the habitat for these species. Table 5 provides a list of significant breeding birds noted within the Boler Mountain site, including one species noted as provincially and nationally Threatened in Ontario (Barn Swallow), but also including species of conservation priority according to Couturier (1999), species of conservation concern in Bird Conservation 13 (Ontario Partners in Flight 2005), and area-sensitive species according to OMNR (2000). These species are further discussed below.



Table 5. Significant breeding bird species noted at the Boler Mountain site. PO = Possible breeding; PR = Probable breeding THR = Threatened according to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or OMNR. S-Rank: S4 = Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors (S4B: status applies to breeding only). S5 = Secure—Common, widespread, and abundant in the nation or state/province.

Scientific Name	Common Name	S-Rank	COSEWIC	OMNR	Conservation Priority in Conservation Region 13	Conservation Priority in Middlesex	Area-Sensitive	Breeding	Habitat Preference
<i>Carduelis tristis</i>	American Goldfinch	S5B				L3		PR	Thickets, young forest
<i>Icterus galbula</i>	Baltimore Oriole	S5			Regional Concern			PO	Young forest, riparian areas
<i>Hirundo rustica</i>	Barn Swallow	S4B	THR	THR		L3		PO	Buildings in open landscapes
<i>Ceryle alcyon</i>	Belted Kingfisher				Regional Concern				Riparian areas
<i>Poecile atricapillus</i>	Black-capped Chickadee	S5				L4		C	Forest
<i>Polioptila caerulea</i>	Blue-gray Gnatcatcher	S4B				L4	Yes	PO	Young forest
<i>Thryothorus ludovicianus</i>	Carolina Wren	S4				L3		PO	Forest
<i>Accipiter cooperii</i>	Cooper's Hawk	S4				L3	Yes	PO	Forest
<i>Tyrannus tyrannus</i>	Eastern Kingbird	S4B			Regional Concern	L3		PO	Thicket
<i>Sayornis phoebe</i>	Eastern Phoebe	S5B				L3		PO	Riparian forest
<i>Contopus virens</i>	Eastern Wood-pewee				Regional Concern				Forest
<i>Spizella pusilla</i>	Field Sparrow	S4B			Regional Concern	L3		PR	Shrubby meadows
<i>Dumetella carolinensis</i>	Gray Catbird	S4B				L4		PR	Thicket
<i>Picoides villosus</i>	Hairy Woodpecker	S5					Yes	PO	Forest
<i>Eremophila alpestris</i>	Horned Lark	S4B				L3		PO	Agricultural fields
<i>Colaptes auratus</i>	Northern Flicker	S4B			Regional Concern			PO	Forest
<i>Dendroica pinus</i>	Pine Warbler	S5B				L3	Yes	PO	Coniferous forest
<i>Melanerpes carolinus</i>	Red-bellied Woodpecker	S4				L1		PR	Forest
<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	S4B			Regional Concern			PO	Forest
<i>Passerculus sandwichensis</i>	Savannah Sparrow	S4B			Regional Concern	L1	Yes	PR	Grassland



Scientific Name	Common Name	S-Rank	COSEWIC	OMNR	Conservation Priority in Conservation Region 13	Conservation Priority in Middlesex	Area-Sensitive	Breeding	Habitat Preference
<i>Piranga olivacea</i>	Scarlet Tanager	S4B				L2	Yes	PO	Forest
<i>Sitta carolinensis</i>	White-breasted Nuthatch	S5					Yes	PO	Forest
<i>Hylocichla mustelina</i>	Wood Thrush	S4B			Continental and Regional Concern	L4		PR	Forest

Note: Eastern Meadowlark (*Sturnella magna*) was not included in Table 5 as it was not located within the study area, but on adjacent properties only.



Provincially Significant Bird Species

One provincially significant bird species was noted on the site: Barn Swallow (with a status of threatened). This species was seen in the west portion of the site, in the strip of successional habitat along the small tributary parallel to Wickerson Road. The Barn Swallow was noted foraging over the fields on the western side of the site and was not noted breeding on the site. Barn Swallow nests were searched for in the barn/shed structure located in the western portion of the site; however, no nests were located within this structure.

An additional provincially significant bird species was noted on adjacent property: Eastern Meadowlark (threatened) was noted on the fence adjacent to the agricultural fields to the west (2011), and from agricultural fields to south of the study area (2012). Although Eastern Meadowlark was not noted on the subject property, this species likely incorporates areas of the site into its breeding territory as there is suitable habitat on the southwestern part of the property (grassy fields). This species is area-sensitive, and depends on large tracts of grassland habitat. It is generally found in broad agricultural landscapes and is extremely rare in urban settings. Both species, and their breeding habitat, are protected by Ontario's Endangered Species Act.

No regionally significant species (species rare in Ecoregion 7, according to OMNR's wetland evaluation manual) were noted within the site.

Bird Species of Conservation Priority

Nine of the species noted on the site are of conservation concern in Bird Conservation Region 13 (Ontario south of the Canadian Shield) (Table 5). These species have not yet been designated as Species at Risk (with the exception of Barn Swallow, which is listed as Threatened), but all are of conservation concern because their populations are declining. One of these species, Wood Thrush, is of the highest priority status because it is of continental and regional conservation concern. A primary objective for these species is to reverse the current decline, or to maintain populations, so preservation of remnant habitat patches within urban areas contributes to this objective, as several species are tolerant of urban surroundings.

Sixteen species have been noted as species of conservation priority in Middlesex County (Couturier 1999). Species of conservation priority are not rare, but conservation of their habitat is a priority because they are declining, depend disproportionately on habitat within Middlesex County, are particularly sensitive to land use change or have highly specific habitat needs, such as need for large areas or specific types of forest.

As discussed above, seven of the species noted within the Boler Mountain site in 2011 and 2012 are considered area-sensitive by OMNR. Blue-gray Gnatcatcher and Savannah Sparrow were noted on the successional areas of the site in fields and young woodlands. Cooper's Hawk, Scarlet Tanager, White-breasted Nuthatch and Hairy Woodpecker are area-sensitive species dependent on forest habitats. Pine Warbler is an area-sensitive species dependent on coniferous forest habitats: however, this species is relatively tolerant of urban habitats and can be found in older neighbourhoods with mature coniferous trees. White-breasted Nuthatch and Hairy Woodpecker are also at the lower end of the spectrum of area-sensitivity and are often found where forest remnants are concentrated or in well-treed neighbourhoods in urban habitat. Blue-gray Gnatcatcher, a species of young open woodlands, is restricted to the southern portions of



southern Ontario but its range has been expanding in recent years. Savannah Sparrow can also be found in larger grasslands in urban habitats such as hydro corridors.

4.3.4 Mammals

The mammals noted on the site were those that are ubiquitous in patches of habitat in urban areas of southern Ontario, for example White-tailed Deer and Red Fox. Though these species are adapted to urban habitat, it is important to include them in planning for sustainable natural areas.

4.3.5 Dragonflies and Damselflies (Odonates)

A total of two Odonate species were noted through incidental field observation at the site during flora surveys completed in 2011. These species include: Widow Skimmer (*Libellula luctuosa*), a species of ponds and marshes, and Common Whitetail (*Plathemis lydia*), a species of ponds, puddles and roadside ditches. Both of these species are fairly common in southern Ontario, and both have SRANKs of S5.

4.3.6 Butterflies (Lepidopterans)

A total of five Lepidopteran species were noted through incidental field observation at the site during flora surveys completed in 2011. These species include: Black Swallowtail (*Papilio polyxenes*), Cabbage White (*Pieris rapae*), Spring Azure (*Celastrina* sp.), Monarch (*Danaus plexippus*), and Red Admiral (*Vanessa atalanta*). Monarch is a national and provincial species of Special Concern (listed by COSEWIC and COSSARO) (S2N, S4B). This species primarily feeds on milkweed plants (*Asclepias* spp.) but will nectar on many other flowering plants as well. Large concentrations of milkweed plants were not observed at Boler Mountain, nor were large congregations of Monarch. Single Monarch butterflies were observed flying and feeding on several occasions within the study area. All other butterfly species are fairly common in southern Ontario and have SRANKs of S5.

4.4 Significant Wildlife Habitat

Significant Wildlife Habitat in a provincial context is evaluated based on criteria listed in OMNR (2000) and further elaborated in technical guidelines for each Ecoregion (i.e., in the London area, OMNR guidelines for Ecoregion 7 should be applied). Under these guidelines, there are no areas that would qualify as SWH within the Boler Mountain study area. The forest block is not of sufficient size, and forested areas do not support sufficient numbers of area-sensitive species or other species of conservation concern, to qualify as SWH. Similarly, wetlands and ponds do not support sufficient numbers of listed species to qualify as SWH, or the ponds are human-made. Even though American Bullfrog are present in the storm pond on the southeast corner of the site, the pond is not a naturally-occurring vegetation community and thus this area does not qualify as SWH.

4.5 Corridors and Linkages

The natural areas at Boler Mountain are connected to additional lands designated as Potential ESA in the City's Official Plan, which are located to the south and which connect to the Dingman Creek ESA. Wildlife species, such as White-tailed Deer, likely move between the



forest patches located north and south of Southdale Road, with connections to Dingman Creek. Scarlet Tanager, an area-sensitive forest breeding species was heard singing in the spring of 2012 during breeding bird surveys near the edge of the forest patch north of Southdale Road. This species likely incorporated the forested areas north and south of the road in its breeding territory, viewing the area as a contiguous habitat patch. Hydrological connections occur along the tributary of Dingman Creek, which runs along the western boundary of the study area. This connection is important for the movement of amphibian species, such as Green Frog, Gray Treefrog, and American Toad recorded in the study area.

The natural areas at Boler Mountain are generally well-connected to natural areas to the south including the connection to the Dingman Creek ESA. Linkages northwards, including a linkage in a northwest direction across Wickerson Road and a linkage to the northeast through Westwood Woods and further to the east across Boler Road are less well connected are a result of the width of the connections and the amount of natural vegetation present. Nonetheless these latter connections likely provide a degree of ecological linkage and despite the higher development intensity present in these areas there are opportunities to manage the existing areas where some ecological linkage exists to improve plant and animal wildlife movement corridors.

Carolinian Canada's Big Picture analysis, which identifies a natural heritage system in Canada's Carolinian Forest Zone, identified a Potential Corridor through the City of London, along the Thames River, which runs in an east west direction. Although opportunities for connection and linkage from Boler Mountain to the Thames River are quite limited, establishing a functional linkage from Boler Mountain to the north would enhance connectivity among natural area patches in the City of London to other Carolinian Core Natural Areas and Other Significant Natural Areas identified by Carolinian Canada, enhancing regional connectivity.

4.6 Fluvial Geomorphic Assessment

4.6.1 Reach Delineation

The characteristics of flow or channel materials can change along a creek or stream. In order to account for these changes, channels are separated into reaches – normally several hundred meters to several kilometres in length. A reach displays similarity with respect to its physical characteristics, such as channel form, function, and valley setting. Delineation of a reach considers sinuosity, gradient, hydrology, local geology, degree of valley confinement, and vegetative control using methods outlined in PARISH Geomorphic Ltd. (2001). Based on degree of valley confinement, riparian vegetation, sinuosity and anthropogenic controls, a total of six reaches were identified for this assessment within the study area (Figure 3).

4.6.2 Reach Descriptions

Reach DC: Dingman Creek

Located on the east side of Westdel Bourne Road, the reach extends upstream through a deciduous forest lined valley with designated trails along tops of valley walls. Bankfull widths measure a range of 16 – 20 m, with bankfull depths measuring 2 m. The channel gradient was moderate, while presenting a sinuous course. It also was characterized by a pool-riffle bed



morphology, with pools typically comprised of coarse sand/silts and riffles comprised of coarse to very coarse sand. Pool-riffle spacing was measured to range 10 – 20 m, with deep pools, shallow riffles, and long transition sections. Although the water in the channel was very turbid, the reach displayed an overall moderate degree of ecological health. In regards to stability, the reach displayed a transitional/stressed condition, primarily being controlled by widening processes with a minor influence of planimetric adjustment. Channel widening was evidenced by fallen and leaning trees, exposed tree roots, basal scour on both sides of channel and extending >50% of subject reach, and fracture lines along the top of banks. Evidence of planimetric adjustment included the formation of chutes. There was also a minor influence of woody debris, however, a large wood debris jam was present mid-reach. A 30 m concrete bridge crosses Westdel Bourne Road at the downstream limit.

Reach DCT-1: Dingman Creek Tributary

Reach DCT-1 extends upstream from Dingman Creek, beginning approximately 700 m upstream from the 30 m bridge on Westdel Bourne Road. It extends in a northeast direction towards Southdale Road West and ends at the forest boundary. Bankfull widths measure a range of 1.5 – 3.0 m, with bankfull depths ranging 0.5 – 0.7 m. Banks have heights ranging 0.7 – 0.8 m, with steep angles throughout, and are densely vegetated by short herbs and deciduous trees. The channel was dry, presenting a moderate gradient and sinuous course. A section of the reach extends through an agricultural field surrounded by electrical fence and has been trampled by livestock. Pool substrate was composed of medium to fine sand, and riffle substrate was composed of cobbles with very coarse sand and pebbles. There was a major influence of woody debris as both large and minor wood debris jams. Overall, the reach displayed a moderate degree of ecological health. The reach also portrayed a state of transitional/stressed stability, being primarily controlled by widening, with aggradation and planimetric adjustment also contributing to the stability. Aggradation and planimetric adjustment were evidenced by the formation of medial bars and the formation of chutes at debris jams, respectively. Fallen and leaning trees, exposed tree roots, and basal scour on both sides of the channel extending through >50% of the reach indicated widening processes within the channel. The channel was undefined for the majority of the reach, remaining undefined up to the confluence with Dingman Creek at the downstream limit.

Reach DCT-2: Dingman Creek Tributary (South of Southdale Rd W)

Reach DCT-2 extends from edge of the deciduous forest through manicured lawns with both tall and short grasses, ending at the road crossing of Southdale Road West. Bankfull widths measure 0.4 – 1.2 m, with depths measuring 0.3 – 0.7 m. The reach presented a dry channel with a moderate gradient and low sinuous course. Substrate in pools consisted of fine sand to silt, while riffle substrate was comprised of very coarse sand to gravel. The reach portrayed a moderate level of ecological health and an “in regime” state of stability. The channel was relatively stable, with minor evidence of widening and planimetric adjustment as the occurrence of large organic debris and chute formation. The reach crosses Southdale Road West via a 1.0 m diameter CSP with an ephemeral pond at the outlet, which was dry at the time of observation.

Reach DCT-3: Dingman Creek Tributary (East Branch)

This reach extends northeast from Southdale Road West upstream, ending at a SWM pond. Bankfull widths measure 2.0 – 4.0 m, and bankfull depths measure 0.6 – 1.0 m. The channel was



dry, presenting a moderate gradient and sinuous course. Pool substrate was composed of medium sand, and riffle substrates were comprised of 5 – 15 cm diameter cobbles. Channel banks were densely vegetated by tall grasses, herbs, and deciduous trees. Channel disturbance included numerous pedestrian crossings, and a moderate influence of woody debris that increased towards the reach end. Overall, the reach portrayed a moderate level of ecological health. From a stability perspective, the channel is in regime, with minor influence of aggradation and widening. These processes are evidenced by the formation of medial bars, and fallen/leaning trees with exposed tree roots and basal scour along both channel banks. The SWM pond at the upstream limit of the reach outlets via a 0.4 m diameter CSP, and the downstream limit crosses Southdale Road West via a 1.0 m diameter CSP.

Reach DCT-4: Dingman Creek Tributary (West Branch)

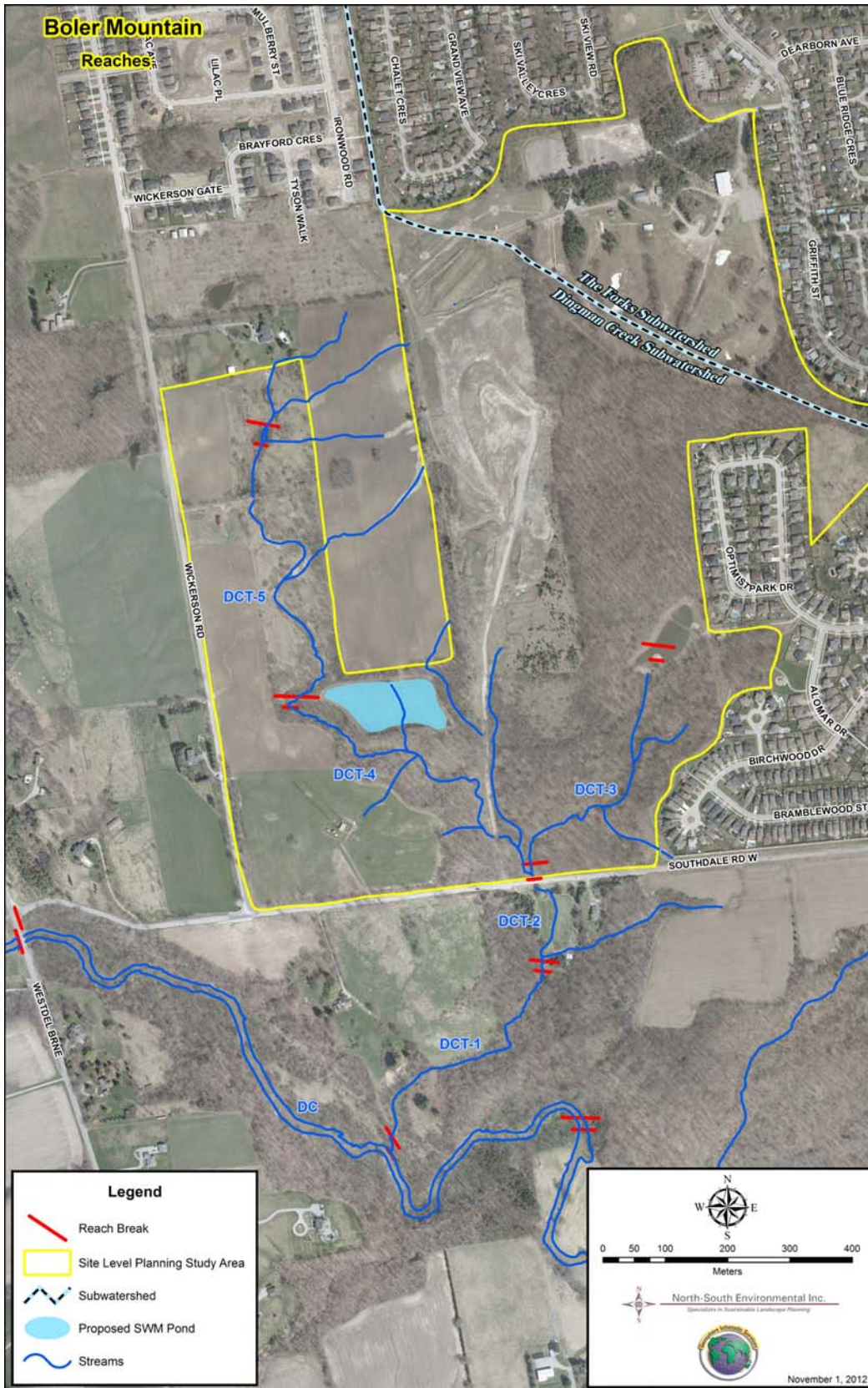
The reach extends upstream in the northwest direction from Southdale Road West with the upstream limit parallel to the proposed SWM pond. Bankfull widths measure 1.5 – 2.5 m, with bankfull depths of 0.4 – 0.8 m. The channel was dry, with a moderate to high gradient and sinuous course. Pool substrates consist of silt and clay, while riffle substrates are comprised of very coarse gravel to large cobble with pebbles. Banks have low heights until the channel has contact with valley wall on both banks, which are vegetated by deciduous trees and both short and tall herbs. Where confinement increases via valley wall contact, the channel becomes more defined. However, it loses definition again towards the downstream end where it dissipates into a wide floodplain immediately before a quarry access road crossing, and remains poorly defined up to the reach break. Overall, the reach portrays a moderate state of ecological health. In terms of stability, the reach is in a transitional/stressed state with influence by widening and planimetric adjustment processes. Widening processes are evidenced by the major influence of woody debris as fallen/leaning trees and exposed tree roots, as well as basal scour on both sides of the channel. Chute formation and the channel adjusting from a single thread to multiple thread channels are indices of the influence of planimetric adjustment. Channel disturbance in this area consists of trail use and pedestrian crossings, as well as a set up for recreational paintball use. At the downstream limit, the channel crosses Southdale Road West via a 1.0 m diameter CSP.

Reach DCT-5: Dingman Creek Tributary (West Branch)

This reach extends through private property, upstream of reach DCT-4 and is upstream of the proposed SWM pond. It is an undefined channel towards the upstream end with an ATV crossing located mid-reach. Bankfull widths measure 0.6 – 1.5 m, with bankfull depths of 0.15 – 0.4 m. The channel was dry, portraying a moderate gradient and sinuous course. Pool substrates consisted of silt and clay, with areas of exposed clay. Dense vegetation was present both along channel banks and within the channel as tall grasses and deciduous trees. The reach presents an overall moderate state of ecological health. In terms of stability, the reach is in regime with minor influences from widening and planimetric form, indicated through the occurrence of large organic debris and the formation of chutes.



Figure 3. Reach Delineation within Boler Mountain Study Area (from Parish 2010)



5.0 RECOMMENDED DESIGNATIONS AND MANAGEMENT

5.1 Proposed ESA Boundary Delineation

The Boler Mountain study area is designated “Potential ESA” on Schedule B-1 (maps 4 and 7) of the Official Plan. Based on this designation the study area was evaluated using the City of London Guideline Document for Environmentally Significant Areas Identification, Evaluation and Boundary Delineation (London 1997). The natural areas within the Boler Mountain study area have a strong ecological connection to the Dingman Creek ESA located approximately 300 metres to the south or Southdale Road. The large area of native woodland present within the study area is connected to the Dingman Creek ESA through a corridor of similar woodland 100 to 200 metres wide south of Southdale Road. In addition, several streams present within the study areas flow in a southerly direction and connect on the north side of Southdale Road, forming a tributary which flows south through a one metre diameter corrugated steel culvert under Southdale Road to Dingman Creek

An extension of the existing Dingman Creek ESA boundary is proposed for the Boler Mountain study area (see Figure 4) predicated on an extension of the Dingman Creek ESA which encompasses intervening areas of woodland located immediately south of Southdale Road. The proposed ESA boundary within the Boler Mountain study area encloses a large, contiguous block composed largely of native deciduous woodland (FOD), but also including smaller areas of cultural woodland (CUW) and cultural thicket (CUT) to enhance the shape of the woodland patch by reducing edge and to increase the area of interior woodland. A stormwater management pond is also included in the proposed ESA boundary in part due to native deciduous woodland almost completely encircling the pond and due to the presence of breeding amphibians, American Bullfrog and Green Frog, both species that breed in areas with permanent water.

5.1.1 Proposed ESA Management Zones and Overlays

To assist in future management and planning for the proposed ESA extension management zones and overlay designations have been identified based on the City of London Planning and Design Standards for Trails in Environmentally Significant Areas (London 2012). The management zones and overlays identified for the proposed ESA extension with the Boler Mountain study area are shown on Figure 5 and include the following:

Natural Area Zone 1 – The majority of the proposed ESA extension is designated Natural Area Zone 1 (Figure 5) to protect areas of moderate to high sensitivity which sustain important ecological features and functions within an area of diverse contiguous upland deciduous forest (FOD4, FOD5-1, FOD5-3, FOD5-8, FOD6-2, FOD9) and tributaries that flow to Dingman Creek. Within this zone a minimum level of trail development is permitted in support of low-intensity nature-based recreation.

Natural Area Zone 2 – A portion of the proposed ESA extension is designated Natural Area Zone 2 (Figure 5) to protect supporting habitat areas of cultural communities including woodland (CUW1), thicket (CUT1), and meadow (CUM1). This zone may support access and trail development from the adjacent Boler Mountain recreation facility.



Restoration Overlay – Two restoration areas have been identified (Figure 5); one is an oval shaped area on City owned lands located south of the stormwater management pond and the second is a larger area on private lands located on the west side of the access road that enters the study area from Southdale Road. Both areas are impacted by well used campfire rings (Photo 1), unregulated mountain bike trails and BMX bike jumps (Photo 2), forts constructed from scrap wood, etc. that have lead to a significant negative impact on understory vegetation, soil compaction and erosion and damage to some mature trees. For the area identified on the west side of the access road, motorized vehicles, motorcycles and ATVs, have also been present and these result in more serious impacts to vegetation and soil. These areas with informal trails are in contrast to the managed mountain bike trails within Boler Mountain that are well defined, managed and controlled resulting minimal impact to natural areas.

An active restoration program is required for these areas including education of users regarding the negative environmental impact of unregulated use, the closure and rehabilitation of trails causing significant impacts, the rehabilitation of lost understory vegetation and compacted soils and the development of a sustainable, low impact mountain bike trail system.



Photo 1. Campfire Area



Photo 2. BMX jump and trails

5.2 Other Significant Areas

5.2.1 Significant Woodlands

Areas of woodland located outside the proposed ESA extension boundary were evaluated using City of London Guideline Document for the Evaluation of Ecologically Significant Woodlands (London 2006). Woodlands associated with the watercourse on the west side of the study area, including ELC communities FOD7-4 and SWD2-2, score high for Criterion 1.1 and 1.2 based on the presence of hydrological features and erosion and slope protection and are therefore shown as significant woodland on Figure 4.

Other woodlands located to the north of the proposed ESA boundary extension were not evaluated as significant woodlands due to existing and proposed development for active recreation, primarily downhill skiing.



5.2.2 Woodlands

An area of woodland outside the proposed ESA extension boundary that is not impacted by existing and proposed development ski runs is meets City of London criteria for designation as “woodlands” based on the quality of mature native woodland present (FOD5-1 and FOD5-3), the contribution of these woodland areas to urban open space, and ecological linkage functions of the woodland. The proposed area of woodland is shown on Figure 4.

5.2.3 Significant Stream Corridors

Stream corridors outside the proposed ESA extension boundary were evaluated based on City of London criteria for the designation of significance. The main stream corridor located on the west side of the study area is associated with a relatively high diversity of upland and wetland communities including deciduous woodland (FOD7-4), deciduous treed swamp (SWD2-2), meadow marsh (MAM2-10), shallow marsh (MAS2-1) and cultural meadow (CUM1). The diversity of communities present, particularly wetlands, the continuous natural corridor linked to the proposed ESA extension, and the presence of moderately steep (15-20 degree) and steep (>25 degree) slopes has resulted in the designation of the stream corridor as significant (see Figure 4).

5.3 City of London Pathways

The City’s existing and proposed walking and cycling pathway system was reviewed to consider pathway connections within the Boler Mountain study area. Figure 4 shows the location of existing trails, consideration was given to the alignment of two new multiuse pathways within the study area. The first multiuse pathway considered would be located at the north end of the study area and could provide an east to west connection for the existing residential communities and a connection to the Boler Mountain recreation area from the existing community pathway connections located at Ironwood Rd, Grandview Avenue and Ski View Road. A multi-use pathway located within this area would not result in any significant impact to natural features and functions.

The second proposed multiuse pathway considered would extend southward from the existing pathway at Ironwood Road to provide a connection to the existing residential community located on the southeast side of Boler Mountain. The Bicycle Master Plan for the City of London conceptually shows this connection currently following the existing construction access road southward to Southdale Road. This proposed alignment would terminate at the intersection of the construction access road and Southdale Road; a location where the existing conditions of Southdale Road are narrow and with relatively steep road slopes both to the east and west of the intersection presenting a dangerous intersection for pathway users to negotiate. In addition, there is no side walk or pathway along the edge of Southdale Road, making onward travel unsuitable for pathway users. Optional alignment of a multiuse pathway link was considered based on the existing ELC communities, topography and slope conditions in the context of the proposed ESA extension. The most suitable location for an alternate pathway alignment is located just outside the northern boundary of the proposed ESA extension and would require crossing of Boler Mountain Bike Trails, passage through cultural communities CUW1 and CUT1, and a descent



through woodland (FOD5-1) in an area of moderately steep slopes to a point where the trail could follow the southern side of the existing stormwater management pond to an existing access road providing the final connection to the community on Optimist Park Drive.

5.4 Stormwater Management

One of the purposes of the study was to assess current terrestrial and aquatic conditions in relation to the potential implementation of a stormwater management pond within the study area. The area proposed for the SWM pond is identified as active agricultural field planted in soya bean in 2010 and is an oval shaped polygon labelled SOY located on the west side of the study area immediately north of the deciduous woodland FOD5-1 (see Figures 2 and 3). Immediately to the south of this area is an east-west trending steep slope (>25%) shown on Figure 6 and a drainage feature connecting to reach DCT-4 (see Figures 2 and 3).

In regard to the natural features and functions present, there appears to be sufficient area for the development of a stormwater facility with appropriate set-backs from the adjacent areas of proposed significant woodland, stream corridor and ESA. In addition, the SWM facility may be naturalized to enhance the natural features and functions of these areas.

The results of the assessment determined that Reach DCT-1, located at the downstream limits of the tributary was the least stable reach from a geomorphic perspective. Of the tributary reaches DCT-1 was the highest gradient (2.3%), had the lowest stream health score (RSAT 21) and scored worst from a geomorphic stability perspective (RGA 0.23). As this reach is situated downstream of the confluence with the east and west branches of the tributary and receives flows from all of the Boler Mountain catchment area which somewhat mitigates the overall impacts of changes in flow regime in one tributary or the other. The second most sensitive reach was determined to be reach DCT-4. This reach, which is located on the west branch of the tributary is immediately downstream of the area of the proposed SWM facility. The valley gradient of this reach is 2.0%, which is slightly less than DTC-1. The reach had an RSAT score of 27, which was the best score of all assessed reaches, but scored relatively low in the RGA (0.21) which is a direct assessment of geomorphic channel stability.

As the SWM facility will outlet to tributaries flowing to the Dingman Creek ESA there is a need to consider the current fluvial conditions and receiving capacity of these watercourses. The study completed by Parish Geomorphic (see Appendix 3) states the receiving stream reaches (DCT-4 located immediately south of the proposed SWM pond and DCT-1 located south of Southdale Road and conveying flows to Dingman Creek) exhibit a dominant geomorphic process of widening as noted through numerous factors, including bank scour, fallen/leaning trees, exposed roots, etc.

The nature of the watercourse, which is intermittent in nature makes both reaches susceptible to changes in flow regime. Should continuous or near-continuous baseflow occur as a result of upstream stormwater management, areas of poor channel definition will eventually develop a defined channel to accommodate the continuous flows. In some cases this may be beneficial to the overall health of the watercourse by extending the wetted period, and increasing the availability of habitat to fish and aquatic organisms.



The next steps are to integrate the geomorphological findings into the development of the SWM pond, leading to a design solution that is appropriate to maintain channel stability. Specifically, to support the SWM facility design an erosion threshold for the receiving watercourse should be determined as a basis for calculating discharge rates which governs the size of the facility as well as the outlet type and location. To determine an erosion threshold a more detailed field investigation would be required in reaches DCT-1 and DCT-4.



Figure 4. Boler Mountain Significant Areas Proposed for Protection – ESA Boundary, Significant Woodlands, Significant Stream Corridor and Woodlands.



Figure 5. Boler Mountain Proposed ESA Management Zones

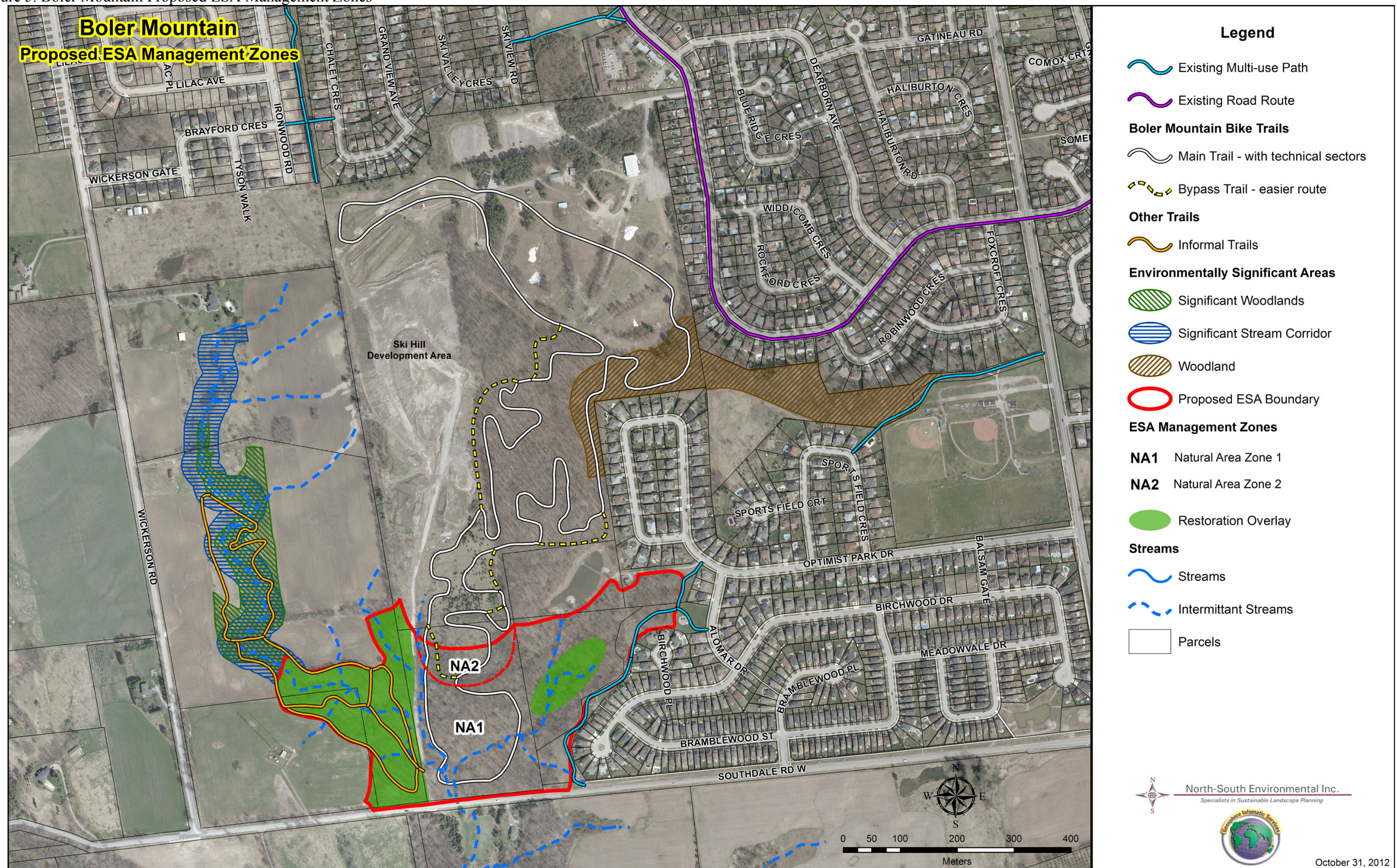
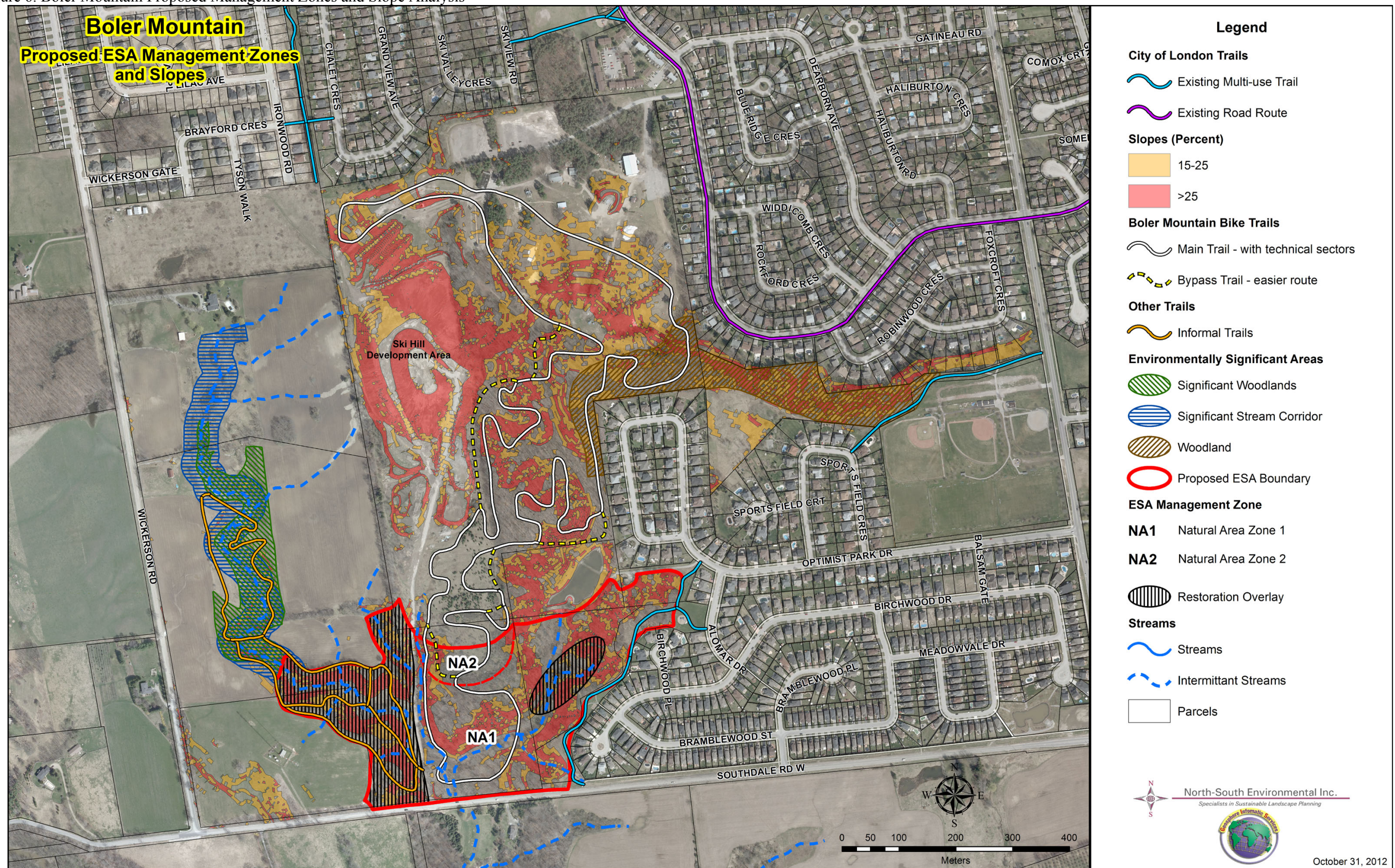


Figure 6. Boler Mountain Proposed Management Zones and Slope Analysis



6.0 CONCLUSIONS

The study has provided a comprehensive and current inventory and analysis of natural heritage features and functions present within the Boler Mountain study area in accordance with City guidelines. Based on the information reported the following recommendations have been made in regard to the identification of significant natural areas:

1. A portion of the study area is proposed as an extension of the Dingman Creek ESA
2. A Management Zone and Restoration Overlay has been recommended for the proposed ESA extension within the study area
3. Other significant areas have been identified including Significant Woodlands, Woodlands, and Significant Stream Corridor.
4. Recommendations have been made for the potential alignment of multiuse pathways within the Boler Mountain study area to provide connections to existing City of London walking and cycling pathway system in a safe manner with minimal impact to natural areas.
5. Recommendations have been made in regard to the feasibility and need for future studies in regard to installing a stormwater management facility within the study area.
6. The Boler Mountain recreation area will continue its programming of compatible recreation use based on the environmental stewardship, protection and management of natural areas and this may include expansion in to areas recommended for restoration.



7.0 REFERENCES

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APPENDIX 1: FLORA



Appendix 1. Flora documented from the Boler Mountain Study Area in 2011. * indicates an introduced species

Scientific Name	Common Name	Rarity Status				Vegetation Community											
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAO	CUP	CUW	CUS	CUT	CUM	H	
Equisetaceae																	
Equisetum arvense L.	Field Horsetail	G5	S5	No	No							x					
Dryopteridaceae																	
Athyrium filix-femina (L.) Roth ex Mert. var. angustum (Willd.) G. Lawson	Lady Fern	G5T5	S5	No	No	x											
Cystopteris fragilis (L.) Bernh.	Fragile Fern	G5	S5	No	No	x											
Dryopteris carthusiana (Vill.) H.P. Fuchs	Spinulose Wood Fern	G5	S5	No	No	x	x										
Dryopteris filix-mas (L.) Schott	Male Fern	G5	S4	No	No	x											
Onoclea sensibilis L.	Sensitive Fern	G5	S5	No	No	x										x	
Polystichum acrostichoides (Michx.) Schott	Christmas Fern	G5	S5	No	No	x											
Pinaceae																	
* Larix decidua Miller	European Larch	G5	SNA	No	No		x										
* Picea abies (L.) Karsten	Norway Spruce	G5	SNA	No	No	x	x						x				x
Picea glauca (Moench) Voss	White Spruce	G5	S5	No	No							x					
* Picea pungens Engelm.	Blue Spruce	G5	SNA	No	No								x				
* Pinus nigra Arnold	Black Pine	GNR	SNA	No	No								x				
Pinus resinosa Sol. ex Aiton	Red Pine	G5	S5	No	No	x											
Pinus strobus L.	White Pine	G5	S5	No	No	x	x					x					x
* Pinus sylvestris L.	Scotch Pine	GNR	SNA	No	No		x						x				x
Cupressaceae																	
Juniperus communis L.	Ground Juniper	G5	S5	No	R1								x				
Thuja occidentalis L.	Eastern White Cedar	G5	S5	No	No								x				
Magnoliaceae																	
Liriodendron tulipifera L.	Tulip Tree	G5	S4	No	No											x	
Ranunculaceae																	
Actaea pachypoda Elliott	White Baneberry	G5	S5	No	No	x											
Actaea rubra (Aiton) Willd.	Red Baneberry	G5	S5	No	No	x											



Scientific Name	Common Name	Rarity Status				Vegetation Community										
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAO	CUP	CUW	CUS	CUT	CUM	H
Actaea sp.	Baneberry	G?	S?	?	?	x										
Anemone cylindrica A. Gray	Thimbleweed	G5	S4	No	No											x
Anemone quinquefolia L.	Wood Anemone	G5	S5	No	No	x										
Anemone virginiana L.	Virginia Anemone	G5	S5	No	No	x						x				x
Aquilegia canadensis L.	Wild Columbine	G5	S5	No	No	x										
Clematis virginiana L.	Virgin's-bower	G5	S5	No	No	x										
Ranunculus abortivus L.	Kidney-leaved Buttercup	G5	S5	No	No	x	x									
Ranunculus fascicularis Muhlenb. ex Bigelow	Early Buttercup	G5	S4	No	R3	x										
Ranunculus recurvatus Poir. var. recurvatus	Rough Crowfoot	G5	S5	No	No	x										
Thalictrum dioicum L.	Early Meadow-rue	G5	S5	No	No	x										
Thalictrum pubescens Pursh	Tall Meadow-rue	G5	S5	No	No	x										
Berberidaceae																
* Berberis thunbergii DC.	Japanese Barberry	GNR	SNA	No	No	x										
Caulophyllum giganteum (Farw.) Leconte & Blackwell	Blue Cohosh	G4G5Q	S4?	No	No	x										
Caulophyllum thalictroides (L.) Michx.	Blue Cohosh	G4G5	S5	No	No	x										
Podophyllum peltatum L.	May Apple	G5	S5	No	No	x										x
Papaveraceae																
* Chelidonium majus L.	Celandine	GNR	SNA	No	No							x				x
Sanguinaria canadensis L.	Bloodroot	G5	S5	No	No	x										
Platanaceae																
Platanus occidentalis L.	Sycamore	G5	S4	No	No		x									
Hamamelidaceae																
Hamamelis virginiana L.	Witch-hazel	G5	S5	No	No	x										x
Ulmaceae																
Celtis occidentalis L.	Hackberry	G5	S4	No	No											x
Ulmus americana L.	American Elm	G5?	S5	No	No	x						x				
Moraceae																



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* Morus alba L.	White Mulberry	GNR	SNA	No	No								x				
Urticaceae																	
Laportea canadensis (L.) Wedd.	Wood Nettle	G5	S5	No	No	x		x					x				
Pilea pumila (L.) A. Gray	Canada Clearweed	G5	S5	No	No			x	x								
Urtica dioica L. ssp. gracilis (Aiton) Selander	American Stinging Nettle	G5T5	S5	No	No		x										
Juglandaceae																	
Carya cordiformis (Wangenh.) K. Koch	Bitternut Hickory	G5	S5	No	No	x							x				x
Carya ovata (Miller) K. Koch	Shagbark Hickory	G5	S5	No	No	x						x	x				x
Juglans cinerea L.	Butternut	G4	S3?	No	No	x											
Juglans nigra L.	Black Walnut	G5	S4	No	No	x	x	x				x	x	x	x	x	x
Fagaceae																	
Fagus grandifolia Ehrh.	American Beech	G5	S4	No	No	x											
Quercus alba L.	White Oak	G5	S5	No	No	x	x										x
Quercus macrocarpa Michx.	Bur Oak	G5	S5	No	No												x
Quercus rubra L.	Red Oak	G5	S5	No	No	x	x						x				x
Betulaceae																	
Betula alleghaniensis Britton	Yellow Birch	G5	S5	No	No	x											
Betula papyrifera Marshall	White Birch	G5	S5	No	No	x											x
Carpinus caroliniana Walter ssp. virginiana (Marshall) Furlow	Blue Beech	G5	S5	No	No	x											
Ostrya virginiana (Miller) K. Koch	Hop Hornbeam	G5	S5	No	No	x											x
Chenopodiaceae																	
* Chenopodium album L. var. album	Lamb's Quarters	G5TNR	SNA	No	No		x										
Amaranthaceae																	
* Amaranthus albus L.	White Pigweed	GNR	SNA	No	No									x			
Portulacaceae																	
Claytonia caroliniana Michx.	Carolina Spring-beauty	G5	S5	No	R3	x											
Claytonia virginica L.	Narrow-leaved Spring Beauty	G5	S5	No	No	x											



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Caryophyllaceae																
* Cerastium fontanum Baumg.	Mouse-eared Chickweed	GNR	SNA	No	No	x										
* Saponaria officinalis L.	Bouncing-bet	GNR	SNA	No	No	x										
* Silene latifolia Poir.	Bladder Champion	GNR	SNA	No	No	x	x					x				x
Polygonaceae																
Polygonum lapathifolium L.	Dock-leaf Smartweed	G5	S5	No	No											x
* Polygonum persicaria L.	Lady's Thumb	G3G5	SNA	No	No			x	x							x
Polygonum virginianum L.	Virginia Knotweed	G5	S4	No	No	x	x									
* Rumex crispus L.	Curly Dock	GNR	SNA	No	No		x						x		x	x
Guttiferae																
* Hypericum perforatum L.	Common St. John's-wort	GNR	SNA	No	No							x		x		x
Hypericum punctatum Lam.	Common St. John's-wort	G5	S5	No	No	x	x					x				x
Triadenum fraseri (Spach) Gleason	Marsh St. John's-wort	G5	S5	No	No	x										
Tiliaceae																
Tilia americana L.	American Basswood	G5	S5	No	No	x							x			x
* Tilia cordata Miller	Little-leaf Linden	GNR	SNA	No	No		x						x			
Malvaceae																
* Malva neglecta Wallr.	Common Mallow	GNR	SNA	No	No	x										
Violaceae																
Viola pubescens Aiton	Downy Yellow Violet	G5TNR	S5	No	No	x	x									
Viola sororia Willd.	Woolly Blue Violet	G5	S5	No	No	x							x			
Viola sp.	Violet	GNR	S?	?	?	x							x			
Cucurbitaceae																
Echinocystis lobata (Michx.) Torr. & A. Gray	Wild Cucumber	G5	S5	No	No	x		x						x		
Salicaceae																
Populus balsamifera L. ssp. balsamifera	Balsam Poplar	G5	S5	No	No											x
Populus deltoides Bartram ex Marshall ssp. deltoides	Eastern Cottonwood	G5T5	SU	No	No							x	x			x



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Populus grandidentata Michx.	Large-tooth Aspen	G5	S5	No	No											x
Populus tremuloides Michx.	Trembling Aspen	G5	S5	No	No	x	x					x	x			
* Salix alba L.	White Willow	G5TNR	SNA	No	No							x				
Salix bebbiana Sarg.	Beaked Willow	G5	S5	No	No			x							x	
Salix exigua Nutt.	Sandbar Willow	G5	S5	No	No										x	
Salix petiolaris Sm.	Slender Willow	G5	S5	No	No			x								x
* Salix x rubens Schrank	Hybrid Willow	GNA	SNA	No	No			x	x						x	
Brassicaceae																
* Alliaria petiolata (M. Bieb.) Cavara & Grande	Garlic Mustard	GNR	SNA	No	No	x	x					x	x			x
* Barbarea vulgaris R. Br.	Yellow Rocket	GNR	SNA	No	No							x				
Cardamine concatenata (Michx.) Schwein.	Cutleaf Toothwort	G5	S5	No	No	x										
Cardamine diphylla (Michx.) Alph. Wood	Two-leaf Toothwort	G5	S5	No	No	x										
Cardamine x maxima (Nutt.) Alph. Wood	Hybrid Cress	GNA	S3	Yes	No	x										
* Hesperis matronalis L.	Dame's Rocket	G4G5	SNA	No	No	x						x	x			
* Nasturtium officinale R. Br.	True Watercress	G?	SNA	No	No	x										
Pyrolaceae																
Pyrola elliptica Nutt.	Shinleaf	G5	S5	No	No		x									
Monotropaceae																
Monotropa uniflora L.	Indian Pipe	G5	S5	No	No							x				
Primulaceae																
Lysimachia ciliata L.	Fringed Loosestrife	G5	S5	No	No	x										
* Lysimachia nummularia L.	Creeping Jennie	GNR	SNA	No	No	x		x								
Grossulariaceae																
Ribes americanum Miller	Wild Black Currant	G5	S5	No	No	x										
Ribes cynosbati L.	Prickly Gooseberry	G5	S5	No	No	x						x				
Rosaceae																
Agrimonia gryposepala Wallr.	Tall Hairy Groovebur	G5	S5	No	No	x						x				
Amelanchier sp.	Serviceberry	GNR	S?	?	?	x										



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Crataegus sp.	Hawthorn	GNR	S?	?	?	x						x	x	x	x	x
Fragaria virginiana Miller ssp. glauca (S. Watson) Staudt	Strawberry	G5	SU	No	No								x			
Fragaria virginiana Miller ssp. virginiana	Virginia Strawberry	G5	SU	No	No	x						x	x	x	x	x
Geum aleppicum Jacq.	Yellow Avens	G5T5	S5	No	No	x							x			x
Geum canadense Jacq.	White Avens	G5	S5	No	No	x	x						x			x
Geum sp.	Geum	GNR	S?	?	?	x										
* Malus pumila Miller	Common Crabapple	G5	SNA	No	No	x						x	x	x		x
Physocarpus opulifolius (L.) Maxim.	Ninebark	G5	S5	No	No											x
Potentilla norvegica L.	Norway Cinquefoil	G5	S5	No	No							x				
* Potentilla recta L.	Sulphur Cinquefoil	GNR	SNA	No	No							x				x
Potentilla simplex Michx.	Common Cinquefoil	G5	S5	No	No	x										x
* Prunus avium (L.) L.	Sweet Cherry	GNR	SNA	No	No	x							x	x		
Prunus nigra Aiton	Canada Plum	G4G5	S4	No	No								x			
Prunus serotina Ehrh.	Black Cherry	G5	S5	No	No	x	x						x			x
Prunus virginiana L.	Choke Cherry	G5	S5	No	No	x	x									x
Rosa blanda Aiton	Smooth Rose	G5	S5	No	No	x										
* Rosa multiflora Thunb. ex Murray	Multiflora Rose	GNR	SNA	No	No	x				x			x		x	
? Rosa sp.	Rose	GNR	S?	?	?	x	x						x			x
Rubus allegheniensis Porter	Allegheny Blackberry	G5	S5	No	No	x										
Rubus canadensis L.	Smooth Blackberry	G5	S4?	Yes	R2	x							x			
Rubus idaeus L. ssp. melanolasius (Dieck) Focke	Red Raspberry	G5T5	S5	No	No	x	x					x	x	x	x	x
Rubus occidentalis L.	Black Raspberry	G5	S5	No	No	x							x	x	x	
Sorbus decora (Sarg.) C.K. Schneid.	Northern Mountain-ash	G4G5	S5	Yes	No	x	x									
Fabaceae																
Amphicarpaea bracteata (L.) Fern.	American Hog-peanut	G5	S5	No	No	x										
* Coronilla varia L.	Crown-vetch	GNR	SNA	No	No	x							x			
Desmodium canadense (L.) DC.	Showy Tick-trefoil	G5	S4	No	No		x									



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Desmodium glutinosum (Muhlenb. ex Willd.) Alph. Wood	Pointed-leaved Tick-trefoil	G5	S4	No	No	x	x									x
Gleditsia triacanthos L.	Honey Locust	G5	S2	No	No							x				
* Lotus corniculatus L.	Birds-foot Trefoil	GNR	SNA	No	No				x		x	x	x	x	x	x
* Medicago lupulina L.	Black Medic	GNR	SNA	No	No											x
* Medicago sativa L. ssp. falcata (L.) Arcang.	Alfalfa	GNRTNR	SNA	No	No									x		
* Melilotus alba Medik.	White Sweet Clover	G5	SNA	No	No	x	x								x	x
* Melilotus officinalis (L.) Pall.	Yellow Sweet Clover	GNR	SNA	No	No						x		x	x		
* Robinia pseudo-acacia L.	Black Locust	G5	SNA	No	No								x			
* Trifolium pratense L.	Red Clover	GNR	SNA	No	No				x						x	
* Trifolium repens L.	White Clover	GNR	SNA	No	No						x					x
* Vicia cracca L.	Tufted Vetch	GNR	SNA	No	No				x		x				x	x
Lythraceae																
* Lythrum salicaria L.	Purple Loosestrife	G5	SNA	No	No			x	x						x	x
Onagraceae																
Circaea lutetiana L. ssp. canadensis (L.) Aschers. & Magnusson	Enchanter's Nightshade	G5	S5	No	No	x	x					x				x
Cornaceae																
Cornus alternifolia L. f.	Alternate-leaf Dogwood	G5	S5	No	No	x										
Cornus foemina Miller ssp. racemosa (Lam.) J.S. Wilson	Grey Dogwood	G5	S5	No	No	x	x	x	x			x		x		x
Cornus stolonifera Michx.	Red-osier Dogwood	G5	S5	No	No				x			x				
Celastraceae																
* Euonymus alata (Thunb.) Siebold	Winged Burning Bush	GNR	SNA	No	No	x										x
Euonymus obovata Nutt.	Running Strawberry-bush	G5	S5	No	No	x										
Rhamnaceae																
* Rhamnus cathartica L.	European Buckthorn	GNR	SNA	No	No	x	x		x		x	x	x	x	x	x
* Rhamnus frangula L.	Glossy Buckthorn	GNR	SNA	No	No	x			x				x			
Vitaceae																



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Parthenocissus vitacea (Knerr) Hitchc.	Inserted Virginia Creeper	G5	S5			x	x					x			x	x
Vitis riparia Michx.	Riverbank Grape	G5	S5	No	No	x	x		x			x	x	x	x	x
Hippocastanaceae																
* Aesculus hippocastanum L.	Horse Chestnut	GNR	SNA	No	No	x										
Aceraceae																
Acer negundo L.	Manitoba Maple	G5	S5	No	No	x		x				x	x			x
* Acer platanoides L.	Norway Maple	GNR	SE5	No	No							x				
Acer rubrum L.	Red Maple	G5	S5	No	No	x										x
Acer saccharinum L.	Silver Maple	G5	S4S5	No	No							x				
Acer saccharum Marshall ssp. nigrum (Michx. f.) Desmarais	Black Maple	G5T5	S4?	No	No	x		x				x				
Acer saccharum Marshall ssp. saccharum	Sugar Maple	G5T5	S5	No	No	x	x					x	x		x	x
Acer spicatum Lam.	Mountain Maple	G5	S5	No	No			x								
Acer x freemanii E. Murr.	Hybrid Soft Maple	GNA	SNR	No	No										x	
Anacardiaceae																
Rhus aromatica Aiton	Fragrant Sumac	G5	S5	Yes	R1										x	
Rhus radicans L. ssp. negundo (Greene) McNeill	Climbing Poison-ivy	G5T5	S5	No	No	x										
Rhus rydbergii Small ex Rydb.	Western Poison-ivy	G5	S5	No	No	x	x					x	x			x
Rhus typhina L.	Staghorn Sumac	G5	S5	No	No	x	x					x	x		x	x
Simaroubaceae																
* Ailanthus altissima (Miller) Swingle	Tree-of-heaven	GNR	SNA	No	No	x						x	x			
Oxalidaceae																
Oxalis stricta L.	Upright Yellow Wood-sorrel	G5	S5	No	No	x	x					x				x
Geraniaceae																
Geranium maculatum L.	Wild Crane's-bill	G5	S5	No	No	x						x				
* Geranium robertianum L.	Herb-robert	G5	SNA	No	No	x	x					x				
Balsaminaceae																
Impatiens capensis Meerb.	Spotted Jewel-weed	G5	S5	No	No	x		x	x			x	x			



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Araliaceae																
Aralia nudicaulis L.	Wild Sarsaparilla	G5	S5	No	No	x										
* Hedera helix L.	English Ivy	GNR	SNA	No	No											x
Apiaceae																
* Aegopodium podagraria L.	Goutweed	GNR	SNA	No	No							x				
* Daucus carota L.	Wild Carrot	GNR	SNA	No	No		x		x		x	x	x	x	x	x
Osmorhiza longistylis (Torr.) DC.	Smooth Sweet-cicely	G5	S5	No	No	x										
Apocynaceae																
Apocynum androsaemifolium L.	Spreading Dogbane	G5	S5	No	No	x									x	x
Apocynum cannabinum L.	Indian Hemp	G5	S5	No	No						x	x				x
* Vinca minor L.	Periwinkle	GNR	SNA	No	No	x	x									
Asclepiadaceae																
Asclepias exaltata L.	Poke Milkweed	G5	S4	No	No	x										
Asclepias incarnata L.	Swamp Milkweed	G5	S5	No	No				x				x		x	
Asclepias syriaca L.	Common Milkweed	G5	S5	No	No						x	x	x	x	x	x
Solanaceae																
* Solanum dulcamara L.	Climbing Nightshade	GNR	SNA	No	No	x						x				x
Convolvulaceae																
Cuscuta gronovii Willd. ex Schultz	Swamp Dodder	G5	S5	No	No				x							
Polemoniaceae																
* Phlox paniculata L.	Fall Phlox	G5	SNA	No	No	x										
Hydrophyllaceae																
Hydrophyllum virginianum L.	Virginia Waterleaf	G5	S5	No	No	x										
Boraginaceae																
* Lithospermum officinale L.	European Gromwell	GNR	SNA	No	No	x						x				
Verbenaceae																
Verbena hastata L.	Blue Vervain	G5	S5	No	No				x						x	
Verbena urticifolia L.	White Vervain	G5	S5	No	No							x			x	



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Lamiaceae																
Clinopodium vulgare L.	Field Basil	G5	S5	No	No	x	x					x	x	x	x	x
Collinsonia canadensis L.	Horsebalm	G5	S4	No	No	x										x
* Leonurus cardiaca L.	Motherwort	GNR	SNA	No	No	x	x					x				x
Lycopus americanus Muhlenb. ex Bartram	American Bugleweed	G5	S5	No	No			x	x						x	
Monarda fistulosa L.	Wild Bergamot	G5	S5	No	No	x							x			x
* Nepeta cataria L.	Catnip	GNR	SNA	No	No										x	
Prunella vulgaris L. ssp. lanceolata (W.C. Barton) Hultén	Heal-all	G5T5	S5	No	No	x	x					x		x		x
Scutellaria lateriflora L.	Mad Dog Skullcap	G5	S5	No	No				x							
Teucrium canadense L. ssp. canadense	Wood Germander	G5T5	S5?	No	R4				x							
Plantaginaceae																
* Plantago lanceolata L.	English Plantain	G5	SNA	No	No							x			x	x
* Plantago major L.	Nipple-seed Plantain	G5	SNA	No	No	x					x		x	x		x
Plantago rugelii Decne.	Black-seed Plantain	G5	S5	No	No										x	
Oleaceae																
* Forsythia viridissima Lindl.	Forsythia	GNA	SNA	No	No							x				
Fraxinus americana L.	White Ash	G5	S5	No	No	x					x	x				x
Fraxinus pennsylvanica Marshall	Green Ash	G5	S5	No	No	x		x	x			x			x	
* Ligustrum vulgare L.	European Privet	GNR	SNA	No	No	x	x					x				
* Syringa vulgaris L.	Lilac	GNR	SNA	No	No							x				
Scrophulariaceae																
* Linaria vulgaris Miller	Butter-and-eggs	GNR	SNA	No	No											x
* Verbascum thapsus L.	Great Mullein	GNR	SNA	No	No	x					x				x	x
* Veronica officinalis L.	Gypsy-weed	G5	SNA	No	No	x						x				
* Veronica serpyllifolia L. ssp. serpyllifolia	Thyme-leaved Speedwell	G5TNR	SNA	No	No	x										
Bignoniaceae																
Campsis radicans (L.) Seem. ex Bureau	Trumpet Creeper	G5	S2?	Yes	No	x						x				



Scientific Name	Common Name	Rarity Status				Vegetation Community												
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAD	CUP	CUW	CUS	CUT	CUM	H		
Campanulaceae																		
Lobelia inflata L.	Indian-tobacco	G5	S5	No	No	x							x			x		
Rubiaceae																		
Galium asprellum Michx.	Rough Bedstraw	G5	S5	No	No					x								
Galium circaezans Michx.	Wild Licorice	G5	S5	No	No												x	
* Galium mollugo L.	White Bedstraw	GNR	SNA	No	No											x		
Galium sp.	Bedstraw	GNR	S?	?	?											x	x	
Galium triflorum Michx.	Fragrant Bedstraw	G5	S5	No	No	x							x	x			x	
Caprifoliaceae																		
Lonicera dioica L.	Mountain Honeysuckle	G5	S5	No	No	x								x				
* Lonicera tatarica L.	Tartarian Honeysuckle	GNR	SNA	No	No	x	x							x		x	x	
Sambucus canadensis L.	Common Elderberry	G5T5	S5	No	No	x												
Sambucus racemosa L. ssp. pubens (Michx.) House	Red-berried Elderberry	G5	S5	No	No	x												
Symphoricarpos albus (L.) S.F. Blake	Snowberry	G5T5	S4S5	No	No											x		
* Symphoricarpos occidentalis Hook.	Northern Snowberry	G5	SNA	No	No	x										x		
Triosteum aurantiacum E.P. Bicknell	Wild Coffee	G5	S5	No	No	x												
Viburnum acerifolium L.	Maple-leaved Viburnum	G5	S5	No	No	x											x	
Viburnum lentago L.	Nannyberry	G5	S5	No	No	x												
* Viburnum opulus L.	Guelder Rose	G5	SNA	No	No									x			x	
Viburnum rafinesquianum Schult.	Downy Arrow-wood	G5	S5	No	No	x												
Viburnum recognitum Fern	Southern Arrow-wood	G4G5	S4	No	No	x												
Viburnum trilobum Marshall	Highbush Cranberry	G5T5	S5	No	No	x	x						x	x				
Dipsacaceae																		
* Dipsacus fullonum L. ssp. sylvestris (Hudson) Clapham	Wild Teasel	GNR	SNA	No	No								x				x	x
Asteraceae																		
* Achillea millefolium L.	Common Yarrow	G5T?	SNA	No	No								x			x		x
Ambrosia artemisiifolia L.	Annual Ragweed	G5	S5	No	No	x					x			x	x		x	x



Scientific Name	Common Name	Rarity Status				Vegetation Community										
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAO	CUP	CUW	CUS	CUT	CUM	H
Ambrosia trifida L.	Great Ragweed	G5	S5	No	No	x	x					x			x	x
Antennaria parlinii Fern. ssp. parlinii	Parlin's Pussy-toes	G5?T5?	SU	No	No	x										
* Arctium minus (Hill) Bernh.	Common Burdock	GNA	SNA	No	No	x						x			x	x
Bidens frondosa L.	Devil's Beggar-ticks	G5	S5	No	No	x							x			x
* Centaurea jacea L.	Brown Starthistle	GNR	SNA	No	No		x					x				x
* Centaurea nigra L.	Short-fringe Starthistle	GNR	SNA	No	No	x						x		x	x	x
* Chrysanthemum leucanthemum L.	Oxeye Daisy	GNR	SNA	No	No									x	x	
* Cichorium intybus L.	Chicory	GNR	SNA	No	No							x	x		x	
* Cirsium arvense (L.) Scop.	Canada Thistle	GNR	SNA	No	No	x				x		x		x	x	x
* Cirsium vulgare (Savi) Ten.	Bull Thistle	GNR	SNA	No	No		x					x	x	x	x	x
Conyza canadensis (L.) Cronquist	Canada Fleabane	G5	S5	No	No								x		x	
Erigeron annuus (L.) Pers.	White-top Fleabane	G5	S5	No	No	x	x	x				x	x	x	x	x
Erigeron philadelphicus L.	Philadelphia Fleabane	G5	S5	No	No	x										
Eupatorium maculatum L. ssp. maculatum	Spotted Joe-pye-weed	G5TNR	S5	No	No			x	x			x	x			
Eupatorium perfoliatum L.	Common Boneset	G5	S5	No	No			x	x							
Euthamia graminifolia (L.) Nutt.	Flat-top Fragrant-golden-rod	G5	S5	No	No				x				x		x	x
Helianthus tuberosus L.	Jerusalem Artichoke	G5	S5	No	No	x						x				
* Hieracium aurantiacum L.	Orange Hawkweed	GNR	SNA	No	No	x									x	
* Hieracium caespitosum Dumort. ssp. caespitosum	Yellow Hawkweed		SNA	No	No	x										
* Lactuca serriola L.	Prickly Lettuce	GNR	SNA	No	No							x				
Prenanthes alba L.	White Lettuce	G5	S5	No	No	x										
Prenanthes sp.	White Lettuce	GNR	S?	?	?	x										
Rudbeckia hirta L.	Black-eyed Susan	G5	S5	No	No	x										x
Solidago caesia L.	Bluestem Goldenrod	G5	S5	No	No	x										x
Solidago canadensis var. canadensis	Canada Goldenrod	G5T5	S5			x	x					x	x	x	x	x
Solidago flexicaulis L.	Broad-leaved Goldenrod	G5	S5	No	No	x										
Solidago gigantea Aiton	Smooth Goldenrod	G5	S5	No	No								x			x



Scientific Name	Common Name	Rarity Status				Vegetation Community											
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAD	CUP	CUW	CUS	CUT	CUM	H	
Solidago juncea Aiton	Early Goldenrod	G5	S5	No	No							x			x	x	
* Sonchus arvensis L. ssp. arvensis	Field Sow-thistle	GNRTNR	SNA	No	No										x		x
Symphotrichum cordifolium (L.) Nesom	Heart-leaved Aster	G5	S5	No	No	x						x					
Symphotrichum ericoides (L.) Nesom var. ericoides	White Heath Aster	G5T5	S5	No	No	x						x					
Symphotrichum lanceolatum (Willd.) Nesom ssp. hesperium (A. Gray) Nesom	Lance-leaved Aster	G5T5?	S5	No	No	x											
Symphotrichum lanceolatum (Willd.) Nesom ssp. lanceolatum	Panicled Aster	G5T5	S5	No	No	x			x			x		x		x	
Symphotrichum lateriflorum (L.) Löve & Löve var. lateriflorum	One-sided Aster	G5T5	S5	No	No												x
Symphotrichum novae-angliae (L.) Nesom	New England Aster	G5	S5	No	No							x	x	x			x
Symphotrichum puniceum (L.) Love & Love	Purple-stemmed Aster	G5	S5	No	No												x
Symphotrichum sp.	Aster	GNR	S?	?	?								x				
Symphotrichum urophyllum (Lindl. in DC.) Nesom	Arrow-leaved Aster	G4G5	S4	No	No	x							x				x
* Taraxacum officinale G. Weber	Common Dandelion	G5	SNA	No	No	x							x	x			
* Tussilago farfara L.	Colt's Foot	GNR	SNA	No	No	x	x										x
Alismataceae																	
Alisma plantago-aquatica L.	Broad-leaved Water-plantain	G5	SNA	No	No					x							
Potamogetonaceae																	
* Potamogeton crispus L.	Curly Pondweed	G5	SNA	No	No						x						
Potamogeton richardsonii (A. Bennett) Rydb.	Richardson's Pondweed	G5	S5	No	R2												x
Araceae																	
Arisaema triphyllum (L.) Schott	Jack-in-the-pulpit	G5	S5	No	No	x											
Lemnaceae																	
Lemna minor L.	Lesser Duckweed	G5	S5	No	No					x							
Commelinaceae																	
* Tradescantia virginiana L.	Virginia Spiderwort	G5	SNA	No	No		x										
Juncaceae																	



Scientific Name	Common Name	Rarity Status				Vegetation Community											
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAO	CUP	CUW	CUS	CUT	CUM	H	
Juncus brevicaudatus (Engelm.) Fern.	Narrow-panicled Rush	G5	S5	Yes	No											x	
Juncus bufonius L.	Toad Rush	G5	S5	No	No	x				x							
Juncus effusus L. ssp. solutus (Fern. & Wiegand) Hämet-Ahti	Soft Rush	G5	S5	No	No											x	
Juncus tenuis Willd.	Path Rush	G5	S5	No	No					x			x	x	x		
Luzula acuminata Raf.	Hairy Woodrush	G5	S5	No	No	x											
Cyperaceae																	
Carex albursina E. Sheld.	White Bear Sedge	G5	S5	No	No	x											
Carex bebbii (L.H. Bailey) Olney ex Fern.	Bebb's Sedge	G5	S5	No	No					x							
Carex cephalophora Muhlenb. ex Willd.	Oval-leaved Sedge	G5	S5	No	No	x											
Carex comosa Boott	Bristly Sedge	G5	S5	No	No					x							
Carex deweyana Schwein.	Short-scale Sedge	G5	S5	No	No	x											
Carex gracillima Schwein.	Graceful Sedge	G5	S5	No	No												x
Carex granularis Muhlenb. ex Willd.	Meadow Sedge	G5	S5	No	No	x											
Carex hitchcockiana Dewey	Hitchcock's Sedge	G5	S5	No	No	x											
Carex intumescens Rudge	Bladder Sedge	G5	S5	No	No	x											
Carex pennsylvanica Lam.	Pennsylvania Sedge	G5	S5	No	No	x							x				x
Carex plantaginea Lam.	Plantain-leaved Sedge	G5	S5	No	No	x											
Carex platyphylla J. Carey	Broad-leaved Sedge	G5	S5	No	No	x											
Carex radiata (Wahlenb.) Small	Stellate Sedge	G4	S4	No	No	x											
Carex rosea Schkuhr ex Willd.	Rosy Sedge	G5	S5	No	No	x											
Carex sp.	Sedge	GNR	S?	?	?	x											
Carex sparganioides Muhlenb. ex Willd.	Burreed Sedge	G5	S5	No	No	x											
Carex stipata Muhlenb. ex Willd.	Stalk-grain Sedge	G5	S5	No	No					x						x	
Carex vulpinoidea Michx.	Fox Sedge	G5	S5	No	No					x				x		x	x
Cyperus strigosus L.	Straw-colored Cyperus	G5	S5	No	No												x
Eleocharis erythropoda Steud.	Red-stemmed Spike-rush	G5	S5	No	No					x	x						
Eleocharis smallii Britton	Creeping Spike-rush	G5?	S5	No	R3											x	



Scientific Name	Common Name	Rarity Status				Vegetation Community										
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAO	CUP	CUW	CUS	CUT	CUM	H
Scirpus atrovirens Willd.	Dark-green Bulrush	G5?	S5	No	No			x	x				x			x
Scirpus cyperinus (L.) Kunth	Wool-grass	G5	S5	No	No										x	
Scirpus validus L.	Softstem Bulrush	GNR	S5	No	No				x							
Poaceae																
* Agrostis gigantea Roth	Red-top	G4G5	SNA	No	No				x							
Agrostis stolonifera L.	Spreading Bentgrass	G5	S5	No	No			x	x							
* Bromus inermis Leys. ssp. inermis	Smooth Brome	G5TNR	SNA	No	No	x					x	x		x	x	x
Calamagrostis canadensis (Michx.) Beauv.	Canada Blue-joint	G5	S5	No	No			x	x				x			x
* Dactylis glomerata L.	Orchard Grass	GNR	SNA	No	No	x	x					x	x		x	x
* Echinochloa crusgalli (L.) P. Beauv.	Barnyard Grass	GNR	SNA	No	No				x						x	x
Elymus hystrix L.	Bottlebrush Grass	G5	S5	No	No											x
* Elymus repens (L.) Gould	Quack Grass	GNR	SNA	No	No							x				x
Glyceria grandis S. Watson	American Manna-grass	G5	S4S5	No	No				x							
Glyceria striata (Lam.) A. Hitchc.	Fowl Manna-grass	G5T5	S4S5	No	No	x		x	x			x				
Leersia oryzoides (L.) Sw.	Rice Cutgrass	G5	S5	No	No			x	x			x				
Panicum sp.	Panic Grass	GNR	S?	No	No	x										
Phalaris arundinacea L.	Reed Canary Grass	G5	S5	No	No			x					x		x	
* Phleum pratense L.	Meadow Timothy	GNR	SNA	No	No				x		x		x	x	x	x
Poa pratensis L. ssp. pratensis	Kentucky Bluegrass	G5T5	S5	No	No	x			x		x		x	x	x	x
* Setaria faberi R.A.W. Herrm.	Giant Foxtail	GNR	SNA	No	No											x
* Triticum aestivum L.	Cultivated Wheat	GNR	SNA	No	No	x										
Sparganiaceae																
Sparganium sp.	Bur-reed	GNR	S?	?	?				x							
Typhaceae																
Typha latifolia L.	Broad-leaf Cattail	G5	S5	No	No				x						x	
Liliaceae																
Allium canadense L.	Canada Wild Onion	G5	S5	No	No		x								x	
Allium tricoccum Aiton	Wild Leek	G5	S5	No	No	x										



Scientific Name	Common Name	Rarity Status				Vegetation Community											
		G Rank	S Rank	SW Ont	Middlesex	FOD	FOM/CUP	SWD/MAM	MAS	OAD	CUP	CUW	CUS	CUT	CUM	H	
* Asparagus officinalis L.	Asparagus	G5?	SNA	No	No							x				x	
* Convallaria majalis L.	Lily-of-the-valley	G5	SNA	No	No		x						x				
Erythronium americanum Ker Gawl.	Yellow Trout Lily	G5	S5	No	No	x							x				
* Hemerocallis fulva (L.) L.	Orange Daylily	GNA	SNA	No	No	x							x				x
Maianthemum canadense Desf.	Wild-lily-of-the-valley	G5	S5	No	No	x											x
Maianthemum racemosum (L.) Link ssp. racemosum	False Solomon's Seal	G5	S5	No	No	x	x						x				x
* Polygonatum multiflorum (L.) All.	Eurasian Solomon's-seal	GNR	SNA	No	No								x				
Polygonatum pubescens (Willd.) Pursh	Downy Solomon's-seal	G5	S5	No	No	x											
Streptopus roseus Michx.	Rose Twisted-stalk	G5	S5	No	No	x											
Trillium erectum L.	Red Trillium	G5	S5	No	No	x											
Trillium grandiflorum (Michx.) Salisb.	White Trillium	G5	S5	No	No	x							x				
Uvularia grandiflora Sm.	Large-flowered Bellwort	G5	S5	No	No	x											
Iridaceae																	
* Iris pseudacorus L.	Yellow Iris	GNR	SNA	No	No							x					
Smilacaceae																	
Smilax herbacea L.	Smooth Herbaceous Greenbrier	G5	S4	No	No	x				x							x
Smilax hispida Muhlenb. ex Torr.	Hispid Greenbrier	G5	S4	No	No	x											
Orchidaceae																	
* Epipactis helleborine (L.) Crantz	Eastern Helleborine	GNR	SNA	No	No	x											



APPENDIX 2. FAUNA



Appendix 2. Fauna documented from the Boler Mountain Study Area in 2011 and 2012. * indicates and introduced species.

Scientific Name	Common Name	Rarity Status							Evidence	Vegetation Communities											
		G Rank	S Rank	COSEWIC	MNR	Middlesex	BCR 13	Area Sensitive		FOD	FOM/CUP	SWD/MAM	MAS	OAD	CUP	CUW	CUS	CUT	CUM	H	
Bird																					
Branta canadensis	Canada Goose	G5	S5						C					x							
Anas platyrhynchos	Mallard	G5	S5						PO					x							
Accipiter cooperii	Cooper's Hawk	G5	S4	NAR	NAR	L3		Yes	PO		x										
Buteo jamaicensis	Red-tailed Hawk	G5	S5	NAR	NAR				PO	x	x										
Charadrius vociferus	Killdeer	G5	S5B,S5N						PO	x							x				
Zenaida macroura	Mourning Dove	G5	S5						PO	x	x					x	x		x	x	
Bubo virginianus	Great Horned Owl	G5	S5						PO												
Ceryle alcyon	Belted Kingfisher	G5	S4B						PO	x				x							
Melanerpes carolinus	Red-bellied Woodpecker	G5	S4			L1			PR	x	x		x								
Picoides pubescens	Downy Woodpecker	G5	S5						PO	x	x		x							x	
Picoides villosus	Hairy Woodpecker	G5	S5					Yes	PO	x											
Colaptes auratus	Northern Flicker	G5	S4B						PO	x										x	
Contopus virens	Eastern Wood-pewee	G5	S4B						PR												
Sayornis phoebe	Eastern Phoebe	G5	S5B			L3			PO	x											
Tyrannus tyrannus	Eastern Kingbird	G5	S4B			L3			PO							x	x				
Myiarchus crinitus	Great Crested Flycatcher	G5	S4B						PO	x										x	
Vireo gilvus	Warbling Vireo	G5	S5B						PO	x			x								
Vireo olivaceus	Red-eyed Vireo	G5	S5B						PR	x	x									x	x
Cyanocitta cristata	Blue Jay	G5	S5						PO	x	x										x
Corvus brachyrhynchos	American Crow	G5	S5B						PO	x			x		x	x				x	x
Eremophila alpestris	Horned Lark	G5	S5B			L3			PO												
Tachycineta bicolor	Tree Swallow	G5	S4B						PO				x				x				
Riparia riparia	Bank Swallow	G5	S4B			L1			OB				x								



Scientific Name	Common Name	Rarity Status							Evidence	Vegetation Communities										
		G Rank	S Rank	COSEWIC	MNR	Middlesex	BCR 13	Area Sensitive		FOD	FOM/CUP	SWD/MAM	MAS	OAD	CUP	CUW	CUS	CUT	CUM	H
Hirundo rustica	Barn Swallow	G5	S4B	THR		L3			OB				x			x	x			
Poecile atricapillus	Black-capped Chickadee	G5	S5			L4			PR	x	x					x	x	x	x	x
Sitta carolinensis	White-breasted Nuthatch	G5	S5					Yes	PO	x							x			
Thryothorus ludovicianus	Carolina Wren	G5	S4			L3			PO	x										
Troglodytes aedon	House Wren	G5	S5B						PR	x	x								x	x
Poliophtila caerulea	Blue-gray Gnatcatcher	G5	S4B			L4		Yes	PO	x							x			
Hylocichla mustelina	Wood Thrush	G5	S4B			L4			PR	x	x									
Turdus migratorius	American Robin	G5	S5B						PR	x							x		x	x
Dumetella carolinensis	Gray Catbird	G5	S4B			L4			PR	x		x			x	x	x	x	x	
* Sturnus vulgaris	European Starling	G5	SNA						PO	x										
Bombycilla cedrorum	Cedar Waxwing	G5	S5B						PR	x							x			
Dendroica petechia	Yellow Warbler	G5	S5B						PR	x			x				x			
Dendroica pinus	Pine Warbler	G5	S5B			L3		Yes	PO		x									
Geothlypis trichas	Common Yellowthroat	G5	S5B						PR				x				x			
Piranga olivacea	Scarlet Tanager	G5	S4B			L2		Yes	PO	x										
Spizella passerina	Chipping Sparrow	G5	S5B						PO	x	x								x	
Spizella pusilla	Field Sparrow	G5	S4B			L3			PR						x	x		x	x	x
Passerculus sandwichensis	Savannah Sparrow	G5	S4B			L1		Yes	PO										x	
Melospiza melodia	Song Sparrow	G5	S5B						PR	x	x						x	x	x	x
Cardinalis cardinalis	Northern Cardinal	G5	S5						PR	x	x						x	x		x
Pheucticus ludovicianus	Rose-breasted Grosbeak	G5	S4B						PO	x										
Passerina cyanea	Indigo Bunting	G5	S4B						PR	x		x					x	x	x	
Agelaius phoeniceus	Red-winged Blackbird	G5	S5						PR				x							
Molothrus ater	Brown-headed Cowbird	G5	S4B						PR	x	x						x	x		
Icterus galbula	Baltimore Oriole	G5	S4B						PO	x							x	x		



Scientific Name	Common Name	Rarity Status							Evidence	Vegetation Communities											
		G Rank	S Rank	COSEWIC	MNR	Middlesex	BCR 13	Area Sensitive		FOD	FOM/CUP	SWD/MAM	MAS	OAD	CUP	CUW	CUS	CUT	CUM	H	
	Carduelis tristis	American Goldfinch	G5	S5B			L3			PR	x	x				x	x	x	x	x	x
*	Passer domesticus	House Sparrow	G5	SNA						PO	x							x			
	Mammal																				
	Marmota monax	Woodchuck	G5	S5						HO	x	x						x			x
	Sciurus carolinensis	Grey Squirrel	G5	S5						OB	x	x							x		
	Tamias striatus	Eastern Chipmunk	G5	S5						OB	x										
	Microtus pennsylvanicus	Meadow Vole	G5	S5						HO											x
	Vulpes vulpes	Red Fox	G5	S5						HO	x	x									
	Odocoileus virginianus	White-tailed Deer	G5	S5						TX/SC	x			x							x
	Amphibian																				
	Bufo americanus	American Toad	G5	S5						OB	x		x								
	Hyla versicolor	Gray Treefrog	G5	S5						VO			x	x	x						
	Rana catesbeiana	American Bullfrog	G5	S4					Yes	VO/OB						x					
	Rana clamitans	Green Frog	G5	S5						VO				x	x						x
	Rana pipiens	Northern Leopard Frog	G5	S5	NAR	NAR				VO				x							
	Reptile																				
	Thamnophis sirtalis sirtalis	Eastern Garter Snake	G5T5	S5						OB	x										x
	Dragonfly/ Damselfly																				
	Libellula luctuosa	Widow Skimmer	G5	S5						OB											x
	Plathemis lydia	Common Whitetail	G5	S5						OB											x
	Butterfly/ Moth																				
	Papilio polyxenes	Black Swallowtail	G5	S5						OB	x										
*	Pieris rapae	Cabbage White	G5	SNA						OB		x				x	x				x
	Celastrina ladon	Spring Azure	G5	S5						OB											x
	Danaus plexippus	Monarch	G5	S2N,S4B	SC	SC				OB						x					x
	Vanessa atalanta	Red Admiral	G5	S5						OB						x					



APPENDIX 3: BOLER MOUNTAIN FLUVIAL GEOMORPHIC ASSESSMENT



DRAFT

Boler Mountain Study Area Fluvial Geomorphologic Assessment

August 2011

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Appendix A – Site Photographs



1. Introduction

In support of a site-level planning study, a geomorphic assessment was conducted throughout a catchment area of Dingman Creek in the City of London, Ontario in the vicinity of Boler Mountain. To provide a primary overview of existing conditions within the study area, a review of existing background information was undertaken as well as basic desktop analyses and a field investigation. In addition to characterizing the existing conditions of the study area, the results of the investigation will be used to support future development plans and to guide associated stormwater management planning.

1.1 Study Area

The Boler Mountain Study Area extends west of Wickerson Road and north of Southdale Road West (**Figure 1.1**). Residential communities occupy the northern and western limits, while land-use to the west and south is predominantly agricultural. Two branches of a Dingman Creek tributary flow in a southerly direction through the area, and confluence just south of Southdale Road West before continuing approximately 370m to Dingman Creek. An existing stormwater management pond is located at the east end of the study area and outlets to the tributary's east branch and a second pond is proposed along the western branch.

In order to account for the potential downstream effect of the proposed development site, the assessment extended beyond the site-level planning study area to include the remainder of the subject tributary and a portion of Dingman Creek immediately downstream of the confluence with the tributary.

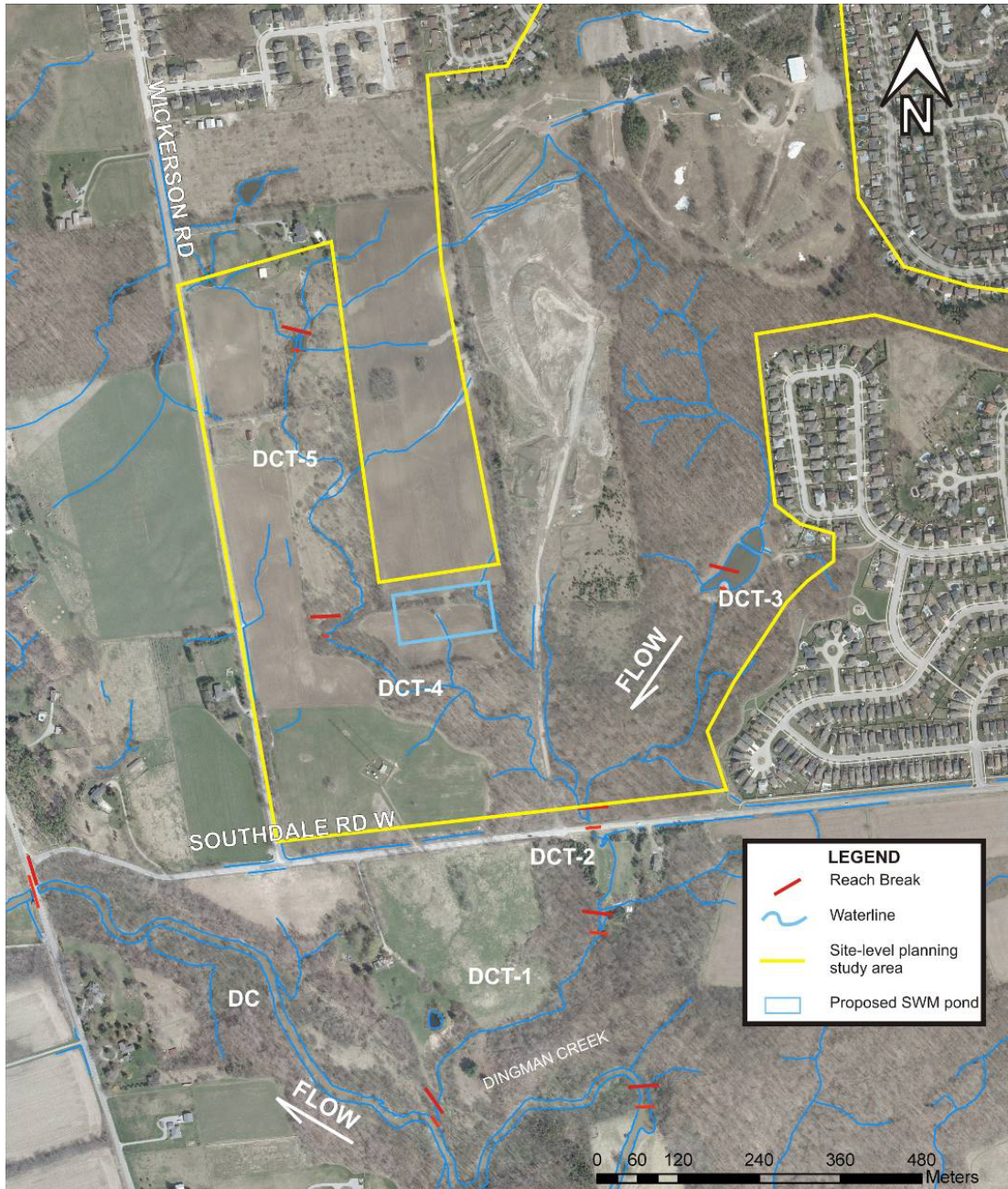


Figure 1.1 - Boler Mountain Study Area and Delineated Reaches

1.2 Aims and Objectives

A desk-based analysis and field assessment were completed to characterize the subject tributary's existing conditions. Based on this information, the potential affects on channel stability and ecological health posed by the proposed SWM pond can be identified and appropriate measures to protect the watercourse can be taken during the design of the SWM facility.



2. Desktop Assessment

2.1 Reach Delineation

The characteristics of flow or channel materials can change along a creek or stream. In order to account for these changes, channels are separated into reaches – normally several hundred meters to several kilometers in length. A reach displays similarity with respect to its physical characteristics, such as channel form, function, and valley setting. Delineation of a reach considers sinuosity, gradient, hydrology, local geology, degree of valley confinement, and vegetative control using methods outlined in PARISH Geomorphic Ltd. (2001). Based on degree of valley confinement, riparian vegetation, sinuosity and anthropogenic controls, a total of six reaches were identified for this assessment within the study area (Figure 1.1).

2.2 Background Review

A background review of available information was undertaken to draw on any previous work undertaken in relation to the study area. Reviewed data included digital aerial images, contour mapping, base plans of the proposed development, historic aerial photographs, and previous reports regarding the Dingman Creek watershed. These materials included:

Foster, G. 1998. Morphology of three semi-alluvial stream channels in Southern Ontario. Master of Science Thesis, Submitted to: The University of Western Ontario.

This research paper provides an analysis of three semi-alluvial channels within southwestern Ontario (Dingman, Oxbow and Nissouri Creeks) using detailed longitudinal profiles. Results of the detailed field investigation indicated that pool-riffle spacing is minimal, and morphology was generally poorly developed within these systems. A sensitivity analysis was also completed for various techniques used to define mean pool-riffle spacing. Findings indicated that these techniques typically over-estimate pool-riffle spacing for semi-alluvial systems. Consequently, use of these models in the development of natural channel designs for semi-alluvial channels should be re-considered, given the results presented through this work.

Aquafor Beech Ltd. 1994. Dingman Creek Subwatershed Study (Supporting Document No. 3) Erosion and Fluvial Geomorphology, Submitted to: The Corporation of the City of London and the Upper Thames River Conservation Authority.

The 1994 Erosion and Fluvial Geomorphology study included a review of watershed physiography, analysis of land use change over time, identification of ‘like’ reaches, identification of erosion sites along the main channel of Dingman Creek, a scoped field investigation and impact assessment of existing stormwater management facilities. The following are major findings with respect to stream morphology and channel erosions:



- The Dingman Creek watershed has been substantially modified through time (approximately 75% of stream reaches within Dingman Creek have been significantly altered).
- Background reports revealed 25 major erosion sites in the former Town of Westminster, and numerous sites were identified in 1982 along Dingman Creek in the former Town of Delaware.
- The channel had likely become adjusted to the landuse change from forest to agricultural land, adjustment to urbanization may still be on-going.
- The primary causes of channel degradation are attributed to sediment loading from agricultural areas, channel alterations and stream bank erosion as well as increases in flow volumes from the urban areas.
- The upper portion of Dingman Creek is subject to bar formation and loss of thalweg (the first level of degradation).
- The mid-reaches have been significantly impacted by increases in sediment load and flow volumes associated with rural and urban land uses.

Stantec Consulting Ltd. 2005. Dingman Creek Subwatershed Study Update – Channel Erosion and Stream Morphology, Submitted to: Delcan.

The intent of the fluvial geomorphology component of the DCSS Update was to follow-up on work that was completed in the 1995 DCSS. The geomorphic component of the study entailed a synoptic level field investigation of the watershed using rapid stream assessment tools (e.g., Rapid Stream Assessment (Galli, 1996) and Rapid Geomorphic Assessment (MOE, 1999)) to gain insight into channel characteristics and to identify processes that are occurring along the channel. A field investigation was undertaken to revisit sites established during the 1993 field season. The detailed field assessment included measurements of cross-sectional shape and dimensions, characterization of substrate and bank materials, flow velocity, and a topographic survey of the field site. Findings of the study indicated in-channel features and general channel form appeared to have changed little between 1993 and 2003. Overall, while the channel appeared to have good vegetative bank protection, it was deemed to be in various states of adjustment or transition towards a quasi-equilibrium form. Channel widening and enlargement were the most prevalent geomorphic processes observed, often accompanied by planform adjustment. Stabilization and recovery of disturbed channel sections was also observed indicating that the channel is working towards re-establishing a quasi-equilibrium condition. For the purpose of the Dingman Creek subwatershed update, the meander belt was defined for general discussion purposes.

Parish Geomorphic Ltd. 2006. Tributary of Dingman Creek Erosion Assessment Report.

In 2006, Parish Geomorphic Ltd conducted a fluvial geomorphic assessment on a tributary of Dingman Creek that is located downstream of Westdel Bourne Road and north of Southdale Road. This site was located near stormwater management facility, and both rapid assessments and detailed field work were conducted to determine areas susceptible to increased erosion as a result of urban development upstream of the study area. Recommendations for restoration were made based on the findings of the field work.



Parish Geomorphic Ltd. 2009. Dingman Creek Fluvial Geomorphic Assessment.

In 2009, Parish Geomorphic Ltd undertook an investigation of Dingman Creek in preparation of a proposed wetland facility at Wonderland Road and Dingman Drive, located upstream of the current study site. Both rapid assessments and detailed investigations were completed along Dingman Creek to determine sensitive areas both upstream and downstream the proposed wetland. Within this study area, Reaches 15 and 16 partially encompass the section of Dingman Creek assessed as Reach DC in the current study. During this Geomorphic Assessment, rapid assessments were completed. The field reconnaissance revealed Reach 15 to be in regime and dominated by widening processes, with Reach 16 in a transitional/stressed state and dominated by widening and degradation.

Parish Geomorphic Ltd. 2010. Wickerson Creek – Flow Monitoring and Design Update.

In 2010, Parish Geomorphic Ltd undertook an assessment and restoration study relating to a stormwater management facility that discharges into a tributary of Dingman Creek, similar to the current study site. This tributary, however, is located downstream of Westdel Bourne, just south of Byron Baseline. The study was undertaken to address concerns of erosion on private property downstream of the development site associated with the stormwater facility. Using the collected data, recommendations for channel restoration and stabilization were developed.

2.3 Morphometric Analysis

In support of the characterization of existing conditions assessment basic morphometric characteristics of the study reaches were determined using available GIS and topographic data. These included the stream length, the valley length, the corresponding sinuosity, and the valley gradient of the reach. A summary of the results has been provided in **Table 2.1**.

Table 2.1 Summary of Morphometric Parameters by Reach

Reach	Stream Length (m)	Valley Length (m)	Sinuosity	Gradient (%)
DC	1296.9	961.23	1.35	n/a
DCT-1	443.86	370.27	1.20	2.3
DCT-2	188.53	156.39	1.21	2.1
DCT-3	477.39	404.2	1.18	1.5
DCT-4	599.45	485.74	1.23	2.0
DCT-5	574.21	425.46	1.35	1.6



3. Field Reconnaissance

3.1 Rapid Assessments

During the site visit, the entire study reach was walked and Rapid Assessments (Rapid Geomorphic Assessment and Rapid Stream Assessment Technique) completed. A Rapid Geomorphic Assessment documents observed indicators of channel instability (MOE, 1999). Observations are quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel widening and planimetric adjustment. The index produces values that indicate whether the channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40) or adjusting (score >0.41).

An RSAT (Rapid Stream Assessment Technique) provides a broader view of the system by also considering the ecological functioning of the stream (Galli, 1996). Observations include instream habitat, water quality, riparian conditions, and biological indicators. Additionally, the RSAT approach includes semi-quantitative measures of bankfull channel dimensions, type of substrate, vegetative cover, and channel disturbance. RSAT scores rank the channel as maintaining a low (<20), moderate (20-35) or high (>35) degree of stream health.

3.2 Results

A summary of the applied rapid assessments is subsequently described for each study reach. Through field reconnaissance, it was observed that the tributaries were typically low-order, ephemeral, and discontinuous streams. A photographic record of existing conditions observed during the site investigations is provided in **Appendix A**.

Table 3.1 Summary of RSAT results for the Boler Mountain study area.

Reach	Factor Value						Overall Score	Condition
	Channel stability	Scour / Deposition	Instream Habitat	Water Quality	Riparian Condition	Biological Indicators		
Max. Score	11	8	8	8	7	8	50	
DC	5	4	5	2	5	3	24	Moderate
DCT-1	4	4	3	3	4	3	21	Moderate
DCT-2	7	6	2	3	2	3	23	Moderate
DCT-3	7	4	4	3	4	3	25	Moderate
DCT-4	6	5	4	4	5	3	27	Moderate
DCT-5	9	3	3	4	3	3	25	Moderate



Table 3.2 Summary of RGA results for the Boler Mountain study area

Reach	Factor Value				Stability Index	Condition
	Aggradation	Degradation	Widening	Planimetric Adjustment		
DC	0	0	0.75 ^	0.14	0.22	Transitional
DCT-1	0.14	0	0.63 ^	0.14	0.23	Transitional
DCT-2	0	0	0.22 ^	0.14	0.09	In Regime
DCT-3	0.14	0	0.57 ^	0	0.18	In Regime
DCT-4	0	0	0.57 ^	0.29	0.21	Transitional
DCT-5	0	0	0.13	0.29 ^	0.1	In Regime

^ - Dominant geomorphic process

Reach DC: Dingman Creek

Located on the east side of Westdel Bourne Road, the reach extends upstream through a deciduous forest-lined valley with designated trails along tops of valley walls. Bankfull widths measure a range of 16 – 20 m, with bankfull depths measuring 2 m. The channel gradient was moderate, while presenting a sinuous course. It also was characterized by a pool-riffle bed morphology, with pools typically comprised of coarse sand/silts and riffles comprised of coarse to very coarse sand. Pool-riffle spacing was measured to range 10 – 20 m, with deep pools, shallow riffles, and long transition sections. Although the water in the channel was very turbid, the reach displayed an overall moderate degree of ecological health. In regards to stability, the reach displayed a transitional/stressed condition, primarily being controlled by widening processes with a minor influence of planimetric adjustment. Channel widening was evidenced by fallen and leaning trees, exposed tree roots, basal scour on both sides of channel and extending >50% of subject reach, and fracture lines along the top of banks. Evidence of planimetric adjustment included the formation of chutes. There was also a minor influence of woody debris, however, a large wood debris jam was present mid-reach. A 30 m concrete bridge crosses Westdel Bourne Road at the downstream limit.

Reach DCT-1: Dingman Creek Tributary

Reach DCT-1 extends upstream from Dingman Creek, beginning approximately 700 m upstream from the 30 m bridge on Westdel Bourne Road. It extends in a northeast direction towards Southdale Road West and ends at the forest boundary. Bankfull widths measure a range of 1.5 – 3.0 m, with bankfull depths ranging 0.5 – 0.7 m. Banks have heights ranging 0.7 – 0.8 m, with steep angles throughout, and are densely vegetated by short herbs and deciduous trees. The channel was dry, presenting a moderate gradient and sinuous course. A section of the reach extends through an agricultural field surrounded by electrical fence and has been trampled by livestock. Pool substrate was composed of medium to fine



sand, and riffle substrate was composed of cobbles with very coarse sand and pebbles. There was a major influence of woody debris as both large and minor wood debris jams. Overall, the reach displayed a moderate degree of ecological health. The reach also portrayed a state of transitional/stressed stability, being primarily controlled by widening, with aggradation and planimetric adjustment also contributing to the stability. Aggradation and planimetric adjustment were evidenced by the formation of medial bars and the formation of chutes at debris jams, respectively. Fallen and leaning trees, exposed tree roots, and basal scour on both sides of the channel extending through >50% of the reach indicated widening processes within the channel. The channel was undefined for the majority of the reach, remaining undefined up to the confluence with Dingman Creek at the downstream limit.

Reach DCT-2: Dingman Creek Tributary (South of Southdale Rd W)

Reach DCT-2 extends from edge of the deciduous forest through manicured lawns with both tall and short grasses, ending at the road crossing of Southdale Road West. Bankfull widths measure 0.4 – 1.2 m, with depths measuring 0.3 – 0.7 m. The reach presented a dry channel with a moderate gradient and low sinuous course. Substrate in pools consisted of fine sand to silt, while riffle substrate was comprised of very coarse sand to gravel. The reach portrayed a moderate level of ecological health and an “in regime” state of stability. The channel was relatively stable, with minor evidence of widening and planimetric adjustment as the occurrence of large organic debris and chute formation. The reach crosses Southdale Road West via a 1.0 m diameter CSP with an ephemeral pond at the outlet, which was dry at the time of observation.

Reach DCT-3: Dingman Creek Tributary (East Branch)

This reach extends northeast from Southdale Road West upstream, ending at a SWM pond. Bankfull widths measure 2.0 – 4.0 m, and bankfull depths measure 0.6 – 1.0 m. The channel was dry, presenting a moderate gradient and sinuous course. Pool substrate was composed of medium sand, and riffle substrates were comprised of 5 – 15 cm diameter cobbles. Channel banks were densely vegetated by tall grasses, herbs, and deciduous trees. Channel disturbance included numerous pedestrian crossings, and a moderate influence of woody debris that increased towards the reach end. Overall, the reach portrayed a moderate level of ecological health. From a stability perspective, the channel is in regime, with minor influence of aggradation and widening. These processes are evidenced by the formation of medial bars, and fallen/leaning trees with exposed tree roots and basal scour along both channel banks. The SWM pond at the upstream limit of the reach outlets via a 0.4 m diameter CSP, and the downstream limit crosses Southdale Road West via a 1.0 m diameter CSP.

Reach DCT-4: Dingman Creek Tributary (West Branch)

The reach extends upstream in the northwest direction from Southdale Road West with the upstream limit parallel to the proposed SWM pond. Bankfull widths measure 1.5 – 2.5 m, with bankfull depths of 0.4 – 0.8 m. The channel was dry, with a moderate to high gradient and sinuous course. Pool substrates consist of silt and clay, while riffle substrates are comprised of very coarse gravel to large cobble with pebbles. Banks have low heights until the channel has contact with valley wall on both banks, which are



vegetated by deciduous trees and both short and tall herbs. Where confinement increases via valley wall contact, the channel becomes more defined. However, it loses definition again towards the downstream end where it dissipates into a wide floodplain immediately before a quarry access road crossing, and remains poorly defined up to the reach break. Overall, the reach portrays a moderate state of ecological health. In terms of stability, the reach is in a transitional/stressed state with influence by widening and planimetric adjustment processes. Widening processes are evidenced by the major influence of woody debris as fallen/leaning trees and exposed tree roots, as well as basal scour on both sides of the channel. Chute formation and the channel adjusting from a single thread to multiple thread channels are indices of the influence of planimetric adjustment. Channel disturbance in this area consists of trail use and pedestrian crossings, as well as a set up for recreational paintball use. At the downstream limit, the channel crosses Southdale Road West via a 1.0 m diameter CSP.

Reach DCT-5: Dingman Creek Tributary (West Branch)

This reach extends through private property, upstream of reach DCT-4 and is upstream of the proposed SWM pond. It is an undefined channel towards the upstream end with an ATV crossing located mid-reach. Bankfull widths measure 0.6 – 1.5 m, with bankfull depths of 0.15 – 0.4 m. The channel was dry, portraying a moderate gradient and sinuous course. Pool substrates consisted of silt and clay, with areas of exposed clay. Dense vegetation was present both along channel banks and within the channel as tall grasses and deciduous trees. The reach presents an overall moderate state of ecological health. In terms of stability, the reach is in regime with minor influences from widening and planimetric form, indicated through the occurrence of large organic debris and the formation of chutes.

4. Conclusions & Recommendations

A fluvial geomorphic assessment was completed for a catchment area of Dingman Creek, upstream of Westdel Bourne Road in London, Ontario. The purpose of this assessment was to determine the current conditions of the subject tributary, prior to the implementation of a stormwater management pond. To complete this assessment, Rapid Stream Assessments were performed along the subject tributary, as well as along a section of Dingman Creek. Through this field reconnaissance, it was determined that the study area was in a moderate state of ecological health. In terms of stability, it was determined the study area was either in regime or transitional/stressed, where it was mostly dominated by widening and planimetric adjustment.

The results of the assessment determined that Reach DCT-1, located at the downstream limits of the tributary was the least stable reach from a geomorphic perspective. Of the tributary reaches DCT-1 was the highest gradient (2.3%), had the lowest stream health score (RSAT 21) and scored worst from a geomorphic stability perspective (RGA 0.23). As this reach is situated downstream of the confluence with the east and west branches of the tributary and receives flows from all of the Boler Mountain catchment area which somewhat mitigates the overall impacts of changes in flow regime in one tributary or the other. The second most sensitive reach was determined to be reach DCT-4. This reach, which is located on the



west branch of the tributary is immediately downstream of the area of the proposed SWM facility. The valley gradient of this reach is 2.0%, which is slightly less than DTC-1. The reach had an RSAT score of 27, which was the best score of all assessed reaches, but scored relatively low in the RGA (0.21) which is a direct assessment of geomorphic channel stability.

In the case of both reaches, the dominant geomorphic process was widening. This was evidence through numerous factors, including bank scour, fallen/leaning trees, exposed roots, etc. It is also of note, that in both reaches the channel was not well-defined throughout the entire reach which appeared to be a product of landuse and vegetation types. Livestock access and other disturbances have influenced the channel form, while areas of forest or canopy cover typically result in a more defined channel. The nature of the watercourse, which is intermittent in nature also makes both reaches susceptible to changes in flow regime. Should continuous or near-continuous baseflow occur, areas of poor definition will eventually develop a defined channel to accommodate the continuous flows. In some cases this may be beneficial to the overall health of the watercourse by extending the wetted period, increasing the availability of habitat to fish and aquatic organisms.

The next steps are to integrate the geomorphological findings into the development of the SWM pond, leading to a design solution that is appropriate to maintain channel stability. Specifically, to support the SWM facility design an erosion threshold for the receiving watercourse should be determined as a basis for calculating discharge rates which governs the size of the facility as well as the outlet type and location. To determine an erosion threshold a more detailed field investigation would be required in one of the two most sensitive reaches (DCT-1 and DCT-4).



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Appendix A



Photo 1 - *Reach DC*. General characteristics showing vegetated banks and pool-riffle sequence.



Photo 2 - *Reach DC*. Large wood debris jam located mid-reach.



Photo 3 - Reach DC. Channel banks are steep and display exposed tree roots and basal scour. Water was turbid throughout reach during the survey



Photo 4 - Reach DCT-1. Channel banks have low heights throughout reach and are densely vegetated. Woody debris is typified by fallen and leaning trees.



Photo 5 - *Reach DCT-1*. Barbed wire and electrical fences near agricultural field boundary mid-reach, with woody debris in channel and basal scour along banks.



Photo 6 - *Reach DCT-1*. Channel has been trampled by livestock as it extends through an agricultural field.



Photo 7 - *Reach DCT-1*. Reach breaks where vegetation changes from forest to short grass at upstream limit.



Photo 8 - *Reach DCT-2*. Culvert at upstream end of reach at road crossing outlets into an ephemeral pool.



Photo 9 - *Reach DCT-2*. Portions of the reach are typified by manicured lawn with some tall grass along channel.



Photo 10 - *Reach DCT-2*. Basal scour prevalent along banks as channel becomes more defined entering a deciduous forest area.



Photo 11 - *Reach DCT-3*. Existing SWM pond located at upstream limit of reach.



Photo 12 - *Reach DCT-3*. SWM pond outlets through 0.4 m CSP, with gravel around outlet.



Photo 13 - *Reach DCT-3*. General characteristics of reach, which include: basal scour along banks, densely vegetated banks, and riffle substrate composed of small cobbles.



Photo 14 - *Reach DCT-3*. Mid-reach pedestrian crossing.



Photo 15 - *Reach DCT-3*. Southdale Road West crossing at downstream limit.



Photo 16 - *Reach DCT-4*. Channel extends through deciduous forest with woody debris and exposed tree roots present.



Photo 17 - *Reach DCT-4*. Pedestrian bridge located within channel. Reach exhibits low bank heights, exposed tree roots, and basal scour along banks.



Photo 18 - *Reach DCT-4*. Channel dissipates into wide floodplain downstream immediately before quarry access road crossing.



Photo 19 - *Reach DCT-4*. Downstream limit crossing Southdale Road West via 1.0 m diameter CSP.

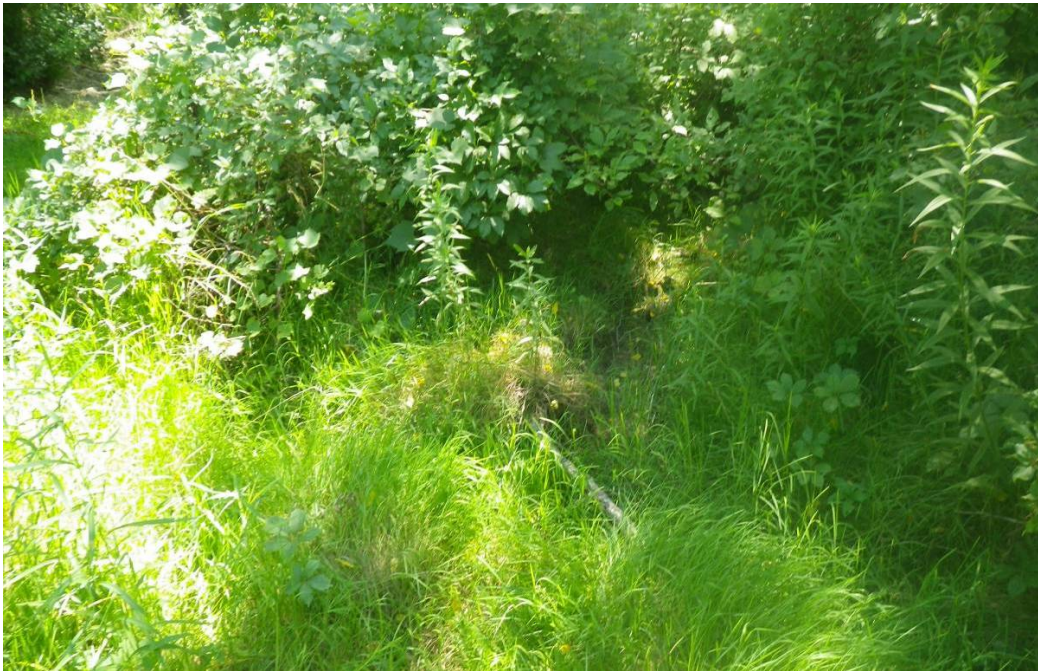


Photo 20 - *Reach DCT-5*. Upstream end of reach exhibits an undefined channel.



Photo 21 - *Reach DCT-5*. Channel begins to gain definition as it progresses downstream, where the defined banks tend to exhibit basal scour.

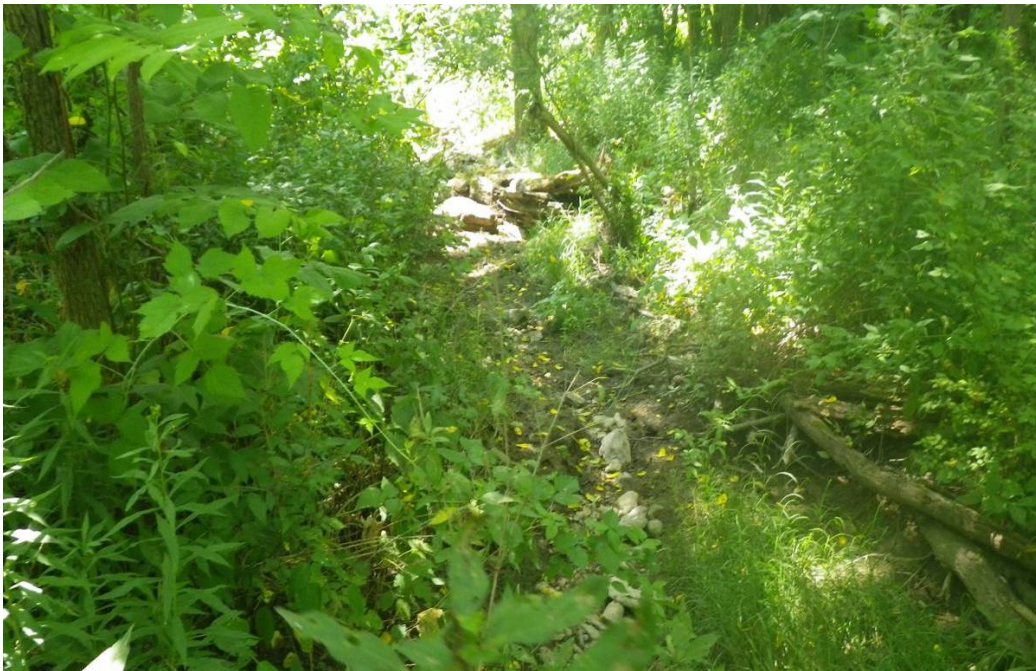


Photo 22 – *Reach DCT-5*. Banks become densely vegetated and contain minor woody debris as channel extends through deciduous forest.



Photo 23 – *Reach DCT-5*. ATV crossing located mid-reach.



Photo 24 - *Reach DCT-5*. Channel becomes defined at downstream end of the reach. Relatively densely vegetated banks exhibit basal scour.