



# The Living City Campus

## Terrestrial Biological Inventory and Assessment

July, 2013



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This report may be referenced as:

Toronto and Region Conservation Authority (TRCA). 2013. The Living  
City Campus Terrestrial Biological Inventory and Assessment.

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## 1.0 Introduction

In 2012 the Toronto Region Conservation Authority (TRCA) conducted breeding bird inventories on sections of the property known as the Living City Campus. This property is located within the City of Vaughan and is owned and managed by the TRCA (Map X). The purpose of this inventory was to update the information in order to document and assess the terrestrial biological baseline conditions of the area. Flora and vegetation community data has been collected in previous years (mostly from 1998 to 2005) but was not updated in 2012 due to limited resources. Combining the flora and fauna data, sets a baseline or current condition of the property that will be used to inform the update of the management plan and subsequent trail plan for the property.

The terrestrial biological data collected through detailed surveys also fills a gap in the regional database, and provides local context for the regional long term monitoring stations that were initiated at the site in 2008. These fixed plots are monitored annually for wetland birds, frogs, and vegetation. They provide valuable supplementary data that can be used to assess the current quality and condition of the site.

At the larger scale, the purpose of the work conducted by the TRCA during the 2012 field season was to *characterize the terrestrial natural heritage features* of the Living City Campus Study Area. Once characterized, the site features can then be understood within the larger Humber watershed and regional contexts of the Terrestrial Natural Heritage Program, enabling a better understanding of biodiversity across the jurisdiction, thereby helping to improve the Terrestrial Natural Heritage System Strategy (TNHSS) targets. The question that the inventory addresses is “*How does the area surveyed at the Living City Campus fit within the regional and watershed natural system, and how should its contribution to this system be protected and maximized?*” The important underlying message offered by this question is that the health of the natural system is measured at the regional scale and specific sites must be considered together for their benefits at all scales, from the site to the larger system.

### 1.1 TRCA’s Terrestrial Natural Heritage Program

Rapid urban expansion in the TRCA jurisdiction has led to continuous and incremental loss of natural cover and species. In a landscape that probably supported 95% forest cover prior to European settlement, current mapping shows that only 17% forest and wetland cover remains. Agricultural and natural lands are increasingly being urbanized while species continue to disappear from a landscape that is less able to support them. This represents a substantial loss of ecological integrity and ecosystem function that will be exacerbated in the future according to current urbanization trends. With the loss of natural cover, diminishing proportions of various natural vegetation communities and reduced populations of native species remain. Unforeseen stresses are then exerted on the remaining flora and fauna in the natural heritage system. They become even rarer and may eventually be lost. This trend lowers the ability of the land to support

biodiversity and to maintain or enhance human society (e.g. through increased pollution and decreased space for recreation). **The important issue is the cumulative loss of natural cover in the TRCA region that has resulted from innumerable site-specific decisions.**

In the late 1990s the TRCA initiated the Terrestrial Natural Heritage Program to address the loss of terrestrial biodiversity within the jurisdiction's nine watersheds. This work is based on two landscape-level indicators: the quality distribution of natural cover and the quantity of natural cover. The aim of the program is to create a conservation strategy that both protects elements of the natural system (vegetation communities, flora and fauna species) *before* they become rare and promotes greater ecological function of the natural system as a whole. This preventive approach is needed because by the time a community or species has become rare, irreversible damage has often already occurred. A healthy natural system capable of supporting regional biodiversity in the long term is the goal of the Terrestrial Natural Heritage Systems Strategy by setting targets – both short- and long-term (100 years) – for the two landscape indicators in order to provide direction in planning at all scales (TRCA 2007a, TRCA 2007b).

A target system that identifies a land base where natural cover should be restored is a key component of the Strategy. Although the objectives of the Strategy are based on making positive changes at all scales, the evaluation models were developed at the landscape scale using a combination of digital land cover mapping and field-collected data. Field-collected data also provides ground-level information in the application of the landscape models at the site scale. The two indicators and the targets that have been set for them are explained in Section 3.1. It is important to understand that habitat quality and distribution are interdependent. For example, neither well-distributed poor-quality natural cover nor poorly-distributed good-quality natural cover achieves the desired condition of sustainable biodiversity and social benefits across the watershed.

The natural habitat at the Living City Campus covers an extensive area as well as forming an important link along the riparian corridor of the East Humber River. It forms a large wedge extending deep into the urban zone of Vaughan from the undeveloped lands and the Oak Ridges Moraine to the north; and is the only example of its kind in the western half of the TRCA jurisdiction. This kind of feature is extremely important in maintaining effective migration and dispersal routes across the rapidly expanding urban landscape.

## 2.0 Study Area Location and History

The Living City Campus is situated in the lower reaches of the East Humber River watershed, within the City of Vaughan, York Region, and covers about 732 ha. It incorporates three tracts of land associated with the East Humber River and a couple of tributaries, including Purpleville Creek which enters from the northeast along a deep ravine. The site is bound to the north by Teston Road, to the south by Langstaff Road, to the east by Pine Valley Drive; and to the west roughly by Islington Avenue (Maps 1 and 2). The three tracts of land include the Glassco Tract (Teston Road

to Major MacKenzie Drive), Boyd North and the Kortright Centre (Major MacKenzie Drive to Rutherford Road), and Boyd Conservation Area (Rutherford Road to Langstaff Road). These parcels of land were acquired by the Toronto and Region Conservation Authority in the early 1960s, within a decade of Hurricane Hazel.

The Living City Campus has been known as an important part of the regional natural heritage system for many years. The TRCA identified seven Environmentally-Significant Areas in what is now the study area in 1982 (MTRCA 1982a). The Province of Ontario identified a large portion of the Boyd Conservation Area as an Area of Natural and Scientific Interest (ANSI) (OMNR 1998a), together with the Kleinburg Woodlots which lie just outside of the study area on the east side of Pine Valley Drive north of Rutherford Road (OMNR 1998b). The area is also included within the provincial Greenbelt designation. At various times, parts of the Living City Study Area have been surveyed, generally in a piecemeal fashion (MTRCA 1982a, MTRCA 1982b, Nowak 1985, Beak Consultants 1991, MTRCA 1995, OMNR 1998a, Kamstra 2002, TRCA 2004). However, this report is the first one to treat the combined area as a unit, bringing together the data from different sources.

The study area lies entirely within the Great Lakes – St. Lawrence floristic region, a region which is composed primarily of mixed coniferous-deciduous forest. At the coarse physiographic level, the site is situated on the Peel Plain physiographic zone, which formed as the bed of a temporary periglacial lake during the retreat of the Wisconsin ice sheet (the lake existed just after the Oak Ridges Moraine formed but before the ice retreated enough to form Lake Iroquois, whose basin was still filled by ice). The Peel Plain generally is characterized by flat topography and heavy but fertile clay loam soils, some of which are formed from Halton till and others of which are glaciolacustrine deposits. However, the Living City Campus is topographically diverse due to the deep valley of the East Humber River and its tributaries. There are sands and gravels along the watercourses, and also small exposed lenses of these lighter-textured soils along the valley slopes and rims, especially to the south in the Boyd Conservation Area. Some of the wetland areas have small pockets of deep organic soil.

The Kortright Centre was established in the middle land parcel (Boyd North) shortly after the land was acquired. This is the centrepiece of the Living City Campus: a public interpretive complex that highlights conservation and increasingly, sustainable urban design and technologies such as the recently-constructed Archetype Sustainable House (2008-2009). Other existing facilities on the Living City Campus include the TRCA nursery (specializing in native trees and shrubs), the Boyd Field Centre (originally an overnight outdoor education centre but now housing offices for TRCA staff), the new LEED-certified TRCA Restoration Services Division building, and Earth Rangers (an NGO dedicated to environmental education for youth, whose building is also LEED-certified). These facilities are all located in the Boyd North Tract, the central block of the Living City Campus; their footprint is still relatively small in relation to the size of the land parcel and its natural habitats. Boyd Conservation Area is a more traditional conservation area with trails and picnic facilities, while the Glassco Tract to the north is relatively undeveloped. The McMichael Gallery which features the Group of Seven and other Canadian art is adjacent to the Glassco Tract and



connected to it via trails and plantings. The National Golf Club occupies an extensive area of land on the east side of Boyd Conservation Area and its forest lands.

Originally in the 1960s there were plans to build a flood control dam on the East Humber River, but that idea was soon abandoned. Plans to extend Pine Valley Drive south from Rutherford, which would have had a major impact on the forest in Boyd Conservation Area, were abandoned in the mid-2000s. The lands to the south, east and west of the Living City Campus were originally rural, but have been urbanized starting in the 1990s, while the area to the north is still rural.

### 3.0 Inventory Methodology

A biological inventory of the Living City Campus Study Area was conducted at the levels of habitat patch (landscape analysis), vegetation community, and species (flora and fauna) according to the TRCA methodologies for landscape evaluation (TRCA 2007c) and field data collection (TRCA 2007d). Habitat patch mapping was taken from the regional 2007/08 mapping of broadly-defined patch categories (forest, wetland, meadow and coastal) and digitized using ArcView GIS software. A key component of the field data collection is the scoring and ranking of vegetation communities and flora and fauna species to generate local “L” ranks (L1 to L5); this process was undertaken in 1996-2000 and ranks are reviewed regularly (TRCA 2010a). Vegetation community scores and ranks are based on two criteria: *local occurrence* and the number of *geophysical requirements* or factors on which they depend. Flora species are scored using four criteria: *local occurrence*, *population trend*, *habitat dependence*, and *sensitivity to impacts associated with development*. Fauna species are scored based on seven criteria: *local occurrence*, *local population trend*, *continent-wide population trend*, *habitat dependence*, *sensitivity to development*, *area-sensitivity*, and *patch isolation sensitivity*. With the use of this ranking system, communities or species of *regional concern*, ranked L1 to L3, now replace the idea of *rare* communities or species. Rarity (*local occurrence*) is still considered as one of many criteria that make up the L-ranks, making it possible to recognize communities or species of regional concern before they have become rare.

In addition to the L1 to L3 ranked species, a large number of currently common or secure species at the regional level are considered of concern in the urban context. These are the species identified with an L-rank of L4. Although L4 species are widespread and frequently occur in relatively intact urban sites, they are vulnerable to long-term declines.

#### 3.1 Landscape Analysis

The quality, distribution and quantity of natural cover in a region are important determinants of the species distribution, vegetation community health and the provision of “ecosystem services” (e.g. air and water quality, recreation, aesthetics) in that region.

##### Base Mapping

The first step in evaluating a natural system or an individual *habitat patch* is to interpret and map land cover using aerial photographs. The basic unit for the evaluation at all scales is the habitat patch in the region, which are then combined and evaluated as a system at any scale. A *habitat patch* is a continuous piece of habitat, as determined from aerial photo interpretation. The TRCA maps habitat according to four broad categories: *forest*, *wetland*, *meadow*, and *coastal* (beach, dune, or bluff). At the regional level, the TRCA jurisdiction is made up of thousands of habitat patches. This mapping of habitat patches in broad categories is conducted through remote-sensing and is used in the evaluation of quality, distribution and quantity of natural cover. It should not be confused with the more detailed mapping of vegetation communities obtained through field surveys and that is used to ground-truth the evaluation (see Section 3.2).

### Quality Distribution of Natural Cover

The quality of each habitat patch is evaluated according to three criteria: *size* (the number of ha occupied by the patch), *shape* (edge-to-area ratio), and *matrix influence* (measure of the positive and negative impacts from surrounding land use) (TRCA 2007c). A total score for each patch is obtained through a weighted average of the scores for the three criteria. This total score is used as a measure of the 'quality' of a habitat patch and is translated into a local rank (L-rank) ranging from L1 to L5 based on the range of possible total scores from 3 to 15 points. Of these L-ranks, L1 represents the highest quality habitat and L5 the poorest.

Species presence or absence correlates to habitat patch quality (size, shape and matrix influence) (Kilgour 2003). The quality target is based on attaining a quality of habitat patch throughout the natural system that would support in the very long term a broad range of biodiversity, specifically a quality that would support the region's fauna Species of Conservation Concern (Table 1).

**Table 1: Habitat patch quality, rank and species response**

Size, Shape and Matrix Influence	Patch Rank	Fauna Species of Conservation Concern
Excellent	L1	Generally found
Good	L2	Generally found
Fair	L3	Generally found
Poor	L4	Generally not found
Very Poor	L5	Generally not found

### Quantity

The amount of natural cover needed in the landscape is based on the quantity required to accommodate and achieve the quality distribution targets described above. The two targets are therefore linked to each other: it will be impossible to achieve the required distribution of natural heritage quality without the appropriate quantity of natural cover. The proportion of the region that needs to be maintained as natural cover in order to achieve the desired quality has been identified as 30%.

### 3.2 Vegetation Communities, Flora and Fauna Species

Vegetation community and flora and fauna species data were collected through field surveys. These surveys were done during the appropriate times of year to capture breeding status in the case of amphibians and birds, and during the optimal growing period of the various plant species and communities. Vegetation communities and flora species were surveyed concurrently.

Botanical field-work was conducted from spring to early fall of 2003 for the area north of Rutherford Road (i.e. the Glassco and Boyd North Tracts), and the same season in 2005 for the Boyd Conservation Area lands south of Rutherford Road (Table 2). A small amount of field work at Glassco Tract from the summer of 1998 was incorporated (TRCA 1998). Botanical data also includes a number of additional records as follows: Ontario Ministry of Natural Resources ANSI data collected at Boyd Conservation Area in 1998 (OMNR 1998a); inventory data for the now-defunct Pine Valley Drive Extension proposal for the east part of Boyd Conservation Area in 2002 collected by Gartner-Lee (Kamstra 2002); and information obtained from the long-term fixed monitoring plots (a forest plot in Boyd Conservation Area and a wetland transect in Boyd North) that were established in 2008. In addition, historic data from 1980-81 (TRCA 1982b), 1983 (OMNR 1998a), and 1993-95 (TRCA 1995) are also considered.

Vegetation community designations were based on the Ecological Land Classification (ELC) and determined to the level of vegetation type (Lee *et al.* 1998). Community boundaries were outlined onto printouts of digital ortho-rectified photographs (ortho-photos) to a scale of 1:2000 and then digitized in ArcView. Flora regional species of concern (species ranked L1 to L3) were mapped as point data with approximate number of individuals seen. A list of all other species observed was documented for the site.

The entire Living City Campus has never been surveyed for fauna as a single entity but rather different sections have been surveyed extensively over the course of the past decade. In 2003, frog and breeding bird surveys were conducted across the large section extending north from Rutherford Road to Teston Road. In 2005, frog and breeding bird surveys were conducted across the section south of Rutherford Road. In 2012, a breeding bird survey was repeated across the central and northern sections from Rutherford Road to Teston Road. Spring surveys search primarily for frog species of regional concern but record incidentally the presence of any early-spring nocturnal bird species (owls and American woodcocks). Surveys in May and June are concerned primarily with the mapping of breeding bird species of regional concern. As per the TRCA data collection protocol, breeding bird surveys in both 2003 and 2012 were carried out by visiting all parts of the site at least twice during the breeding season (last week of May to mid-July) to determine the breeding status of each mapped point. The methodology for identifying confirmed and possible breeding birds follows Cadman *et al.* (2007). All initial visits were completed by the end of the third week of June. The field-season is to be organized so that by late June only repeat visits are being conducted. It is imperative that any visit made in the first half of June is subsequently validated by a second visit later in the season. Fauna species of regional

and urban concern (species ranked L1 to L4) were mapped as point data with each point representing a possible breeding territory.

In addition to the data collected during extensive formal surveys, this inventory considers the incidental fauna observations mapped during the annual long term monitoring plot counts initiated in 2008 (one wetland bird and frog station, two forest bird stations, one meadow bird station and one *Plethodontid* salamander station). Note that the fauna data management protocol imposes a 10 year threshold on use of historical data, and therefore observations made prior to 2003 are not included in the current fauna inventory.

**Table 2. Schedule of TRCA biological surveys at the Living City Campus Study Area**

Survey Item	Survey Dates	Survey Effort (hours)
Patch / Landscape	2007/08: ortho-photos	21 hours
Vegetation Communities and Flora Species	1998: July 20; Aug 5. 2003: Apr 30; May 2,5,6,13,14,16,20,23, 26,27,28,29; June 25,27; July 15,17, 18,21,23; Aug 19,25,27; Sep 23,24, 25,26,29,30; Oct 2,7,8,9,10,14. 2005: May 3,4,6,9,10; Jun 1,6,27; Jul 7; Aug 8,20,22,26,30.	340 hours
Terrestrial long-term forest and wetland monitoring plots	2008-2012: spring and summer (various)	40 hours
Frogs and Nocturnal Spring Birds	2003: April 12 – 27 2005: April 10 - 19	18.5 hours
Breeding Songbirds	2003: June 1 – 13, and June 16 2005: June 14, 16, 30 and July 6 2012: June 2 - 29	156.5 hours

## 4.0 Results and Discussion

Information pertaining to the Living City Campus Study Area was collected through both remote-sensing and ground-truthing surveys. This information contains three levels of detail: habitat patch, vegetation community, and species (flora and fauna). This section provides the information collected and its analysis in the context of the TNHS Strategy.

### 4.1 Regional Context

Based on 2007/08 ortho-photography, 25% of the land area in the TRCA jurisdiction consists of natural cover but this figure includes meadow. Although historically, the region would have consisted of up to 95% forest cover, currently (i.e. 2007/08) only about 17% is covered by forest and wetland. Of the non-natural cover (i.e. the remaining 75%), 48% is urban and 27% is rural / agricultural.

The regional level analysis of habitat patches shows that the present average patch quality across the TRCA jurisdiction is “fair” (L3); forest and wetland cover is contained largely in the northern half of the TRCA jurisdiction, especially on the Oak Ridges Moraine; and the quantity is 16.7% of the surface area of the jurisdiction (Map 3). In addition, meadow cover stands at 8.1% of the region. Thus the existing natural system stands below the quantity target that has been set for the region (30%) and also has an unbalanced distribution. The distribution of fauna species of

concern is also largely restricted to the northern part of the jurisdiction; fauna species of regional concern are generally absent from the urban matrix (Map 4). The regional picture, being the result of a long history of land use changes, confirms that **all** site-based decisions contribute to the condition of a region.

The extensive natural cover at the Living City Campus provides continuity in an important migration and dispersal route between the more rural areas to the north (e.g. the Oak Ridges Moraine) and significant migrant staging areas in the lower reaches of the Humber River and along the Lake Ontario shoreline.

## **4.2 Habitat Patch Findings for the Living City Study Area**

The following details the site according to the two natural system indicators used in designing the Terrestrial Natural Heritage System Strategy: the *quality distribution* and *quantity* of natural cover. Analysis was based on 2007/08 ortho-photos.

### **4.2.1 Quantity of Natural Cover**

The area of the Humber watershed is approximately 91,077 ha containing 32.0% natural cover (2007/08), including 18,934.7 ha as forest and successional woody cover, 5169.2 ha as meadow and 2078.2 ha as wetland. The Living City Campus is 732 ha in size and contains 693.4 ha of natural habitat (Table 3; Appendix 1), which amounts to 2.4% of the total natural cover in the Humber watershed (29182.3 ha). The size and location of the Living City Campus at the border between the urban and rural land use zone confers a high degree of importance to the area from the perspectives of both habitat patch integrity and connectivity along the Humber River (Figure 1). The natural cover includes 397.8 ha of forest, 72.9 ha of successional, 178.6 ha of meadow, 13.9 ha of aquatic and 28.0 ha of wetland.



**Figure 1. Extensive Natural Cover in Landscape at Living City Campus (Glassco Tract, north of Major MacKenzie) (photo by Sue Hayes, July 2012)**

#### **4.2.2. Quality Distribution of Natural Cover**

The results for quality distribution are reported below under the headings of habitat patch size and shape, matrix influence and total score.

##### **Habitat Patch Size and Shape**

The study area is fairly evenly split between “fair” and “good” in regards to habitat patch size, with especially large continuous patches of habitat in each of the three main sections: south of Rutherford Road; between Rutherford Road and Major Mackenzie Drive (the north-central forest patch within this mid-section); and north of Major Mackenzie Drive (the bulk of this northern section scores as “good” for patch size). Meanwhile, patch shape is very irregular throughout with much of the habitat fragmented by watercourses, roads, park infrastructure, and patches of open habitat, resulting in rather low scores for patch shape. This latter aspect therefore results in a surprisingly low occurrence of forest interior habitat, with no interior beyond 200 metres from any edge. The most extensive continuous patch of forest cover on the site (in the middle section of the

site, within the Kortright Centre) has an area of 107 ha, while the most extensive open habitat covers 21.2 ha (the south west corner of the middle section (Map 5).

### **Habitat Patch Matrix Influence**

Analysis based on the 2007/08 ortho-photos shows that the matrix influence score for habitat in the study area is largely “fair” to the north of Rutherford Road, with pockets of “good” influence increasing to the north of Major Mackenzie Drive. South of Rutherford Road, with urbanization encroaching to a greater degree, the matrix influence – as should be expected – deteriorates to “poor” (Maps 6 and 7). The TRCA measures matrix influence at the landscape level by assigning set values; positive, neutral and negative, to the type of landscape use occurring within 2 km of the subject site. This urban landscape exerts a negative matrix influence particularly at the more southern extent of the site.

### **Habitat Patch Total Score**

The natural cover within the Living City Campus is extensive enough to provide some buffering from the urban land uses now abutting the Campus on three sides. The combination of mainly “fair” matrix influence on the site, and the mix of “fair” to “good” habitat patch size with “very poor” and “poor” patch shape, results in an overall “poor” to “fair” (L4 to L3) habitat patch quality (Map 8), quality improving as one moves from south to north within the site. Landscape scores are intended to be applied at the broader landscape level and therefore caution needs to be exercised when referring to such measures at the more refined site level.

## **4.3 Vegetation Community Findings for the Living City Campus**

### **4.3.1 Vegetation Community Representation**

The Living City Campus has a total of 146 different vegetation communities, 18 of which are found solely as an inclusion or complex within a larger community. Forest occupies more than half the total cover; this reflects the abundance of non-farmable valley land as well as the decades-long history of the land as conservation area with concomitant reforestation activity (Table 3). More recently-abandoned lands are meadow, while a sizeable share is successional or semi-forested with partial tree or shrub cover. Wetlands are diverse but occupy only a portion share of the landscape. The prevalence and diversity of various classes of vegetation community are similar to large valley-land tracts of comparable size in the TRCA jurisdiction such as Seaton Trail or Bolton Tract (TRCA 2007e, TRCA 2008a). There is somewhat more forest and somewhat less wetland than at Seaton Trail or Bolton Tract largely because the Humber Valley here cuts largely through Halton Till and intercepts fewer ground water-releasing aquifer layers (though there are some).



**Table 3. Summary of Vegetation Communities, Living City Campus**

<b>Class</b>	<b>Number of Types</b>	<b>Area (hectares)</b>
Forest	72	397.8
Successional	17	72.9
Meadow	3	178.6
Wetland	37	28.0
Aquatic	9	13.9
Dynamic (beach, bluff, barren)	8	2.3
<i>Total</i>	<i>146</i>	<i>693.4</i>

There are 397.8 ha of forest, 57% of the whole study area. Almost a third of this (122.7 ha) is plantation, mostly conifer plantation (CUP3). The more recent plantations have more attention to native species and suitability to site, while some of the older plantations; especially those along Islington Avenue in the Boyd Conservation Area are in decline. However, the greatest share of forest is the 188.5 ha of deciduous forest (mostly dominated by sugar maple (*Acer saccharum* ssp. *saccharum*) with variable mixes of other species (i.e. various FOD5 and FOD6 vegetation types). These largely-mature sugar maple forest communities occupy 114.6 ha There are 37.5 and 14.2 ha of Fresh-Moist Manitoba Maple Lowland Deciduous Forest (FOD7-a) and Fresh-Moist Willow Lowland Deciduous Forest (FOD7-3) respectively.

Mixed and coniferous forests occupy 62.3 and 24.2 ha. These occupy cooler slopes and terraces above the bottomland, especially in Boyd Conservation Area. The most prominent vegetation types are Fresh-Moist Sugar Maple – Hemlock Mixed Forest (FOM6-1), Dry-Fresh Hemlock – Sugar Maple Mixed Forest (FOM3-2), Fresh-Moist Hemlock – White Pine Coniferous Forest (FOC3-A) , Fresh-Moist White Cedar – Hardwood Mixed Forest (FOM7-2), and Fresh-Moist White Cedar Coniferous Forest (FOC4-1).

Successional communities are represented by 17 regenerating communities totalling 72.9 ha. Native regeneration is slightly dominant, although these communities tend to have the most exotics. Typically they are dominated by varying mixes of trees and shrubs including those found in the lowland deciduous forests, as well as hawthorn (*Crataegus* spp) white ash (*Fraxinus americana*), riverbank grape (*Vitis riparia*), staghorn sumac (*Rhus typhina*), and buckthorn (*Rhamnus cathartica*). The major successional communities are Native Deciduous Successional Woodland (CUW1-A3), Native Deciduous Successional Savannah (CUS1-A1), Hawthorn Successional Woodland (CUW1-D), and Exotic Deciduous Thicket (CUW1-b). The species composition shows evidence of livestock pasturing in recent decades.

Open meadow covers 172.8 ha and occurs mostly on the tableland, especially in the northern two blocks (Glassco and Boyd North). Native Forb Meadow (CUM1-A) is prevalent, dominated by tall

goldenrod (*Solidago altissima*) and asters (*Symphyotrichum* spp). Most of the meadow areas and remaining leased agricultural fields are being reforested.

Wetlands account for 28.0 ha (just 4% of the total natural cover) along with 1.2 ha of vegetated aquatic cover. The prevalence of Halton Till on the Peel Plain (dominated by silts and clays) implies that there is less groundwater discharge than one would find on the Oak Ridges Moraine or in the vicinity of the Iroquois shoreline. However, there are some areas of groundwater discharge associated with occasional sand and gravel lenses that do occur on the Halton Till. Other wetlands are associated with shallow depressions on the tableland; here the impermeable soils restrict drainage and allow for surface water retention and vernal pools. In the past, these surface wetlands were drained for agricultural use and few remain in the TRCA jurisdiction; however, the Halton Till is conducive to constructing new wetlands as part of ecological restoration projects and several new wetlands have been made since the 1970s. In addition, there are numerous small wetlands associated with former channels of the East Humber River (oxbows) across the Living City Campus.

Coniferous and mixed swamps total 4.5 ha and occur in the areas of cool ground water discharge, mostly associated with one area in the Glassco Tract (a White Cedar – Hardwood Organic Mixed Swamp, SWM4-1) and a small part of the Boyd Conservation Area (Hemlock Mineral Coniferous Swamp, SWC2-2). Deciduous swamps occupy 8.9 ha, and are associated with some of the tableland and oxbow wetlands. These are mostly divided between Silver Maple Mineral Deciduous Swamp (SWD3-2), Willow Mineral Deciduous Swamp (SWD4-1), and Paper Birch – Poplar Mineral Deciduous Swamp (SWD4-3).

Shallow marsh occupies 7.5 ha, and most of this is cattail marsh (6.9 ha). The cattail marsh (as of 2003) was mostly the native Broad-leaved Cattail Shallow Marsh (Mineral: MAS2-1A and Organic: MAS3-1A). Meadow marsh occupies 6.7 ha, most of which is Reed Canary Grass Mineral Meadow Marsh (MAM2-2) at 4.4 ha. Eleven other meadow marsh types occur in small quantities.

Most of the aquatic habitat is unvegetated (OAO1) riverine along the East Humber River. Vegetated aquatic communities are mostly associated with constructed wetlands from restoration projects.

#### **4.3.2 Vegetation Communities of Concern**

The vegetation communities that occur in the TRCA jurisdiction are scored and given a local rank from L1 to L5 based on the two criteria mentioned in Section 3.2. Vegetation communities with a rank of L1 to L3 are considered of concern across the entire jurisdiction while L4 communities are considered of concern in the urban portion of the jurisdiction. There are 37 vegetation communities at the Living City Campus with a rank of L2 or L3 and 48 that are ranked L4 (communities are listed with ranks in Appendix 1; location and boundaries shown on Map 9). The communities of conservation concern (L2 to L3) occupy 30.5 ha, 4% of the total natural cover. However, the L-rank in itself is not sufficient for determining whether a particular community at the

site is of high conservation concern. The health and composition of the stand also needs to be taken into consideration. For example, the Fresh-Moist Hemlock – Sugar Maple Mixed Forest (FOM6-1) and associated wetlands in Boyd Conservation Area includes a significant old-growth component and many species of conservation concern (both flora and fauna) (Figure 3). The L-rank of this community as such is L4, but the particular stand is of extremely high conservation concern because of its quality. Likewise, many of the various sugar maple deciduous forest patches at the Living City Campus are mature and have an intact spring ephemeral ground layer.



**Figure 2. Old-growth hemlock forest and vernal pool oxbow wetland at Boyd Conservation Area (photo by Sue Hayes, May 2007)**

The L2 communities include Shrub Sand Barren (SBS1), associated with sand exposures in the Boyd Conservation Area; Dry-Fresh Red Oak Deciduous Forest (FOD1-1) and Dry-Fresh White Pine – Oak Forest (FOM2-1) also associated with lighter soils at the conservation area. Small tableland wetland features (mini-kettles) in the Glassco Tract have Silver Maple Organic Deciduous Swamp (SWD6-2) and Winterberry Organic Thicket Swamp (SWT3-7). The Bur Oak Mineral Deciduous Swamp (SWD1-2) has a rank of L3 but is considered to be provincially- and globally-rare according to the Natural Heritage Information Centre (NHIC 2008).

All of these communities, whether or not they are rare, are vulnerable to changes in the environment, resulting in change years later. For example, most of the wetland communities are common in TRCA in areas with intact hydrology and rural matrix. However, trampling, drainage alteration (e.g. tile drains) due to agriculture and urbanization, and urban heat island effects (exacerbated by broader-scale climate change) can send these communities into decline, to be replaced by weedier communities such as Fresh-Moist Manitoba Maple Lowland Deciduous Forest (FOD7-a) with a high loading of exotic species.

Native-dominated wetlands (e.g. with *Carex* spp) can be affected by storm water, nutrient and silt loading to the extent that they are replaced by the exotic hybrid cattail (*Typha x glauca*) or reed canary grass (*Phalaris arundinacea*).

Disturbance to the forest and other upland communities is mostly from two sources: pedestrian and dog traffic, and invasive species. Trampling is a significant problem, especially in mature forest communities where trail use is poorly managed. Invasive species are encouraged by trampling as well as by storm water runoff. Unsupervised succession of disturbed areas and restoration plantings can also promote invasive species such as buckthorn , which make opportunistic inroads and colonize more effectively than natives.

## 4.4 Flora Findings for the Living City Campus

### 4.4.1 Flora Species Representation

Floristic surveys conducted by TRCA in 1998, 2003 and 2005 in addition to supplementary data from the wetland and forest vegetation monitoring plots (2008-12), identified a total of 567 species of vascular plants (Table 4; Appendix 2a). Of these, 542 species recorded were naturally occurring; there were also 25 planted species that were not established. Of the non-planted species recorded, 383 (71%) are native. Biodiversity of this site is moderately high given the study area size, and reflects the range of forest and wetland communities; each with their own unique suite of species. Species richness is slightly lower here than at the comparable Seaton Trail and Bolton Tract areas that had 609 and 620 flora species recorded respectively (TRCA 2007e, TRCA 2008a). This is likely due to the small total area of wetland habitat, and perhaps because of visitor pressure (e.g. trampling) in the forest habitats. On the other hand, the relatively high proportion of native species (71%) is more characteristic of a rural natural area (exotics can comprise about half the species in urban natural areas in TRCA).

**Table 4. Summary of Flora Species, Living City Campus**

Total # of species	567
Naturally-occurring species	542
Planted species	25
Native (naturally-occurring) species	383
Number of L1 - L3 species	102
Number of L4 species	140
Exotic species (established)	159

#### 4.4.2 Flora Species of Concern

There are 102 vascular plant species of regional conservation concern (rank L1 to L3) at the Living City Campus; of these, 9 are ranked L2 (there are no L1 flora species). Appendix 2a lists plant species by ranks and locations are shown on Map 10. The ranks are based on sensitivity to human disturbance associated with development; and habitat dependence, as well as on rarity (TRCA 2010a). Higher-ranked species therefore may not be currently rare but are at risk of long-term decline due to the other criteria.

Fifteen species at the Living City Campus are considered regionally-rare, occurring in 6 or fewer of the 42 10x10km UTM grid-squares that comprise the TRCA jurisdiction. The Living City Campus is noteworthy for having several species that are extremely rare, with only one to three known TRCA locations. Smooth rock-cress (*Boechera laevigata*) is one of the rarest plants in TRCA, with the three populations mapped at Boyd Conservation Area in 2005 being the only known records for this species, although there is a historic record for the Rouge Valley dating from 1980 (Varga *et al.* 1991). Burnweed (*Erechtites hieracifolia*) was found at Boyd Conservation Area in 2002 (Kamstra 2002); the other TRCA record is at Albion Hills in 2001. Fleshy hawthorn (*Crataegus succulenta*) has an unknown distribution but the 1998 record is the only one in TRCA's database (OMNR 1998a). Whorled loosestrife (*Lysimachia quadrifolia*) has two other records in the TRCA database: High Park (1997) and Gibson Lake (2004). Wild crabapple (*Malus coronaria*) is known from two or three other TRCA sites, all in the Humber Valley; the population at Boyd North is the furthest north of these.

Some species in the Living City Campus, whether they are rare or not, are declining precipitously in population due to disease or unknown factors: rock elm (*Ulmus thomasi*) (Figure 4) is severely hit by Dutch elm disease (*Ophiostoma novo-ulmi*) and is less prolific than the still-common white elm (*U. americana*). This tree is now rare. Butternut (*Juglans cinerea*), though widespread, is affected by butternut canker (*Sirococcus clavignenti-juglandacearum*). Spotted St. John's-wort (*Hypericum punctatum*) appears to be disappearing from TRCA and is now almost never seen; it was observed in 1998 in a woodlot in the Glassco Tract (still considered a recent record). However, it was not found in 2003.

Eleven species reported historically have not been found in the last 15 years (Appendix 2b). Ten of these are species of regional conservation concern. Some, such as marsh horsetail (*Equisetum*

*palustre*), last seen in 1981 are difficult to identify and the record cannot be verified. Others, such as blue-eyed grass (*Sisyrinchium montanum*) and wild coffee (*Triosteum aurantiacum*) are inconspicuous except at flowering time and are likely still on site. However, the wild blue phlox (*Phlox divaricata*), plantain-leaved pussytoes (*Antennaria parlinii* ssp. *fallax*), and Indian cucumber-root (*Medeola virginiana*) are fairly visible species and have likely disappeared due to direct habitat loss (i.e. subdivisions built on the east side of Boyd Conservation Area in the 1990s) or degradation (such as trampling).



**Figure 3.** Rock elm (*Ulmus thomasi*) at Boyd North (photo by Gavin Miller, March 2009)

Out of the 102 flora species of concern at the Living City Campus, 101 are considered to be sensitive to development, being vulnerable to at least one kind of disturbance that is associated with land use changes (see Map 6 for sensitivity to development scores). A major issue at this site is trampling disturbance resulting from the site's popularity as a recreation destination. In a sense, the Living City Campus is at risk of becoming a victim of its own success. Increased urbanization in the surrounding area, as well as the promotion of the Living City Campus sustainability initiatives, can be expected to increase visitor pressure. This is of concern particularly to forest ground layer species such as rose twisted-stalk (*Streptopus lanceolatus*), star-flower (*Trientalis borealis*), and wood anemone (*Anemone quinquefolia*). Their roots and stems are not resilient enough to withstand soil compaction resulting from constant treading. Some of the trails have widened to become large expanses of bare, compacted soil (Figure 5).





**Figure 4. Trail damage to forest at Boyd Conservation Area (photo by Sue Hayes, May 2007)**

Urbanization of the matrix also is associated with hydrological changes that affect the ecosystem both at the level of plant communities (see section 4.3.2) and individual species. The size of the Living City Campus affords it some protection; however it is still subject to increasing urban heat island effects, storm water runoff entering through watercourses from off-site, and subtle alterations of ground water. At the level of individual species, plants of swamps and mixed forests such as oak fern (*Gymnocarpium dryopteris*), marsh pennywort (*Hydrocotyle americana*) and bulblet fern (*Cystopteris bulbifera*) require cool, moist, sheltered conditions, often with groundwater close to the surface. Increasing warmth and dryness (more pavement meaning impermeability, reduced ground water recharge, and higher temperatures) will cause these species to decline. Even major keystone species currently common at the Living City Campus such as hemlock (*Tsuga canadensis*), are at risk from hydrological changes. If this tree declines, the opening of the canopy and loss of deep coniferous shade will further warm and dry out the old-growth ecosystem, which could collapse as a result.

Storm water runoff is also a source of erosion, siltation, and nutrient loading. Nutrient loading also results from atmospheric nitrate deposition. Species that are adapted to stable, low-nutrient conditions, including shining club-moss (*Huperzia lucidula*) and rattlesnake fern (*Botrychium virginianum*) are likely to be affected. The shining club-moss is generally not found even in the most intact mature forests in the urban land-use zone. The small Living City Campus population seen in 2005 is one of the only observations known where there is urbanization in the surrounding area.

High populations of white-tailed deer (*Odocoileus virginiana*) in settled landscapes browse heavily on palatable species. Trillium (*Trillium* spp) and hemlock saplings are among the vulnerable species. Humans may collect or pick showy plants such as Michigan lily (*Lilium michiganense*) or edibles such as wild leek (*Allium tricoccum*).

Some species actually require the right kind of disturbance regime; suppression of fire, grazing, or natural water level changes may happen due to land use changes and management practices. For example, the wild crabapple, as well as hawthorns (*Crataegus* spp) and common juniper (*Juniperus communis*) are shade-intolerant species that are often associated with post-agricultural landscapes. They are likely to disappear with canopy closure and shading. Likewise, needle spike-rush (*Eleocharis acicularis*), false pimpinell (*Lindernia dubia*), and water purslane (*Ludwigia palustris*) require unregulated water levels. They appear on exposed mud at times of low water level in the large Kortright wetland at the bottom of the hill below the visitors' centre.

Additionally, the various forms of disturbance associated with development help facilitate the spread of invasive species. Most of the flora species of concern at the Living City Campus are not competitive enough under such disturbed conditions to maintain their populations. Further discussion of particular invasive species follows at the end of this section.

All 102 of the flora species of regional concern at the Living City Campus (and many L4 species as well) are habitat specialists, scoring relatively high in *habitat dependence*. Habitat dependence

scores are shown on Map 11. Roughly, they are found in seven or fewer vegetation cohorts (groupings of vegetation types with similar floristic characteristics) (TRCA 2010a). They will not readily recover when these habitats are lost or altered. The Living City Campus has habitat specialists corresponding to forest, open upland habitats (successional and sand barren), and wetland (swamp, marsh, and aquatic).

Species of deciduous forest are particularly well-represented. For example, spring ephemerals are abundant in places, including narrow-leaved spring beauty (*Claytonia virginica*), wood anemone (*Anemone quinquefolia*), squirrel-corn (*Dicentra canadensis*) and Dutchman's breeches (*Dicentra cucullaria*). There is also a high diversity of forest sedge species, e.g. broad-leaved sedge (*Carex platyphylla*), rather slender sedge (*Carex gracilescens*) and spreading wood sedge (*Carex laxiculmis*). Running strawberry-bush (*Euonymus obovatus*), a Carolinian species, is abundant throughout the deciduous forests at the Living City Campus. Glade fern (*Diplazium pycnocarpon*) (Figure 6) and rock polypody (*Polypodium virginianum*) as well as a number of other fern species, occurs at Boyd Conservation Area. The mixed and coniferous forests have northern species such as star-flower and rose twisted-stalk.



**Figure 5. Glade fern (*Diplazium pycnocarpon*) at Boyd Conservation Area (photo by Vladimir Kricsfalusy, June 2005)**

Open and semi-wooded areas have Canada plum (*Prunus nigra*), hawthorns, wild crab-apple, and rock elm. Where the soil is sandy, one can find hairy beard-tongue (*Penstemon hirsutus*), northern bedstraw (*Galium boreale*), sand dropseed (*Sporobolus cryptandrus*), and smooth rock-cress.

The Living City Campus has a wide representation of wetland types with their associated species in spite of the relative lack of total wetland cover. The areas of seepage mixed swamp have goldthread (*Coptis trifolia*), water pennywort (*Hydrocotyle americana*), fen star sedge (*Carex interior*), and golden saxifrage (*Chrysosplenium americanum*). The areas of deciduous and thicket swamp on the tableland have winterberry holly (*Ilex verticillata*), Tuckerman's sedge (*Carex tuckermanii*), and silky dogwood (*Cornus amomum*). Marsh and meadow marsh habitats – often in old oxbow channels, include such species as swamp candles (*Lysimachia terrestris*), water horsetail (*Equisetum fluviatile*), and eastern manna grass (*Glyceria septentrionale*). Aquatic species of conservation concern include large-leaved pondweed (*Potamogeton amplifolius*) and common bladderwort (*Utricularia vulgaris*).

### **Invasive Species**

Several invasive plant species are a threat to the biotic integrity of the Living City Campus. Their spread is facilitated by disturbance, but some of them are quite capable of altering and taking over habitats even where there is little disturbance. Dog-strangling vine (*Cynanchum rossicum*) is abundant in parts of the Glassco Tract but there are populations throughout the Living City Campus. The trail system could act as a pathway for which this aggressive exotic vine can easily spread into the interior reaches of the study area. This species is particularly problematic in the TRCA jurisdiction and other parts of the Lower Great Lakes (TRCA 2008b). It invades every kind of upland habitat, especially semi-open successional and young forest communities but can even get into old-growth forest and edges of wetlands. The best hope to control this species is through a regional biological control program, research for which is currently under way (Weed *et al.* 2011). In the meantime, trail disturbance should be monitored and mitigated.

Oriental bittersweet (*Celastrus orbiculatus*) is associated with old plantings along the east side of the Boyd Field Centre (western part of the Boyd North tract), and may be starting to spread elsewhere. This extremely aggressive woody vine should be removed while its numbers are still low enough that this is a feasible possibility. It has become a serious problem at some places in the TRCA jurisdiction such as the Maple Nature Reserve (TRCA 2010b).

Garlic mustard (*Alliaria petiolata*), hedge parsley (*Torilis japonica*) and dame's rocket (*Hesperis matronalis*) are locally abundant in floodplain forests and along trails including old logging tracks. These can become severe competitors with native spring ephemerals (Figure 7). The best approach is to minimize trampling disturbance to allow the existing vigorous native species to hold their own against these species; to maintain and restore hydrology, and to prevent yard waste dumping.



**Figure 6. Garlic mustard (*Alliaria petiolata*) with narrow-leaved spring beauty (*Claytonia virginica*) at Boyd Conservation Area (photo by Sue Hayes May 2009)**

Buckthorn is extremely abundant in successional areas and in the understorey of some plantations. It is shading out native species that require sunlight and may be inhibiting regeneration of forest species.

Common reed (*Phragmites australis* ssp. *australis*) is invading a few small wetlands mostly near the East Humber River in Boyd Conservation Area. It is currently in dense but relatively small and localized populations. It may be possible to contain this infestation with wick application of herbicide; otherwise, this huge grass may eventually take over most of the marsh and meadow marsh habitats at the Living City Campus.

Hybrid cattail (*Typha x glauca*) is starting to dominate the open marshes but does not at this point monopolize them. Controlling storm water inputs and maintaining adequate variability in topography and water level will allow for other species to coexist.

A population of giant hogweed (*Heracleum mantegazzianum*) was observed near the west bank of the East Humber River in 2005 at Boyd Conservation Area. Groundskeepers were notified, but the site should be revisited to ensure control. Giant hogweed is phototoxic and can cause serious burns to people who encounter its sap and are exposed to sunlight.

Emerald ash borer (*Agrillus planipennis*) is in the southeastern part of the TRCA jurisdiction and poses an imminent threat to ash trees (*Fraxinus* spp) throughout our area. TRCA forestry staff have now found infestations across the Living City Campus and in most TRCA properties across York Region.

### **Plantings**

The Living City Campus is a very high profile TRCA property and hosts the TRCA's own nursery and Restoration Services offices. As such, it has had many plantings dating back to the 1950s or 60s, starting with large areas of conifer plantation. More recently, restoration efforts have involved more native trees and wetland creation. Several of the wetlands and ponds have successfully supported plantings of species such as pickerelweed (*Pontederia cordata*), tuberous white water-lily (*Nymphaea odorata* ssp. *tuberosa*), and tape-grass (*Vallisneria americana*).

In addition, the Archetype Sustainable House has a small green roof on which native Ontario alvar plants were planted in 2009, including bluets (*Houstonia longifolia*) (Figure 8). It is hoped that green roofs can be a support to the on-the-ground terrestrial natural heritage system, both through their mitigation of some urban impacts (storm water, microclimate) and by the direct provision of habitat.



**Figure7. Bluets (*Houstonia longifolia*), an alvar plant at the Archetype Sustainable House green roof (photo by Gavin Miller, Oct 2009)**

## **4.5 Fauna Species Findings for the Living City Campus**

### **4.5.1 Fauna Species Representation**

Over the course of the past decade (2003 to 2012) a total of 121 vertebrate fauna species have been documented as possible breeding species within the Living City Campus study area. An additional eight species have been recorded historically, primarily by staff naturalists working at the Kortright Centre through the late 20<sup>th</sup> century. The current list of 121 species is broken down into: 90 bird species, 16 reptiles and amphibians, and 15 mammal species. The list of eight archive-only species includes one species that is considered regionally extirpated: southern flying squirrel (*Glaucomys volans*). A concerted search for this species was conducted by Stephen Patterson in 2003 but no evidence was found of the species in the area. However, northern flying squirrel (*Glaucomys sabrinus*) has been documented at Kortright as recently as 2009 which suggests that there are still opportunities within the local landscape for the southern species to persist.

The site list, with a total of 121 breeding vertebrate fauna species, ranks among the longest species list compiled for any site within the region; the extensive East Duffins Headwaters study area amassed a list of 131 documented species including 106 bird species, 15 mammal species and 10 reptiles and amphibians. At first glance it seems remarkable that a site located at the very edge of the urbanized landscape of Toronto, in what can be referred to as the urban-rural interface, has documented almost as many breeding fauna species as the largest expanse of forest habitat in the region. However, it is important to understand the context of much of the documentation of fauna species at the Living City Campus. At the centre of the Campus is the Kortright Centre with a year-round staff presence including several naturalists who have submitted observations over the past decade. It is particularly telling that the list of herpetofauna is 60% longer than the East Duffins Headwaters list (16 species versus 10 species); this group of species is not well surveyed by the rather rapid assessment conducted during routine TRCA fauna inventories which are designed primarily for the reporting of breeding songbirds and frogs (both of which are well-recorded through audio indicators). Refer to Appendix 3 for a list of the fauna species and their corresponding L-ranks.

#### 4.5.2 Fauna Species of Concern

Fauna species, like vegetation communities and flora species are considered of regional conservation concern if they rank L1 to L3 based on their scores for the seven criteria mentioned in Section 3.2. Since the subject site is situated within the urban zone this report also considers those species ranked as L4, i.e. those species that are of concern in urban landscapes. As with flora, this is a proactive, preventive approach, identifying where conservation efforts need to be made before a species becomes rare.

Fauna surveys at the Living City Campus over the past decade have reported 29 bird species of regional concern (L1 to L3), including two L2 ranked species (blue-winged warbler, *Vermivora pinus*; and grasshopper sparrow, *Ammodramus savannarum*). In addition, there were 13 herpetofauna and 4 mammal species of regional concern, including two L1 species (the two mole salamanders: Jefferson salamander, *Ambystoma jeffersonianum*; and spotted salamander, *Ambystoma maculatum*) and eight L2 species (including common snapping turtle, *Chelydra serpentina*; eastern newt, *Notophthalmus viridescens*; and porcupine, *Erethizon dorsatum*). Of these species, four are classified as Species at Risk at either the Federal or Provincial levels. Bobolink, *Dolichonyx oryzivorus*, (federally and provincially “Threatened”) depends on carefully managed and relatively undisturbed meadow habitats; Jefferson salamander (federally and provincially “Endangered”) requires large undisturbed tracts of deciduous or mixed mature forest with easy access to fish-less breeding ponds; common snapping turtle (federally and provincially considered of “Special Concern”) is dependent on wetlands, and, again, on easy access to nesting sites away from the water; and eastern milksnake (federally and provincially considered of “Special Concern”), is often associated with habitat around old and derelict buildings. Locations of breeding fauna are depicted on Map 12.



**Table 5. Summary of Fauna Species of Regional and Urban Concern Reported from the Living City Campus.**

Fauna	Number of Species	Number of Species of Regional and Urban Concern (L1 to L4 rank)
birds	90	66
herps	16	16
mammals	15	12
<b>TOTALS</b>	121	94

**Local occurrence** is one of seven scoring criteria for fauna species and is based on TRCA data and information from the Natural Heritage Information Centre (NHIC) of the Ontario Ministry of Natural Resources (OMNR) (NHIC 2008). Using local occurrence as a measure of regional rarity, any species that is reported as a probable or confirmed breeder in fewer than 10 of the forty-four 10x10 km UTM grid squares in the TRCA jurisdiction is considered regionally rare (i.e. scores three to five points for this criterion) (TRCA, 2010).

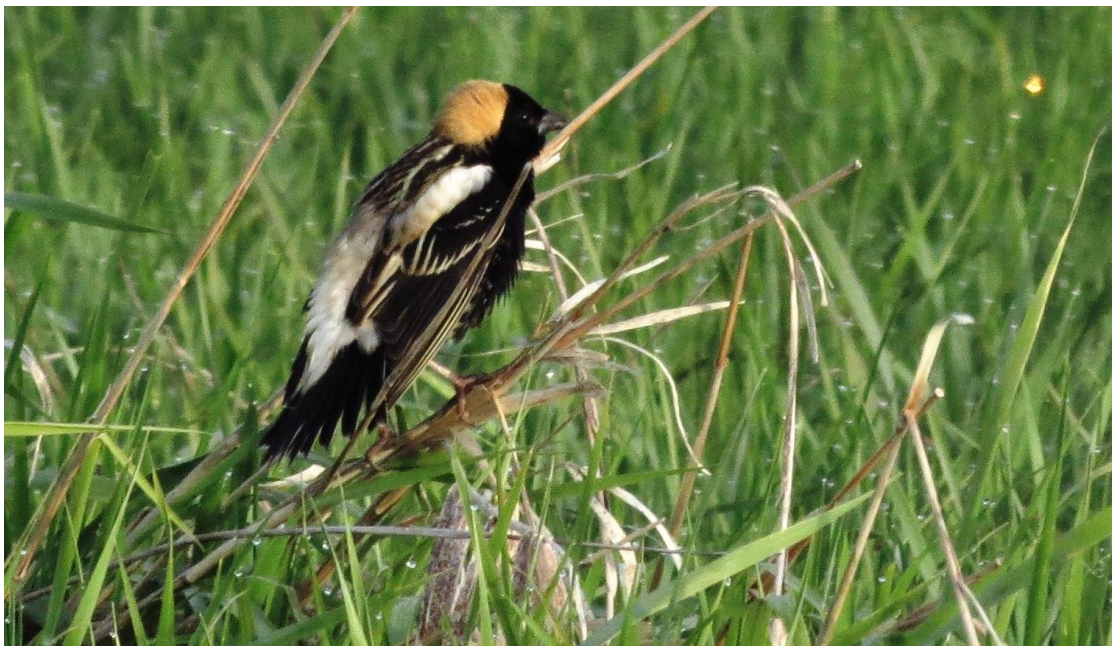
A total of 15 of the fauna species documented at the Living City Campus over the past decade are considered regionally rare: 6 bird species, 6 herp species and 3 mammals. Of the six bird species three are ground-nesting open country obligates (grasshopper sparrow; clay-coloured sparrow, *Spizella pallida*; and sedge wren, *Cistothorus platensis*) with a fourth species - blue-winged warbler (*Vermivora pinus*) - nesting on the ground at woodland edges and in shrubby open habitat. The rarity of these species is a reflection of the scarcity of undisturbed tracts of meadow and open habitat within the region. The loss or reduction in quality of any of this particular habitat type has a significant impact on the regional populations of these and other open habitat species. Unfortunately, open habitats are dependent on long-term active management policies, and given that the majority of species associated with such habitats are ground-nesting species, even a relatively low level of disturbance can result in nest-abandonment and clutch failure. Only one of the six “rare” birds that breed at the Living City Campus is a forest species: golden-crowned kinglet (*Regulus satrapa*) is a temperate migrant associated with pine forests and pine plantations, a habitat that is widespread and fairly abundant across the region and this species’ population status is more a reflection of the species’ northern affinity rather any lack of nesting opportunities.

**Sensitivity to development** is another criterion used to determine the L-rank of fauna species. A large number of impacts that result from local land use, both urban and agricultural, can affect the local fauna. These impacts – considered separately from the issue of actual habitat loss – can be divided into two distinct categories. The first category involves changes that arise from local urbanization that directly affect the breeding habitat of the species in question. These changes alter the composition and structure of the vegetation communities; for example, the clearing and manicuring of the habitat (e.g. by removal of dead wood and clearance of shrub understorey). The second category of impacts involves changes that directly affect individuals of the species in question. Examples include increased predation from an increase in the local population of predator species that thrive alongside human developments (e.g. blue jays, *Cyanocitta cristata*; American crows, *Corvus brachyrhynchos*; squirrels, *Sciuridae*; raccoons, *Procyon lotor*; and house

cats, *Felis catus*); parasitism (from facilitating the access of brown-headed cowbirds, *Molothrus ater*, a species which prefers more open, edge-type habitat); competition (for nest-cavities with bird species such as house sparrows, *Passer domesticus*; and European starlings, *Sturnus vulgaris*); flushing (causing disturbance and abandonment of nest) and, sensitivity to pesticides.

Fauna species are considered to have a high sensitivity to development if they score three or more points (out of a possible five) for this criterion. At the Living City Campus many of the species that are ranked L1 to L4 receive this score (74 of the 95 species) and are therefore considered sensitive to one or more of the impacts associated with development (Map 8).

Eighteen of the 28 L1 to L3 ranked bird species considered sensitive to development habitually nest on or near to the ground and as such are highly susceptible to ground-borne disturbance, e.g. off-leash dog-walking. However, 4 of these species nest in wetlands, a habitat that is not as much visited by such disturbances; the fact that there were 7 Virginia rail (*Rallus limicola*) territories throughout the site's wetlands supports this. Of the remaining 14 species, bobolink is well-represented with as many as 17 territories throughout the site, while mourning warbler (*Geothlyphis philadelphia*), a low-nesting species often associated with riparian habitat, is represented by a seemingly very healthy population of 25 pairs. Bobolink is listed as a Species at Risk and as such the presence of such a relatively high local population suggests the potential for maintaining high quality nesting habitat for this declining species.



**Figure 8. Bobolinks (*Dolichonyx oryzivorus*), a Species at Risk, are well established in the open habitat at the Living City Campus (photo by Paul Prior, May 2013)**

Ground-nesting birds are highly susceptible both to increased predation from ground-foraging predators that are subsidized by local residences (house cats, raccoons) and to repeated flushing

from the nest (by pedestrians, off-trail bikers and dogs) resulting in abandonment and failed breeding attempts. Even though the study area is criss-crossed by an extensive network of trails, the large size of the study area does allow some pockets of habitat (forest, meadow and riparian) to remain relatively undisturbed and unaffected by the traffic on these trails, be it hikers, bikers or dog walkers, but it is significant that the quintessential forest ground-nesting songbird - the ovenbird (*Seiurus aurocapilla*) – is represented by only 5 territories across the extensive forest habitat on site. With the proximity of busy trails and the fact that the site is flanked to the east and west by residential development which imposes additional predator pressures upon the native fauna, it is of little surprise that, other than open habitat in the northern sector (north of Major Mackenzie Drive), sensitive ground-nesting species (at least away from wetland habitats) are so poorly represented at the site.



**Figure 9. Only five ovenbird territories – the quintessential forest ground-nesting songbird - have been documented at the Living City Campus over the past decade (*Seiurus aurocapilla*), (photo by Paul Prior, May 2013)**

Many of the negative influences associated with urbanization can be transferred deep within an otherwise intact natural matrix by extensive trail networks used by large numbers of people originating from quite distant urban and suburban centres. Extensive public use of a natural

habitat can have substantial negative impact through the cumulative effects of hiking, dog-walking and biking on the site. Similarly, clearing of forest understory to accommodate trails displaces sensitive low-nesting species.

Various studies have shown that many bird species react negatively to human intrusion (i.e. the mere presence of people) to the extent that nest-abandonment and decreased nest-attentiveness lead to reduced reproduction and survival. One example of such a study showed that abundance was 48% lower for hermit thrushes (a ground-nesting/foraging species) in intruded sites than in the control sites (Gutzwiller and Anderson 1999). Elsewhere, a recent study reported that dog-walking in natural habitats caused a 35% reduction in bird diversity and a 41% reduction in abundance, with even higher impacts on ground-nesting species (Banks and Bryant 2007).

In contrast to the rather depauperate population of ground-nesting forest-bird species there are several canopy and mid-canopy nesting species that are well-represented in the extensive forest habitat at the Campus. Scarlet tanager (*Piranga olivacea*), pine warbler (*Setophaga pinus*) and wood thrush (*Hylocichla mustelina*) – the latter recognized as showing persistent decline in national population over recent decades – held up to 14, 39 and 17 territories respectively. Such upper and middle canopy nesting species are somewhat less affected by responsible trail use, but are still susceptible to artificially high densities of predators (domestic cats, raccoons, opossums, *Corvids*) and brood parasites (i.e. brown-headed cowbirds) subsidized by backyard feeders and poor garbage management. It should be noted that the TRCA fauna inventory assesses the presence of species, i.e. the number of territories of each species at the site, but does not give any indication of the success of nesting attempts.

As far as the non-avian species are concerned, all of the 16 herpetofauna species are considered very sensitive to development. The sensitivity of these species varies considerably but again the majority of them are impacted by ground-borne disturbances at some stage of their life cycles. The two native turtle species – common snapping turtle and midland painted turtle (*Chrysemys picta marginata*) – both nest in terrestrial situations, and in both cases their eggs are very vulnerable to predation by artificially elevated populations of predators such as raccoons and Virginia opossums (*Didelphis virginiana*). The aquatic species are very sensitive to water quality in their native wetlands: run-off from roads and trails can carry road-salt and oils into the breeding habitats.

**Area sensitivity** is a scoring criterion that can be closely related to the issue of a species' need for isolation. Fauna species are scored for area sensitivity based on their requirement for a certain minimum size of preferred habitat. Species that require large tracts of habitat (>100 ha in total) score the maximum five points, while species that either show no minimum habitat requirement, or require <1 ha in total, score one point. Species scoring three points or more (require ≥5 ha in total) are deemed area sensitive species. Researchers have shown that for some species of birds, area sensitivity is a rather fluid factor, dependent and varying inversely with the overall percentage forest cover within the landscape surrounding the site where those species are found (Rosenburg *et al.* 1999).

Forty of the fauna species of regional and urban concern that were recorded at the Living City Campus over the past decade are considered area sensitive; all of these species – including 20 bird species ranked L1 to L3 - require at least 5 ha of habitat. Seven of the area sensitive bird species score 4 points in this criterion and as such require at least 20 ha of continuous habitat; six of these species are forest-dependent and certainly their area requirements are well met by the extensive forest at the Campus. Of these forest species, only the ovenbird is severely under-represented and it is believed that the low number of ovenbirds is due more to matrix influence and disturbance rather than to the extent of forest habitat available. Three of the area sensitive forest birds (scarlet tanager, pine warbler, and pileated woodpecker) are present in fairly good numbers, significantly even throughout the central section between Major Mackenzie Drive and Rutherford Road, the area that has the highest visitor use. These three species are canopy or mid-level nesters (in the case of the woodpecker) and as such are not as impacted by responsible trail use in the vicinity of their breeding territories as are ground- or low-nesting species.

The three area sensitive frog species (wood frog, *Lithobates sylvaticus*; spring peeper, *Pseudacris crucifer*; and grey treefrog, *Hyla versicolor*), two salamanders and one newt species which occur at the Living City Campus, are area sensitive primarily due to their need for two habitat types in which they complete their life cycle: wetlands for breeding, and upland forests for foraging and over-wintering. Again, habitat availability does not appear to be an issue for any of these sensitive species at the Campus, any declines that occur are more likely to be due to the quantity and quality of visitor pressure. These species are impacted by heavy trail use particularly during the period of their spring migration and summer dispersal, while the terrestrial juvenile stage of eastern newts (“red eft”) are often seen foraging across the forest floor (and therefore along trails) after wet spring and summer weather.

In conclusion, species’ patch-size constraints are due to a variety of factors including foraging requirements and the need for isolation within a habitat block during nesting. In the latter case, regardless of the provision of a habitat patch of sufficient size, if that block is seriously and frequently disturbed by human intrusion, such species will be liable to abandon the site. Such a variety of habitat needs are more likely satisfied within a larger extent of natural cover. The amount of forest cover at the study area accommodates multiple territories of area-sensitive species and other species that spend their time in the forest canopy.



**Figure 10. Eastern newt (*Notophthalmus viridescens*), terrestrial juvenile phase (“red eft”) can often be seen foraging across the forest floor after wet weather (photo by Paul Prior, May 2013)**

**Patch isolation sensitivity** in fauna measures the overall response of fauna species to fragmentation and isolation of habitat patches. One of the two main aspects of this scoring criterion is the physical ability or the predisposition of a species to move about within the landscape and is related to the connectivity of habitat within a landscape. The second main aspect is the potential impact that roads have on fauna species that are known to be mobile. Thus most bird species score fairly low for this criterion (although they prefer to forage and move along connecting corridors) whereas many herpetofauna score very high (since their life cycle requires them to move between different habitat types which may increase likelihood of road-kill). One example of how this criterion affects species populations is the need for adult birds to forage for food during the nestling and fledgling stage of the breeding season. By maintaining and improving the connectivity of natural cover within the landscape (e.g. by restoration of intervening lands) we are able to positively influence the populations of such species, improving their foraging and dispersal potential.

Thirty-one fauna species of regional and urban concern reported from the study area are considered sensitive to patch isolation including 21 L1 to L3 ranked species of which 13 are herp species. This excellent representation of patch isolation sensitive herp species at the Living City

Campus is due in large part to the effective connectivity between the habitat types accommodating these species' various life cycle elements, a degree of connectivity that is not compromised by excessive trail use. For many of the herp species their passage across the landscape, from one corner of the Living City Campus to the other, is facilitated by the presence of multiple aquatic habitats. This is perhaps why, despite the deteriorating matrix influence, so many herpetofauna are persisting at this site, including the Special Concern common snapping turtle and eastern milksnake, and the Endangered Jefferson salamander. However, within such a landscape, road-kill has the potential to gradually diminish local populations of these species and, if the species are to persist at the site, measures need to be taken to enable safe passage for these fauna elements throughout the site; in other parts of the Toronto region it has become clear that road-kill applies to paved and un-paved trails frequented by bicycles.

The other fauna that are heavily impacted by roads are mammals. Slow-moving and highly vagile (i.e. prone to moving long distances across the landscape) species such as porcupine are frequent victims of road-kill in areas of heavy vehicular traffic, and certainly this is borne out at the Living City Campus where the most recent reports of the species have been from road-kill carcasses on Major Mackenzie Drive. As visitor use increases in the lower sections of the Living City Campus and animals are motivated to disperse into the less disturbed northern section, it seems highly likely that a higher incidence of road-kill during such forced dispersals will eventually lead to the disappearance of this mammal from the Campus. Smaller faster moving mammals such as the flying squirrels and ermine (reported historically, but likely still a feature of the extensive forest and riparian habitat at the Campus) should be able to fare a little better than the porcupine, but the population statuses of these species are extremely difficult to assess. Matrix influence factors are more likely to limit the population of flying squirrels in the area (along with any decrease in the number of potential nest sites as standing dead-wood is removed), but certainly, fragmentation of the larger forest block by roads has likely not benefitted any of these species.

Fauna species that score greater than three points under the **habitat dependence** criterion are considered habitat specialists (Map 13). These species exhibit a combination of very specific habitat requirements that range from the microhabitat (e.g. decaying logs, aquatic vegetation) and requirements for particular moisture conditions, vegetation structure or spatial landscape structures, to preferences for certain community series and macro-habitat types. Twenty-nine fauna species that occur in the study area are considered habitat specialists including 25 species of regional concern. Of the 16 habitat dependent bird species present at the Living City Campus, 9 are dependent on various types of forest. The relatively high number suggests that the forest at the Living City Campus is still functioning at a fairly high level as far as avifauna is concerned, despite the decline in ground-nesting species. The presence of good numbers of scarlet tanagers and wood thrushes (the latter a species that has recently been listed as Threatened at the federal level by COSEWIC) in the deciduous and mixed forest on the site is in stark contrast to these same species' absence from forest fragments further within the urban landscape to the south. The coniferous element of the Living City Campus forest cover holds excellent numbers of the L3 ranked pine warbler and even a small number of golden-crowned kinglets.

Special mention should be given here to the bank swallow (*Riparia riparia*) colony which exists in the high cliff on the first major meander of the Humber River, north of Rutherford Road. This colony, varying in size from year to year, with a recent peak of approximately 180 cavities in 2009, is the largest persistent bank swallow colony in the region away from the Lake Ontario shoreline. This species is now listed as Threatened in Canada and although there is little that management can do to ensure the future of this species at the Living City Campus, this site should be monitored fully each year to properly understand the significance of the colony.

Bank swallows and other cavity nesters score high for habitat dependence primarily due to their very specific nesting requirements. Similarly, flying squirrels are highly dependent on the availability of tree cavities, usually adopting those excavated in large dead and dying trees by woodpeckers. In an extensive natural forest a shortage of such nest opportunities is rarely an issue; however, in a forest that is managed in part for public use, many such trees are removed for safety reasons, reducing the nesting and foraging opportunities for many fauna species.

A site's species list presents only the species' richness, i.e. it indicates only the presence or absence of species at a site but indicates neither the breeding success nor the population stability of each species at the site. A healthy functioning system will accommodate a whole suite of species that are adapted to the habitat types at the site, and will allow those particular species to thrive and breed successfully. As the quality of the habitat patch improves so will the representation of flora and fauna species associated with that habitat. In this way, representation biodiversity is an excellent measure of the health of a natural system. Degraded forest habitats in urban landscapes often accommodate only generalist species with the more sensitive forest-dependent species entirely absent. Currently there is fairly good representation of sensitive forest species at the Living City Campus suggesting that the forest habitat is still reasonably functional, but future management of the site will need to address the issue of visitor pressure in order to avoid the decline in sensitive fauna species that is more expected in natural systems embedded in an urban landscape.

## **5.0 Summary and Recommendations**

The recommendations for the Living City Campus take into consideration the regional targets for natural heritage in the TRCA jurisdiction. To reach the regional targets for quality distribution and quantity of natural cover, every site will require its own individualized plan of action. Following is a short summary of the study area within the regional context, followed by specific recommendations.

### **5.1 Site Summary**

1. The site is located in the lower reaches of the East Humber River watershed, at the interface between the rural and urban land-use zones. It is very large, with 693 ha of natural cover. As such the Living City Campus fills an important function in helping to maintain a viable connection between the rural landscape to the north of the city and



- important staging areas for migrant birds located in the lower reaches of the Humber River and the Lake Ontario shoreline.
2. There are 146 vegetation types, ranging from old-growth forest to shallow marsh and aquatic communities. The site includes 72 forest, 37 wetland, 9 aquatic, 17 successional, 8 dynamic and 3 meadow vegetation community types. This high community diversity reflects the size of the site and its diverse topography and history including pre-existing older forest types, more recent plantings and natural regeneration, streams and ponds. The vegetation diversity is comparable to other high-quality sites of similar size in the TRCA jurisdiction.
  3. The old-growth hemlock mixed forest at Boyd Conservation Area, along with some drier oak-dominated deciduous forests, sand barrens, and small organic wetlands are all vegetation communities of very high conservation concern (ranked L2 or outstandingly high-quality examples of more common communities).
  4. Several small wetlands (natural and created) are located throughout the site providing breeding opportunities for a very high number of amphibian species including two L1 ranked salamanders. Such populations are even more significant given the proximity of the encroaching urbanizing landscape. This location is the closest to the city centre that several of these species occur.
  5. The wetlands and aquatic habitat at the site provide habitat opportunities for two Species at Risk, Jefferson salamander and snapping turtle.
  6. Five hundred and forty-two naturally-occurring flora species were observed including 102 plants ranked L2 or L3 (considered flora species of regional concern) plus an additional 140 species of concern in urban areas (L4). Many of these species are associated with the forest and wetland vegetation communities. Total species richness is thus very high though somewhat less strong for wetland species. Native species are still predominant, comprising 71% of the total.
  7. Several flora species are known in recent times only from the Living City Campus or from one or two other sites in the TRCA jurisdiction. These include smooth rock-cress, burnweed, wild crab-apple, and whorled loosestrife.
  8. There is good representation of forest species typical of both deciduous forest such as running strawberry-bush and mixed or coniferous forest such as star-flower. Spring ephemerals are abundant in much of the deciduous forest. The wetland species persist in spite of being sensitive to urban impacts.
  9. Plantings include maturing plantations several decades old, newer restoration projects involving mixed native trees and constructed wetlands. The green roof demonstration at the Archetype Sustainable House exhibits the potential for green roofs to provide habitat for certain native species.

10. The 121 species of vertebrate fauna observed is a total which ranks alongside some of the highest quality TRCA properties across the region. This exceptionally high diversity is in part due to the representation of the various habitat types, but also because of a higher reporting level due to the constant staff presence on site.
11. Although forest ground-nesting species (e.g. ovenbird, ruffed grouse) are poorly represented, the forest canopy supports good populations of some typical canopy nesting species such as pine warbler (39 pairs), and scarlet tanager (14 pairs).
12. In addition to the relatively high richness and representation in the breeding bird population, the site is important for migrating songbirds moving along the Humber River corridor to and from migrant staging areas on the Lake Ontario shoreline.
13. The Living City Campus' high profile and facilities means that there is high potential to use its natural habitats for further interpretive and educational opportunities in this growing urban community.

## 5.2 Site Recommendations

The recommendations primarily address objectives of protecting regional biodiversity in the TRCA jurisdiction. In order to maintain or enhance the current level of biodiversity at the Living City Campus, the overall integrity of the natural heritage system that includes the site must be protected. The high public profile and educational character of the Living City Campus makes this objective even more critically important, since it provides an example to the public for how natural heritage is to be protected. Therefore, at the landscape scale, in keeping with the TNHSS, connections to other natural habitat patches in the landscape need to be created and maintained. Furthermore, the recommendations identify the issues that may occur with any increased public use of the Study Area as the urban landscape continues to expand. Local community stewardship needs to address this potential increase in negative matrix influence and ensure that effective mitigation is included as part of any future management of the site. This includes strategic placement of any interpretive signage, managing public use, allowing healthy dynamic natural processes to proceed, and controlling invasive species.

The following recommendations address the above natural heritage concerns, with an emphasis upon bolstering the existing natural features on site. Thus, we recommend overall that 1) existing habitats and features be protected and enhanced; 2) that public use be managed; and 3) that invasive species be controlled.

### 1. Protect and Enhance Existing Features

The first priority should be to focus on ***maintaining conditions that allow existing communities or species of conservation concern to thrive***. This is especially true of the mature forest habitats throughout the site.

- a. There are still opportunities to increase the size and connectivity of habitat patches at the Living City Campus. Connectivity should be increased by providing tunnels for wildlife passage under the east-west roads that cut across the Humber Valley (Teston Road, Major MacKenzie Drive, Rutherford Road, and Langstaff Road). There are already bridges that provide some passage, but additional opportunities should be pursued.
- b. A study should be conducted regarding how much and what kind of wildlife crosses the north-south roads (Islington Avenue and Pine Valley Drive) to get to adjacent habitats. In particular, Pine Valley Drive separates the Kleinburg Woodlots from the Living City Campus. Improving connectivity here may help the movement of native species of plants and animals, but it may also simply enhance the spread of opportunistic species associated with the residential backyards around the Kleinburg Woodlots (e.g. cats, raccoons) in which case it should not be pursued.
- c. Additional land should be secured to enlarge the natural system in the vicinity of the Living City Campus. In particular, the National Golf Club is located adjacent to the old-growth forest at Boyd Conservation Area, where it provides a buffer of lower-intensity land use between the forest and the residential areas further east. Consideration should be given to including this land in the provincial Greenbelt whose boundary currently encompasses the Living City Campus. In the long term, it could be targeted for acquisition and restoration. Lands to the north of the Living City Campus (e.g. Purpleville Creek and a link to the Don River headwaters to the northeast) should also be considered for addition to the natural system. The enlarged natural system would be better able to accommodate and buffer public use.
- d. While it is important at this site to maintain the diversity of habitats, there are opportunities for extending the forest canopy, especially to expand and shelter existing areas of mature forest. It should be noted that there is no expectation that sensitive low-nesting bird species will return to breed in the area but by enhancing the canopy there may be added opportunities for canopy-nesting species.
- e. Areas selected for restoration should have soil and moisture assessments conducted in order to help determine suitable lists of species for planting. If soil conditions are suitable, e.g. on flat areas of impermeable Halton Till that are

currently meadow or agricultural field, consideration should be given to adding vernal pool features.

- f. Ensure effective and adequate passage (e.g. tunnels and culverts) for frogs, snakes and mammals across or under trails.
- g. Given the management requirement to remove hazard trees in the vicinity of trails, providing properly protected and fully-monitored nest-boxes would enhance opportunities for species such as great-crested flycatcher (*Myiarchus crinitus*), and increase the likelihood of recruitment of other cavity-nesters such as eastern screech-owl (*Megascops asio*).
- h. Hydrology should be restored in the areas that form the catchment basin of the Living City Campus. Measures that would help toward this end would be the disconnection of roof leaders and adding soak-away pits in the adjacent residential neighbourhoods, and blocking any drains or ditches that might convey ground water away from seepage areas. Conversely, watercourses that are heavily affected by storm water should be kept off-line from existing wetlands which they might contaminate.

## 2. Manage Public Use

Landscape metrics indicate that the existing matrix influence at this urban-edge site is largely negative. The impact of these urban influences is undoubtedly exacerbated by the disturbance that occurs along the trails. Visitor pressure is likely to increase in the future, and it is important that this increase in use does not impact sensitive habitat features such as the wetlands.

- a. Decisions about public use and what facilities to install at the Living City Campus should take into account what is appropriate in terms of promoting conservation biology and sustainable land planning (e.g. a focus on “passive” low-impact nature observation and interpretation; and explication of built landscape technology such as green roofs, energy efficiency, storm water controls, native plants, etc.)
- b. The existing trail system should be reviewed so as to protect sensitive natural features and species; trails that are too wide or eroding should be narrowed and repaired, and some trails may need to be closed or re-routed.
- c. Extensive use of interpretive signs, augmenting the already impressive series of signs posted throughout the northern section of the trail system, should serve to foster greater community involvement and awareness of the natural history of the site.

- d. It is important that dogs are kept leashed in any of the natural habitats on site at all times, in part to ensure public safety, but also in order to facilitate the nesting success of any ground-nesting birds. In specific areas of open habitat where the sensitive ground-nesting Species at Risk, bobolink and eastern meadowlark (*Sturnella magna*) - both listed as Species at Risk in Canada - occur, dog-walking (i.e. both on and off-leash) should be prohibited throughout the nesting season. Dog-leash by-laws at other properties throughout the region have proven unenforcable and therefore a policy of zero tolerance (such as exists at Tommy Thompson Park) may be the best course of action.
  - e. Involving the local community in any restoration efforts at the Living City Campus will enhance feelings of good stewardship, which in turn will result in more ecologically positive behaviour, e.g. responsible gardening practices including proper disposal of yard waste; diminished use of salt on paved surfaces in close proximity to the site; responsible dog-ownership. The stewardship could be implemented as part of a Sustainable Neighbourhood Action Plan (SNAP).
3. Control Invasive Species

Several invasive plant species are threats to the native biodiversity at the Living City Campus. ***It is essential that well-planned and realistic measures be undertaken to control invasive species.*** Management for invasive species will need to be tailored to the individual species in question, depending on how wide-spread and established they are.

- a. Since most of the invasive species at the site have large and/or diffuse populations, the best approach is to control disturbance that would aid their further spread rather than eradication efforts. For example, trail repair, trailside plantings of competitive native ground covers such as bloodroot (*Sanguinaria canadensis*) and discouraging dumping would reduce the disturbance that encourages garlic mustard.
- b. Oriental bittersweet and common reed might be realistic candidates for eradication efforts from the Living City Campus. These two species are currently present in discrete populations but have a high potential for spread. Their removal would thus be both feasible and have a highly protective effect on biodiversity.
- c. Invasive species control should be undertaken as a proactive maintenance measure along the trail corridors as well as to any other areas targeted for restoration planting. This would include local removal of dog-strangling vine, buckthorn, Manitoba maple (*Acer negundo*), and other species that are widespread across the site as a whole.

- d. Emerald ash borer is now established across the TRCA jurisdiction. This insect is will kill many ash trees. At this stage, Emerald Ash borer has become more of a public safety issue and a source of disturbance to the overall ecosystem, as control is not realistic. Dead trees near trails will become hazards and expensive to remove. Trail alignments should be directed away from dense ash populations. At the same time, areas with ash should be targeted for control of other invasive species that are likely to take advantage of the increased light resulting from loss of ash in the canopy. TRCA forestry staff have completed treatments for some high-value ash trees at Kortright and Boyd Conservation Area
- e. Monitoring for other invasive pest species should continue: e.g. beech bark disease and the hemlock woolly adelgid (not yet established in Ontario).

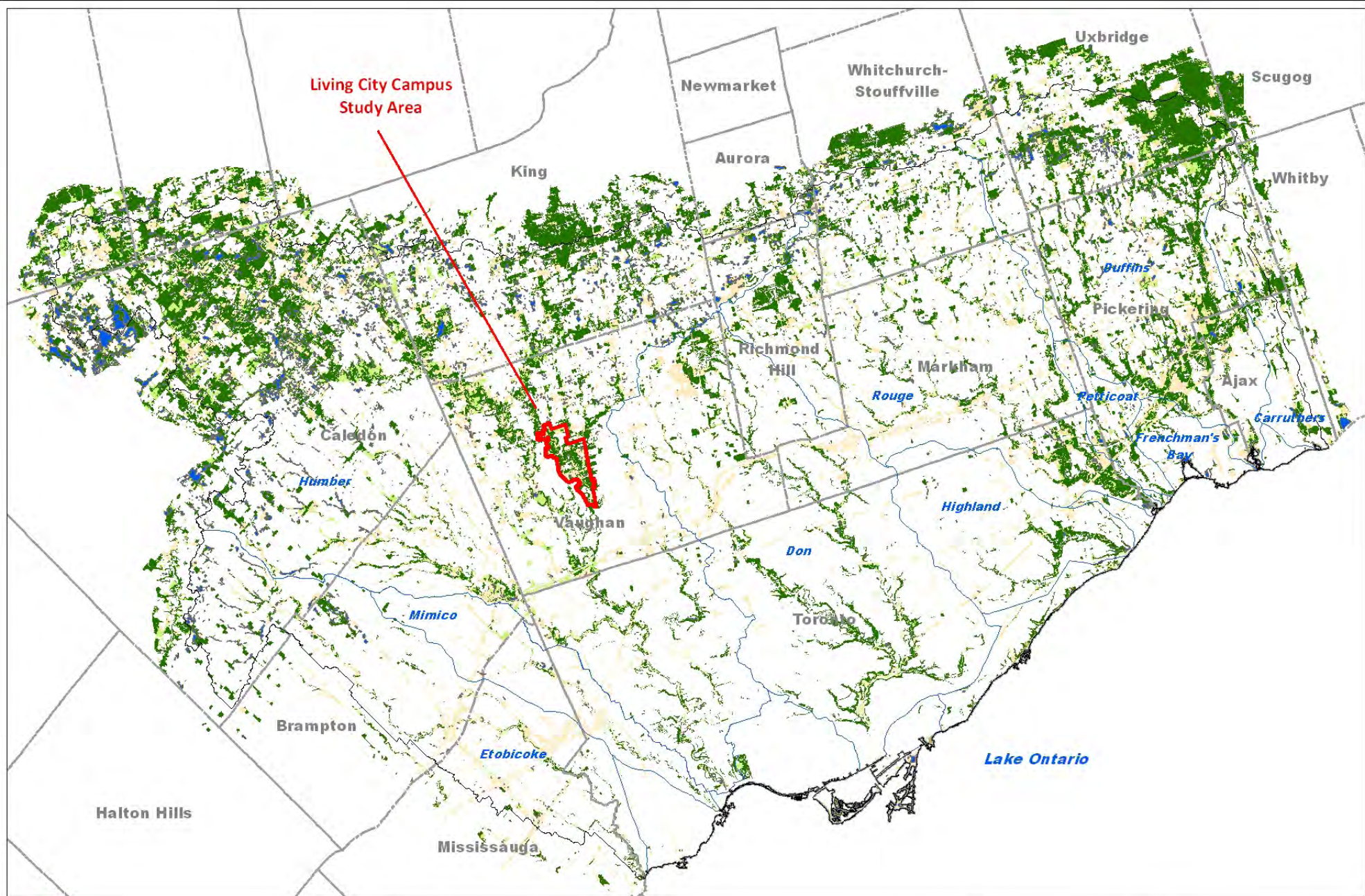
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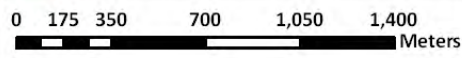
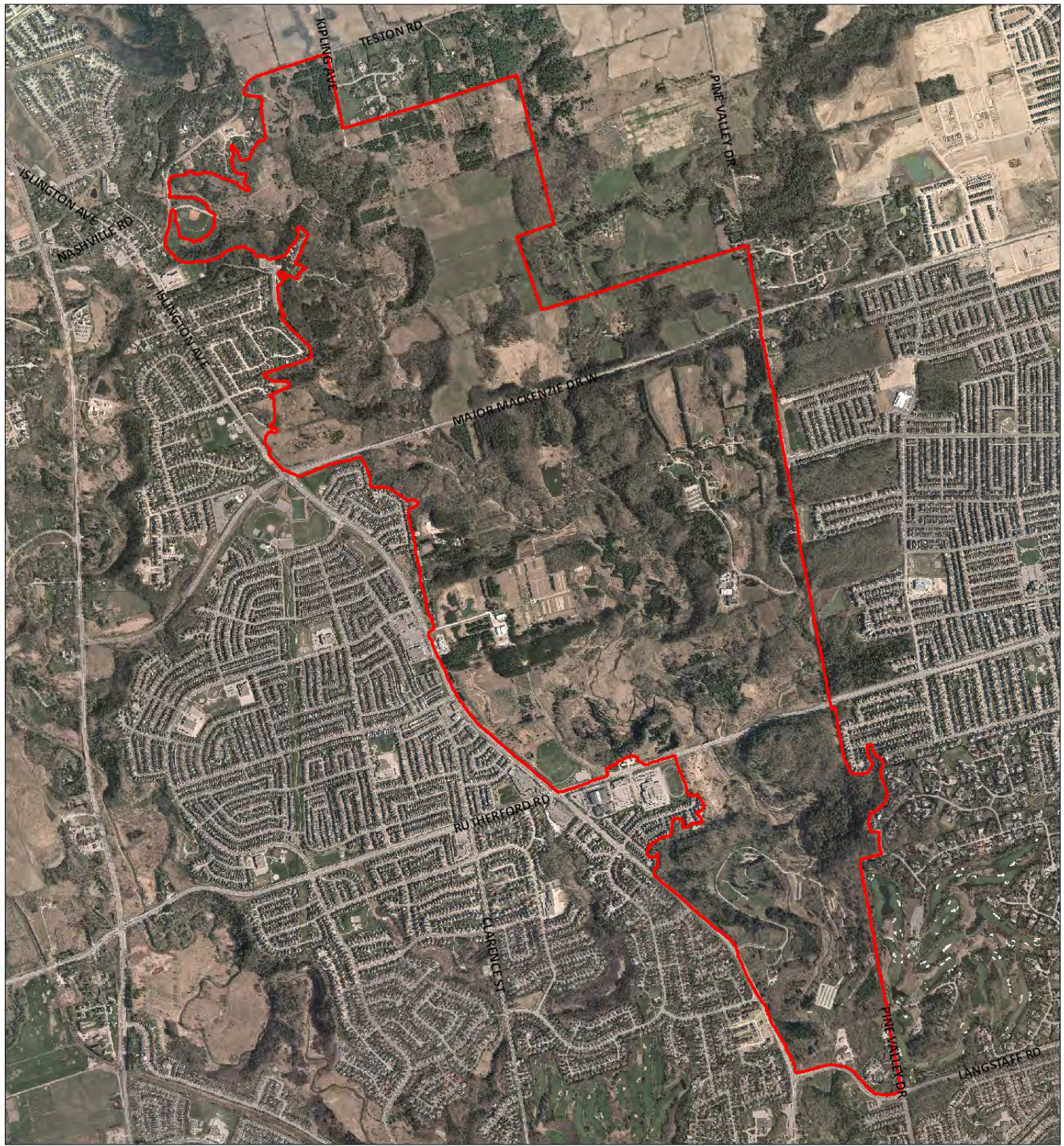


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**Map 1:**  
**Living City Campus in the Context**  
**of Regional Natural Cover**


Natural Cover *		Legend	
	Forest		Living City Campus Study Area Boundary
	Successional		TRCA Jurisdiction
	Meadow		Watershed
	Wetland		Municipal Boundary
	Beach/Bluff		

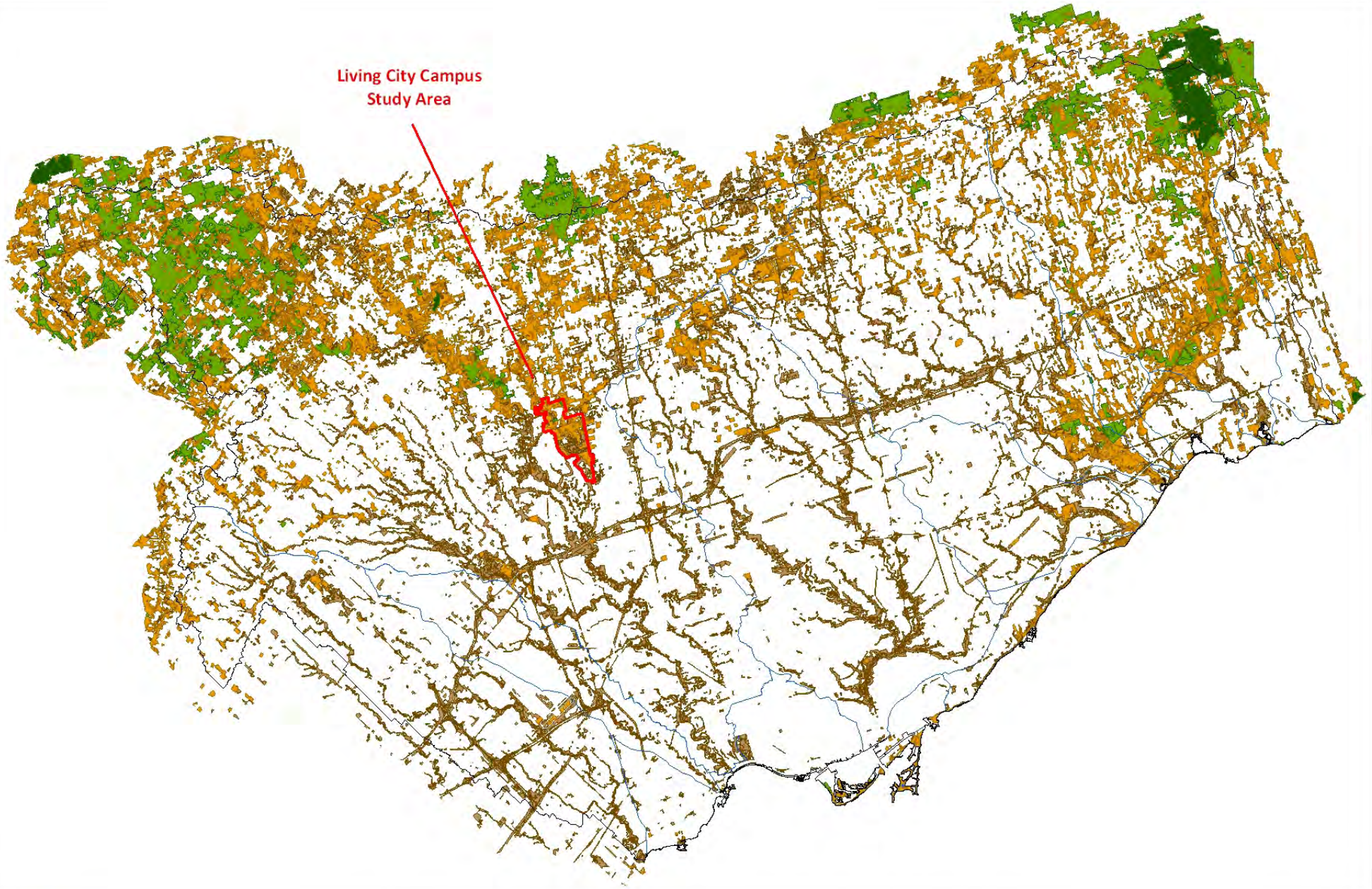


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 Orthophoto: Spring 2012, First Base Solutions Inc.



### Map 2: Living City Campus Study Area

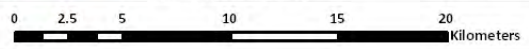
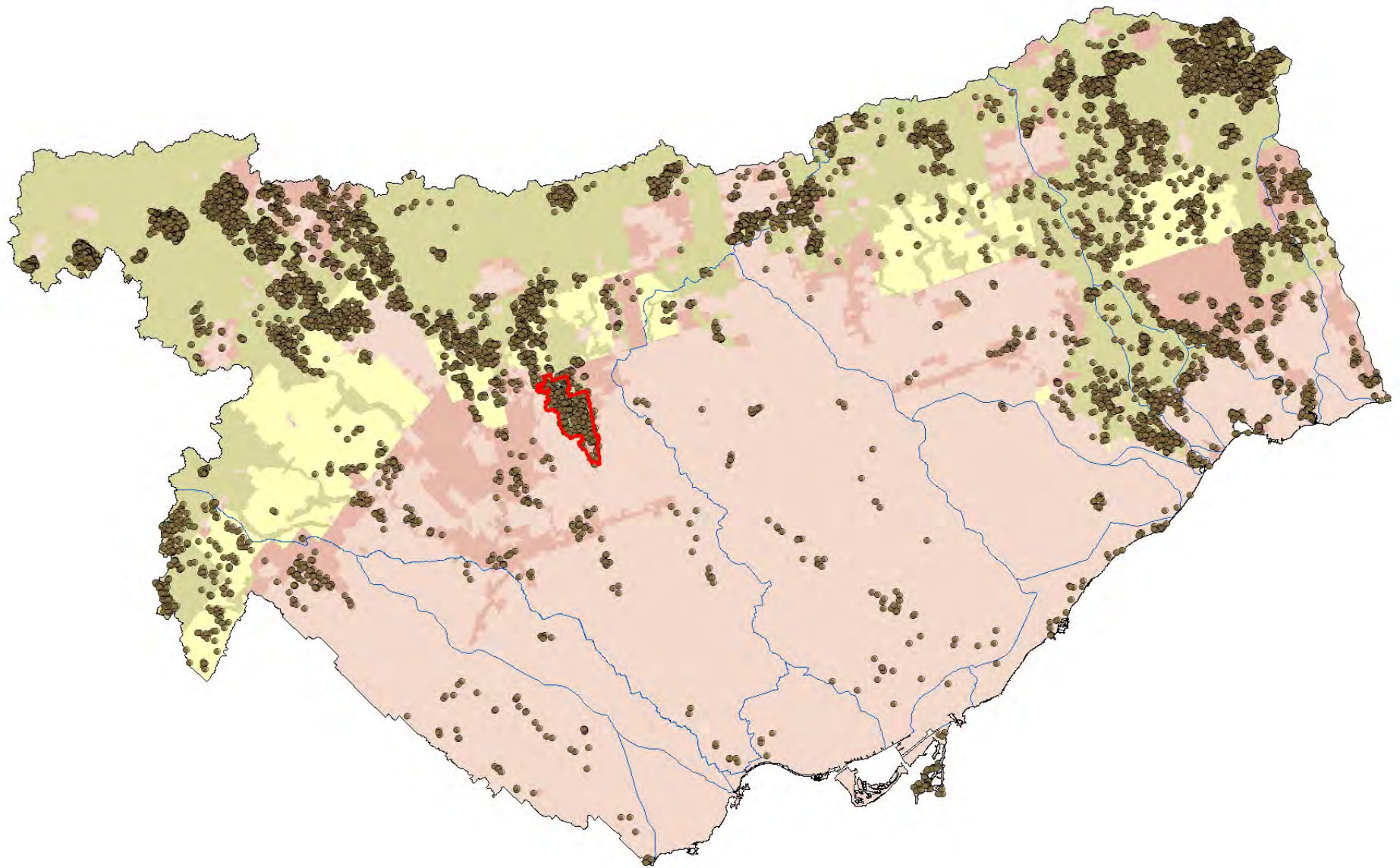
#### Legend

 Living City Campus Study Area Boundary



### Map 3: Regional Natural System Habitat Patch Quality

Habitat Patch Quality *		Legend	
	L1 - Excellent		Living City Campus Study Area Boundary
	L2 - Good		TRCA Jurisdiction
	L3 - Fair		Watershed
	L4 - Poor		
	L5 - Very Poor		

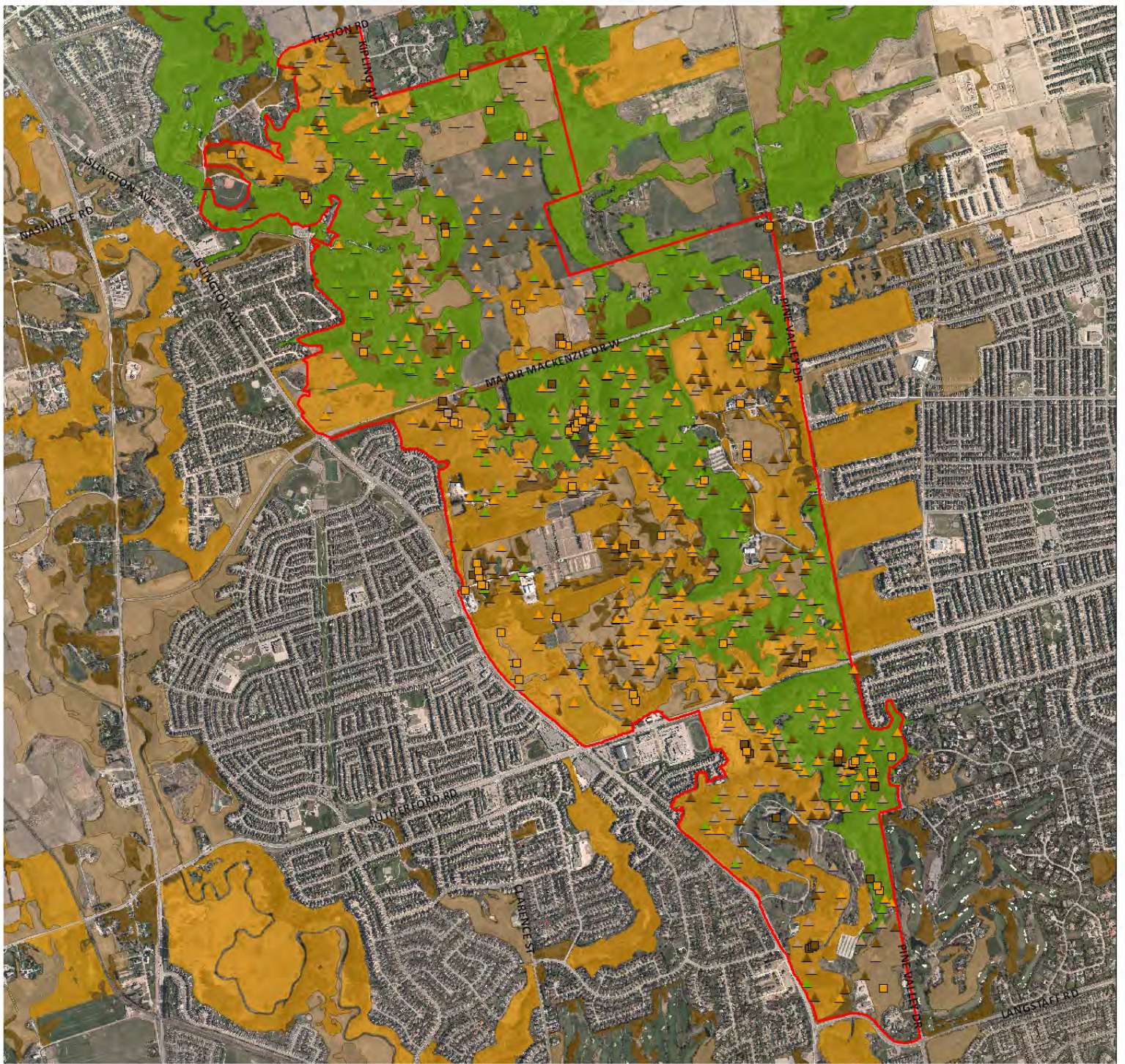


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**Map 4:**  
**Distribution of Fauna**  
**Regional Species of Concern**

**Legend**

-  Fauna Species of Concern (L1 - L3)
-  Living City Campus Study Area Boundary
-  TRCA Jurisdiction
-  Watershed
-  Agricultural & Rural Area
-  Built-up Area
-  Designated Greenfield Area
-  Greenbelt Area



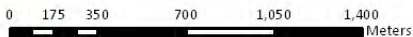
**Fauna Area Sensitivity Scores**

- ▲ 5 - >100ha
- ▲ 4 - >20ha
- ▲ 3 - > 5ha
- ▲ 2 - > 1ha
- ▲ 1 - < 1ha

- △ Fauna Species
- Frog Species

**Habitat Patch Size Scores \***

- 5 - Excellent
- 4 - Good
- 3 - Fair
- 2 - Poor
- 1 - Very Poor



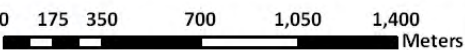
Date: April 2013  
 Orthophoto: Spring 2012, First Base Solutions Inc.  
 \* Landscape analysis based on 2007/2008 Orthophotography

**Map 5:  
 Habitat Patch Size  
 Scores with Fauna Area  
 Sensitivity Scores**

**Legend**

- Living City Campus Study Area Boundary

NOTE: All fauna species with their associated scores for area sensitivity can be found in Appendix #3.

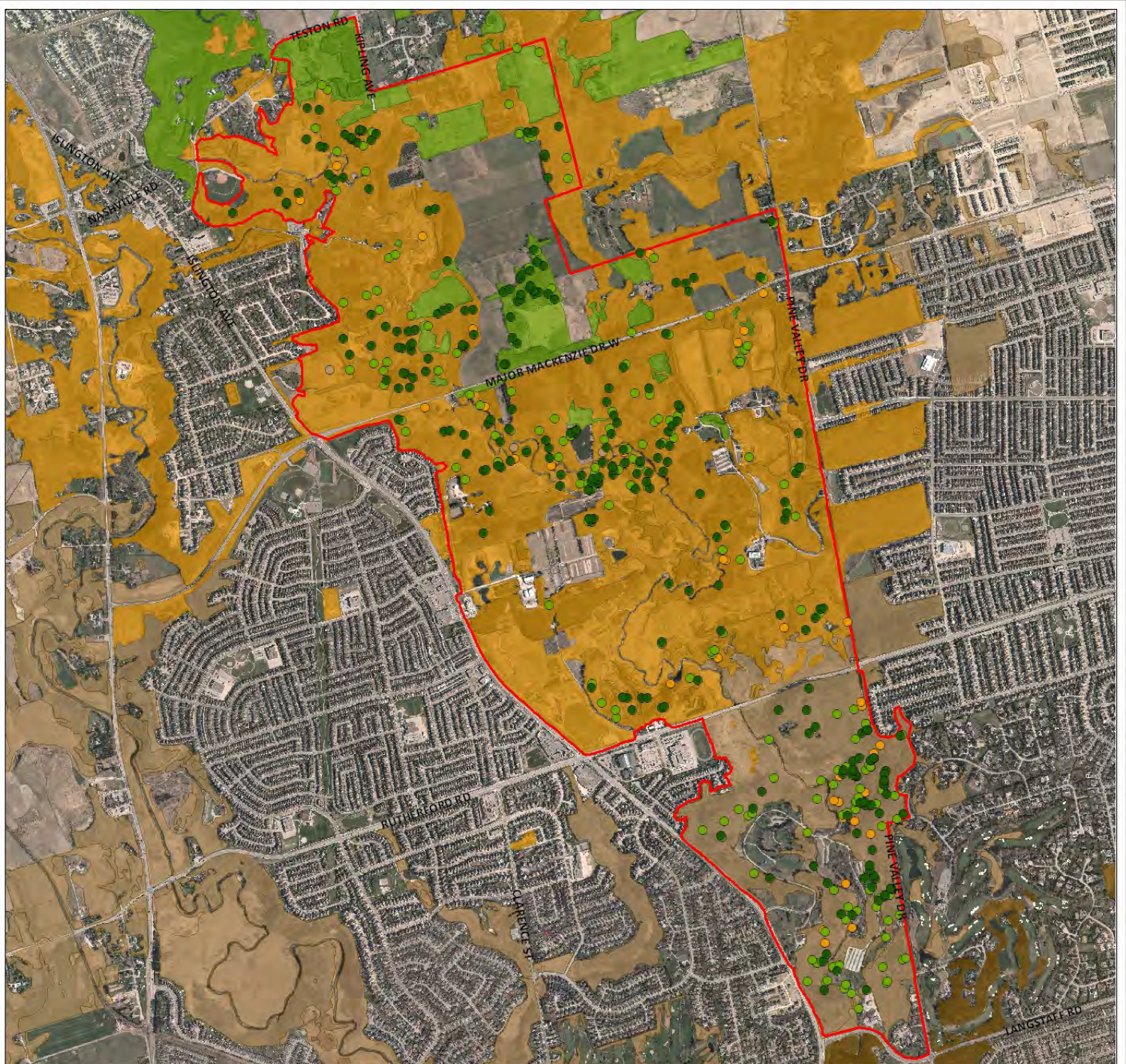


Date: April 2013  
 Orthophoto: Spring 2012, First Base Solutions Inc.  
 \* Landscape analysis based on 2007/2008 Orthophotography

### Map 6: Interior Forest at Living City Campus

#### Legend

- Living City Campus Study Area Boundary
- Forest
- Forest Interior**
- 100m-200m
- 400m-500m
- 200m-300m
- 500m-600m
- 300m-400m
- 600m-700m

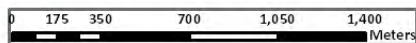


**Flora Sensitivity to Development Scores**

- 5 - Species receives severe negative impact from development-related disturbances
- 4 - Species receives moderately severe negative impact from development-related disturbances
- 3 - Species receives significant negative impact from development-related disturbances
- 2 - Species receives slight negative impact from development-related disturbances
- 1 - Species experiences no overall benefit or detriment from development-related disturbances (neutral)
- 0 - Species benefits significantly from development-related disturbances

NOTE: All flora species with their associated scores for sensitivity to development can be found in Appendix #2.

○ Flora Species



Date: April 2013  
 Orthophoto: Spring 2012, First Base Solutions Inc.  
 \* Landscape analysis based on 2007/2008 Orthophotography

**Map 7:  
 Scores for Matrix Influence  
 and Flora Sensitivity to  
 Development**

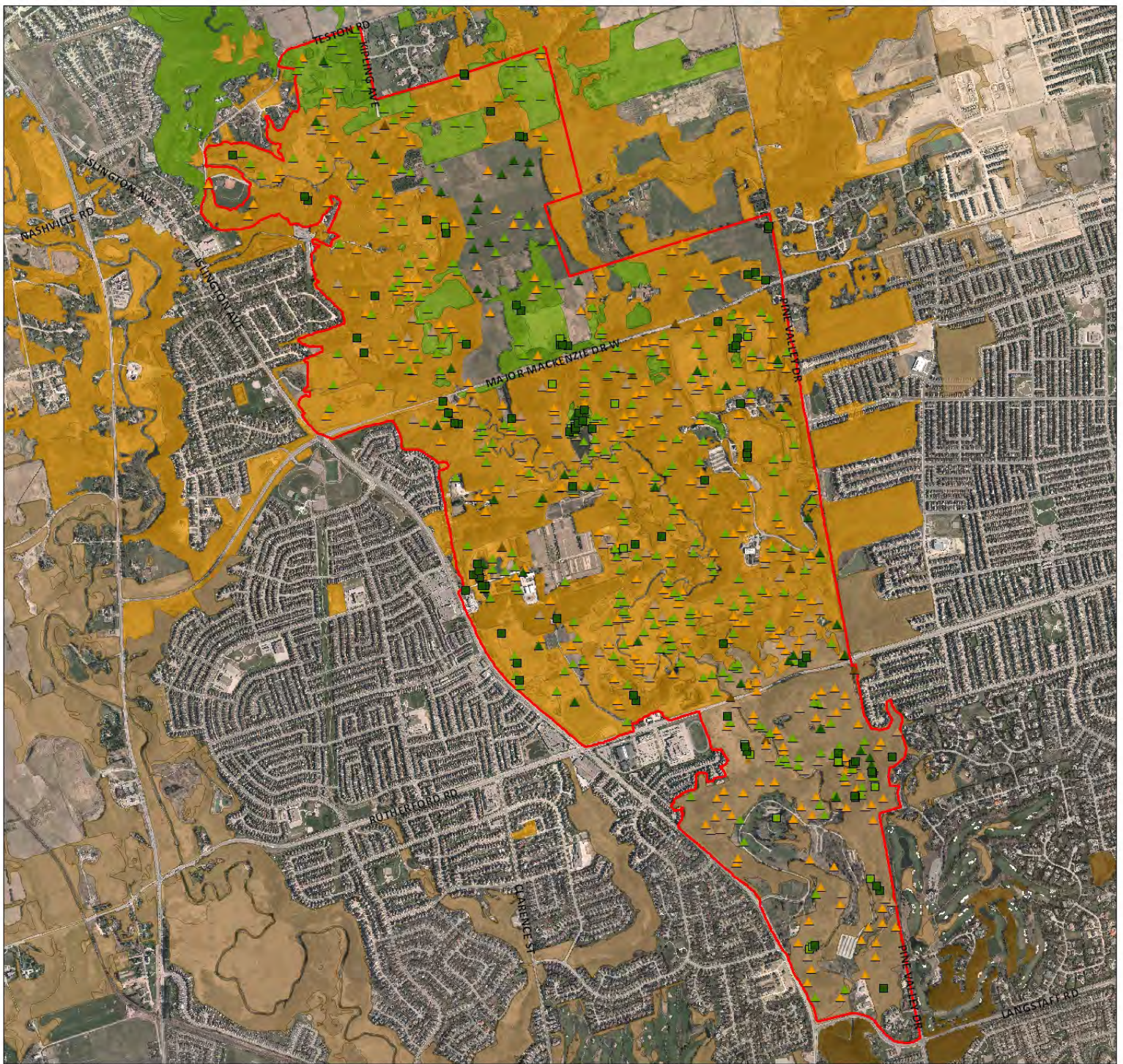
**Legend**

Habitat Matrix Influence Scores \*

- 5 - Excellent
- 4 - Good
- 3 - Fair
- 2 - Poor
- 1 - Very Poor

□ Living City Campus Study Area Boundary



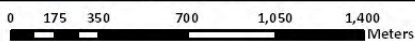


**Fauna Sensitivity to Development Scores**

- ▲ ■ 5 - Species receives severe negative impact from development-related disturbances
- ▲ ■ 4 - Species receives moderately severe negative impact from development-related disturbances
- ▲ ■ 3 - Species receives significant negative impact from development-related disturbances
- ▲ ■ 2 - Species receives slight negative impact from development-related disturbances
- ▲ ■ 1 - Species experiences no overall benefit or detriment from development-related disturbances (neutral)
- ▲ ■ 0 - Species benefits significantly from development-related disturbances

NOTE: All fauna species with their associated scores for sensitivity to development can be found in Appendix #3.

- △ Fauna Species
- Frog Species



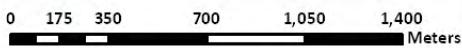
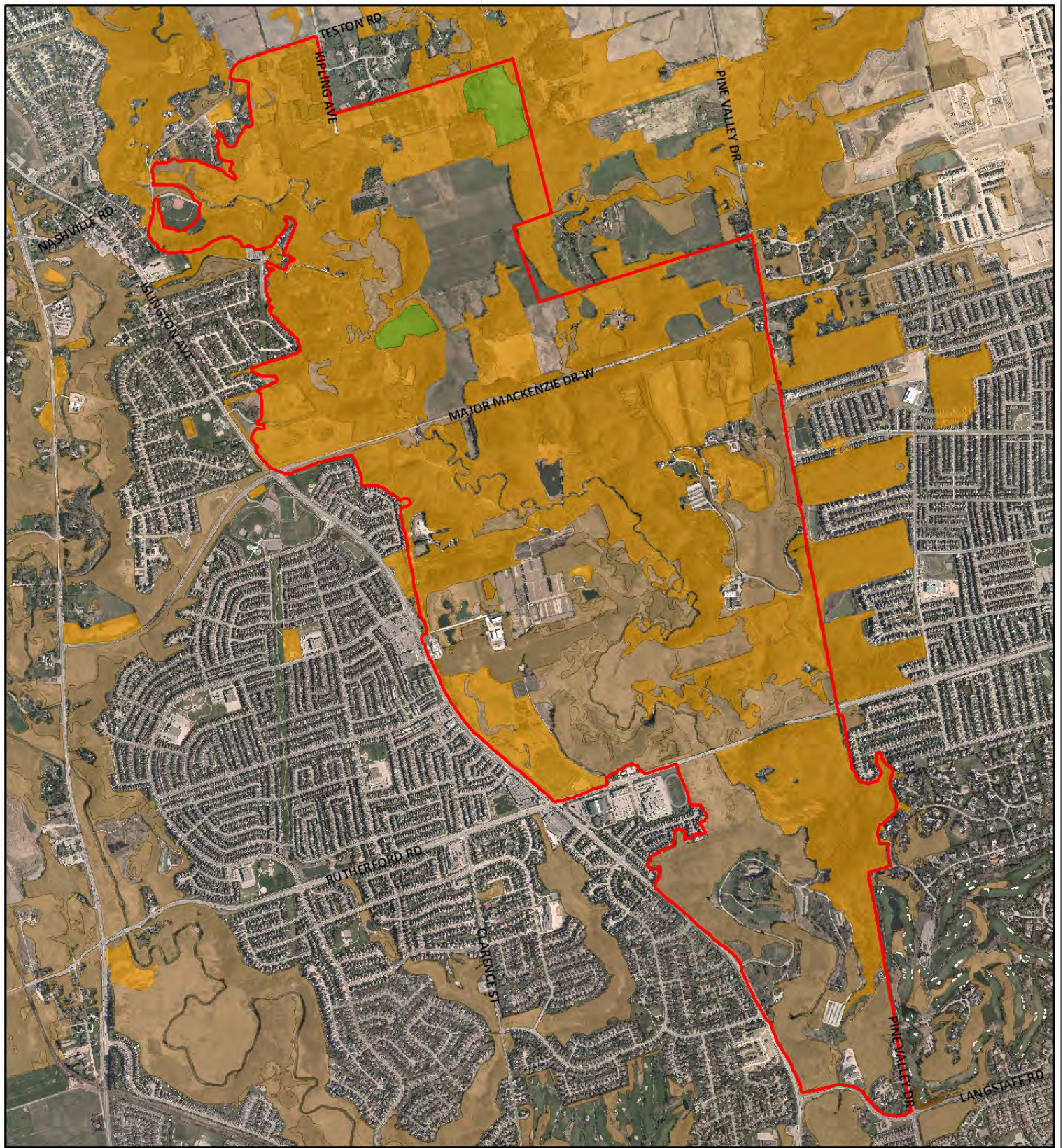
Date: April 2013  
 Orthophoto: Spring 2012, First Base Solutions Inc.  
 \* Landscape analysis based on 2007-2008 Orthophotography

**Map 8:  
 Scores for Matrix Influence  
 and Fauna Sensitivity to  
 Development**

**Legend**

Habitat Matrix Influence Scores \*

- 5 - Excellent
- 4 - Good
- 3 - Fair
- 2 - Poor
- 1 - Very Poor
- Living City Campus Study Area Boundary



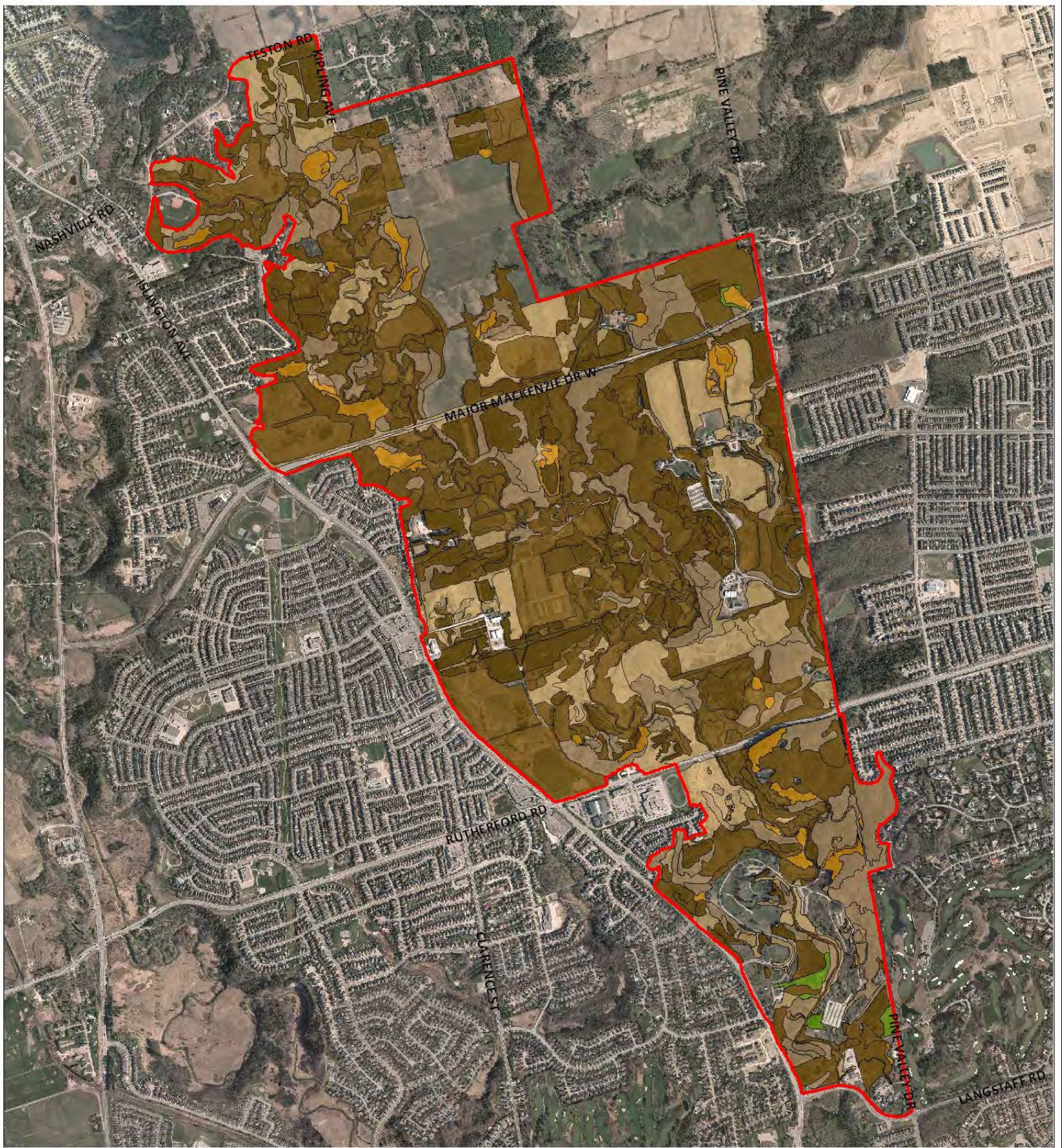
### Map 9: Habitat Patch Quality

Date: April 2013  
 Orthophoto: Spring 2012, First Base Solutions Inc.  
 \* Landscape analysis based on 2007/2008  
 Orthophotography

#### Legend

##### Habitat Patch Quality \*

- L1 - Excellent
  - L2 - Good
  - L3 - Fair
  - L4 - Poor
  - L5 - Very Poor
- Living City Campus Study Area Boundary



0 175 350 700 1,050 1,400  
Meters


Date: April 2013  
Orthophoto: Spring 2012, First Base  
Solutions Inc.

## Map 10: Vegetation Communities with their Associated Local Ranks

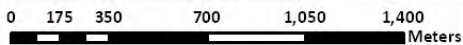
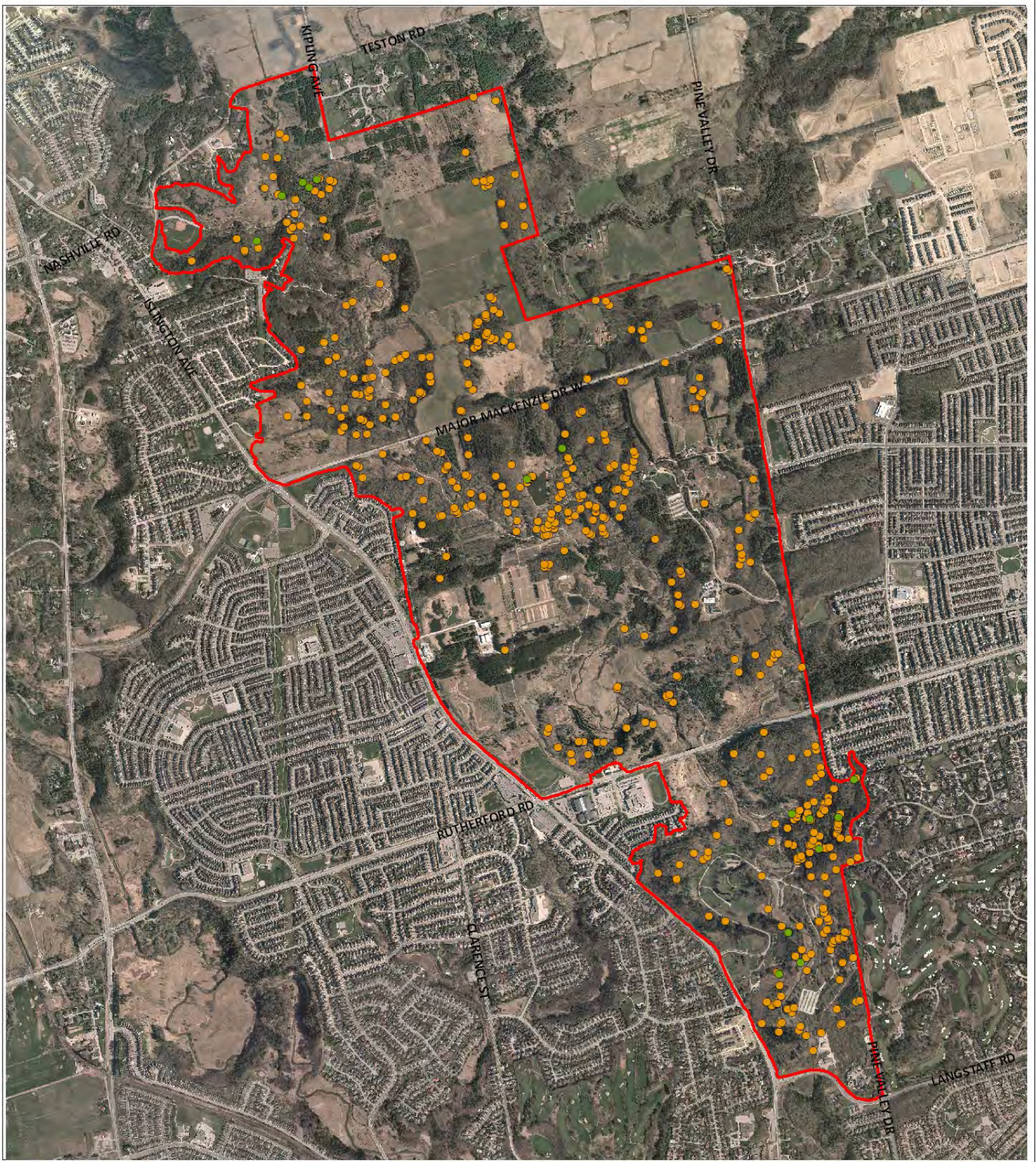
### Legend

#### Vegetation Community Ranks

	L1		L4
	L2		L5
	L3		L+

 Living City Campus Study Area Boundary

NOTE: All vegetation communities with their associated scores and ranks can be found in Appendix #1.



Date: April 2013  
 Orthophoto: Spring 2012, First Base  
 Solutions Inc.

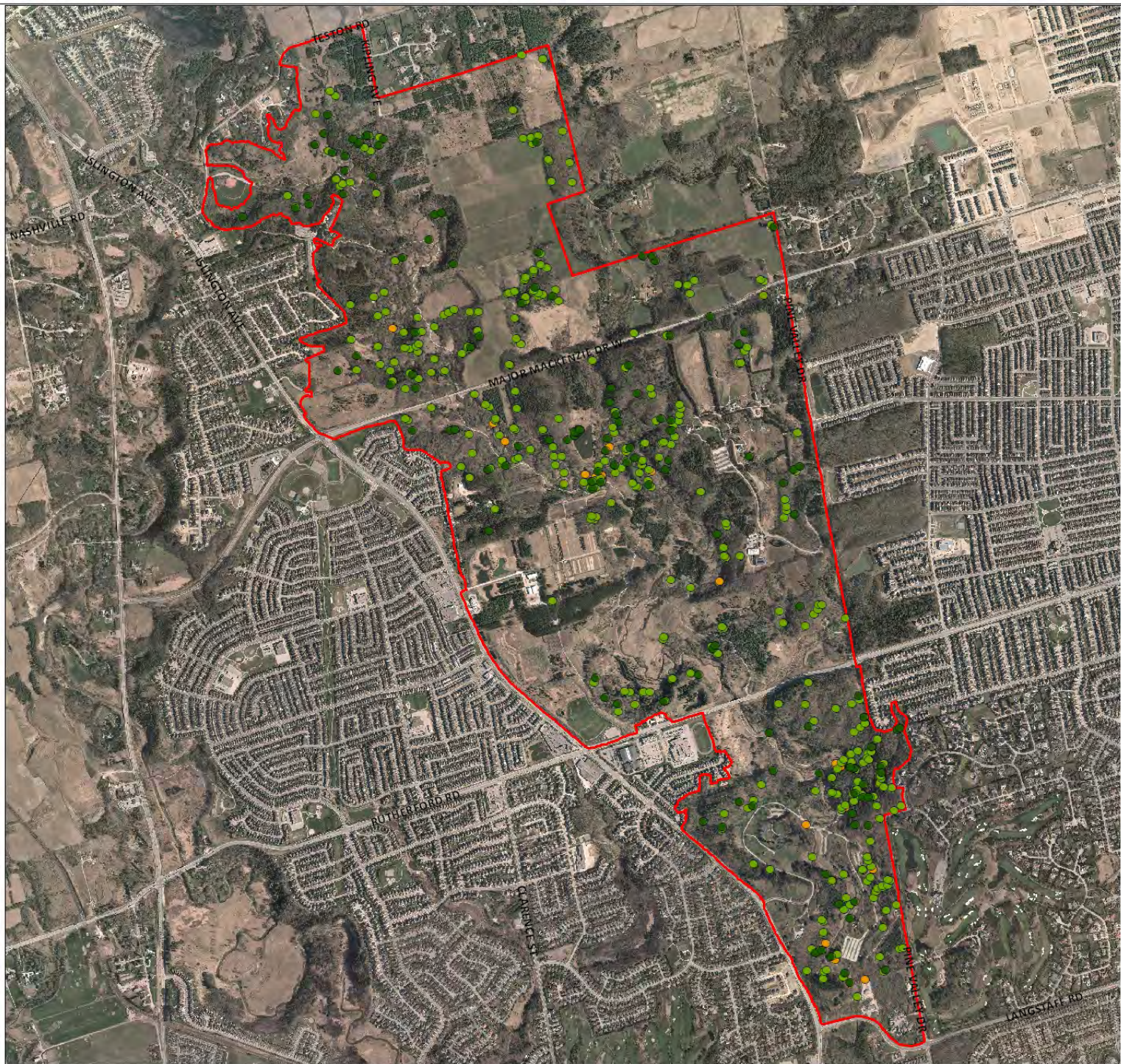
### Map 11: Locations of Flora Species of Concern

#### Legend

Flora Species of Concern

- L1
- L3
- L2

Living City Campus  
 Study Area Boundary



**Flora Habitat Dependence Scores**

- 5 - Extreme habitat specialist
- 4 - Strong habitat specialist
- 3 - Moderate habitat specialist
- 2 - Moderate habitat generalist
- 1 - Strong habitat generalist
- 0 - Extreme habitat generalist

○ Flora Species

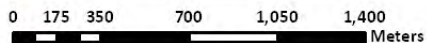
NOTE: All flora species with their associated scores for habitat dependence can be found in Appendix #2.



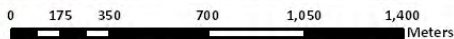
**Map 12:  
Flora Species Habitat  
Dependence Scores**

Legend

Living City Campus Study Area Boundary



Date: January 2013  
Orthophoto: Spring 2012, First Base Solutions Inc.



Date: April 2013  
 Orthophoto: Spring 2012, First Base  
 Solutions Inc.

### Map 13: Locations of Fauna Species of Concern

#### Legend

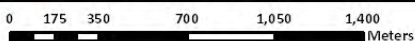
Fauna Species of Concern		Frog Species of Concern	
▲ L1	▲ L3	■ L1	■ L3
▲ L2	▲ L4	■ L2	■ L4
Living City Campus Study Area Boundary			



**Fauna Habitat Dependence Scores**

- ▲ ■ 5 - Extreme habitat specialist
- ▲ ■ 4 - Strong habitat specialist
- ▲ ■ 3 - Moderate habitat specialist
- ▲ ■ 2 - Moderate habitat generalist
- ▲ ■ 1 - Strong habitat generalist
- ▲ ■ 0 - Extreme habitat generalist

NOTE: All fauna species with their associated scores for habitat dependence can be found in Appendix #3.



Date: April 2013  
 Orthophoto: Spring 2012, First Base Solutions Inc.

**Map 14:  
 Fauna Species  
 Habitat Dependence  
 Scores**

**Legend**

- Living City Campus Study Area Boundary
- △ Fauna Species
- Frog Species

**Appendix 1: Vegetation Communities at Living City Campus 1998-2005**

ELC Code	Vegetation Type (* indicates present as inclusion and/or complex only)	Tot. area # ha	Scores			Local Rank (2012-08)
			Local Occur.	Geophy. Requir.	Total Score	
<b>Forest</b>						
*FOC1-2	*Dry-Fresh White Pine (- Red Pine) Coniferous Forest		3.5	2.0	5.5	L3
FOC2-2	Dry-Fresh White Cedar Coniferous Forest	0.2	2.5	2.0	4.5	L4
FOC3-1	Fresh-Moist Hemlock Coniferous Forest	5.4	2.5	2.0	4.5	L4
FOC3-A	Fresh-Moist Hemlock - White Pine Coniferous Forest	9.7	3.0	2.0	5.0	L3
FOC4-1	Fresh-Moist White Cedar Coniferous Forest	5.6	2.0	2.0	4.0	L4
FOC4-2	Fresh-Moist White Cedar - Hemlock Coniferous Forest	2.3	2.5	2.0	4.5	L4
FOC4-A	Fresh-Moist White Cedar - White Pine Coniferous Forest	1.1	3.0	2.0	5.0	L3
FOM2-1	Dry-Fresh White Pine - Oak Mixed Forest	2.0	3.0	4.0	7.0	L2
FOM2-2	Dry-Fresh White Pine - Sugar Maple Mixed Forest	4.6	2.5	1.0	3.5	L4
FOM2-A	Dry-Fresh White Pine - Hardwood Mixed Forest	2.8	2.5	1.0	3.5	L4
FOM3-2	Dry-Fresh Hemlock - Sugar Maple Mixed Forest	11.4	2.5	2.0	4.5	L4
FOM6-1	Fresh-Moist Sugar Maple - Hemlock Mixed Forest	31.6	2.0	2.0	4.0	L4
FOM6-2	Fresh-Moist Hemlock - Hardwood Mixed Forest	0.4	2.0	3.0	5.0	L3
FOM7-1	Fresh-Moist White Cedar - Sugar Maple Mixed Forest	0.2	2.5	2.0	4.5	L4
FOM7-2	Fresh-Moist White Cedar - Hardwood Mixed Forest	6.3	1.5	2.0	3.5	L4
FOM8-1	Fresh-Moist Poplar Mixed Forest	2.6	3.5	2.0	5.5	L3
*FOM8-2	*Fresh-Moist Paper Birch Mixed Forest		3.5	2.0	5.5	L3
FOMA-A	Fresh-Moist White Pine - Sugar Maple Mixed Forest	0.1	3.5	2.0	5.5	L3
FOMA-B	Fresh-Moist White Pine - Hawthorn Mixed Forest	0.4	4.5	0.0	4.5	L4
FOD1-1	Dry-Fresh Red Oak Deciduous Forest	0.8	3.5	4.0	7.5	L2
FOD2-4	Dry-Fresh Oak - Hardwood Deciduous Forest	0.4	2.5	2.0	4.5	L4
FOD3-1	Dry-Fresh Poplar Deciduous Forest	0.5	2.0	2.0	4.0	L4
FOD3-2	Dry-Fresh Paper Birch Deciduous Forest	0.7	2.5	1.0	3.5	L4
*FOD4-1	*Dry-Fresh Beech Deciduous Forest		2.5	1.0	3.5	L4
FOD4-2	Dry-Fresh White Ash Deciduous Forest	0.4	2.5	0.0	2.5	L5
FOD4-b	Dry-Fresh Manitoba Maple Deciduous Forest	1.8	2.5	0.0	2.5	L+
FOD4-d	Dry-Fresh Norway Maple Deciduous Forest	1.3	3.5	0.0	3.5	L+
FOD5-1	Dry-Fresh Sugar Maple Deciduous Forest	28.3	1.5	0.0	1.5	L5
FOD5-2	Dry-Fresh Sugar Maple - Beech Deciduous Forest	14.6	1.5	0.0	1.5	L5
FOD5-3	Dry-Fresh Sugar Maple - Oak Deciduous Forest	19.3	1.5	2.0	3.5	L4
FOD5-4	Dry-Fresh Sugar Maple - Ironwood Deciduous Forest	0.4	2.5	0.0	2.5	L5
FOD5-5	Dry-Fresh Sugar Maple - Hickory Deciduous Forest	2.6	3.5	1.0	4.5	L4
FOD5-7	Dry-Fresh Sugar Maple - Black Cherry Deciduous Forest	3.0	2.0	0.0	2.0	L5
FOD5-8	Dry-Fresh Sugar Maple - White Ash Deciduous Forest	18.5	1.5	0.0	1.5	L5



**Appendix 1: Vegetation Communities at Living City Campus 1998-2005**

ELC Code	Vegetation Type (* indicates present as inclusion and/or complex only)	Tot. area # ha	Scores			Local Rank (2012-08)
			Local Occur.	Geophy. Requir.	Total Score	
FOD5-10	Dry-Fresh Sugar Maple - Paper Birch - Poplar Deciduous Forest	2.3	2.5	1.0	3.5	L4
FOD6-1	Fresh-Moist Sugar Maple - Ash Deciduous Forest	3.8	2.0	0.0	2.0	L5
FOD6-2	Fresh-Moist Sugar Maple - Black Maple Deciduous Forest	8.6	2.5	1.0	3.5	L4
FOD6-4	Fresh-Moist Sugar Maple - White Elm Deciduous Forest	1.2	3.0	1.0	4.0	L4
FOD6-5	Fresh-Moist Sugar Maple - Hardwood Deciduous Forest	5.8	1.5	0.0	1.5	L5
FOD7-1	Fresh-Moist White Elm Lowland Deciduous Forest	3.6	2.0	1.0	3.0	L4
FOD7-2	Fresh-Moist Ash Deciduous Forest	2.9	2.0	1.0	3.0	L4
FOD7-3	Fresh-Moist Willow Lowland Deciduous Forest	14.2	2.0	0.0	2.0	L5
FOD7-5	Fresh-Moist Black Maple Lowland Deciduous Forest	4.0	3.5	1.0	4.5	L4
FOD7-a	Fresh-Moist Manitoba Maple Lowland Deciduous Forest	37.5	1.5	0.0	1.5	L5
FOD7-E	Fresh-Moist Hawthorn - Apple Deciduous Forest	4.2	2.5	0.0	2.5	L5
FOD7-F	Fresh-Moist Basswood Lowland Deciduous Forest	2.6	3.0	1.0	4.0	L4
FOD8-1	Fresh-Moist Poplar Deciduous Forest	1.5	1.0	0.0	1.0	L5
FOD9-1	Fresh-Moist Oak - Sugar Maple Deciduous Forest	2.1	3.0	2.0	5.0	L3
FOD9-3	Fresh-Moist Bur Oak Deciduous Forest	1.6	3.0	1.0	4.0	L4
CUP1-3	Black Walnut Deciduous Plantation	0.8	3.0	0.0	3.0	L+
CUP1-4	Hybrid Poplar Deciduous Plantation	0.2	3.0	0.0	3.0	L5
CUP1-7A	White Ash Deciduous Plantation	0.4	4.0	0.0	4.0	L5
CUP1-8	Red Oak Deciduous Plantation	0.4	3.5	0.0	3.5	L5
CUP1-A	Restoration Deciduous Plantation	15.7	2.0	0.0	2.0	L5
CUP1-c	Black Locust Deciduous Plantation	1.1	2.0	0.0	2.0	L+
CUP1-d	Horticultural Deciduous Plantation	2.0	3.5	0.0	3.5	L+
CUP1-g	Apple Deciduous Plantation	0.3	3.5	0.0	3.5	L+
CUP2-1A	Black Walnut - Conifer Mixed Plantation	0.4	4.0	0.0	4.0	L5
CUP2-A	Restoration Mixed Plantation	0.3	2.5	0.0	2.5	L5
CUP2-c	Norway Maple - Conifer Mixed Plantation	0.6	3.5	0.0	3.5	L5
CUP2-E	Silver Maple - Conifer Mixed Plantation	0.1	3.0	0.0	3.0	L5
CUP2-f	Hybrid Poplar - Conifer Mixed Plantation	0.3	3.5	0.0	3.5	L5
CUP2-l	Red Oak - Conifer Mixed Plantation	1.3	3.5	0.0	3.5	L5
CUP3-1	Red Pine Coniferous Plantation	18.4	1.5	0.0	1.5	L5
CUP3-2	White Pine Coniferous Plantation	11.8	1.5	0.0	1.5	L5
CUP3-3	Scotch Pine Coniferous Plantation	0.5	2.0	0.0	2.0	L+
CUP3-8	White Spruce - European Larch Coniferous Plantation	0.2	3.5	0.0	3.5	L5
CUP3-C	White Spruce Coniferous Plantation	7.2	2.0	0.0	2.0	L5
CUP3-D	Black Spruce Coniferous Plantation	0.1	4.0	0.0	4.0	L5

**Appendix 1: Vegetation Communities at Living City Campus 1998-2005**

ELC Code	Vegetation Type (* indicates present as inclusion and/or complex only)	Tot. area # ha	Scores			Local Rank (2012-08)
			Local Occur.	Geophy. Requir.	Total Score	
CUP3-e	Norway Spruce Coniferous Plantation	0.7	2.0	0.0	2.0	L+
*CUP3-F	*Tamarack Coniferous Plantation		4.5	0.0	4.5	L5
CUP3-H	Mixed Conifer Coniferous Plantation	59.8	1.5	0.0	1.5	L5
<b>Successional</b>						
CUT1-1	Sumac Deciduous Thicket	0.2	2.0	0.0	2.0	L5
CUT1-4	Grey Dogwood Deciduous Thicket	0.2	4.0	0.0	4.0	L4
CUT1-A1	Native Deciduous Sapling Regeneration Thicket	2.7	2.0	0.0	2.0	L5
CUT1-A2	Native Mixed Sapling Regeneration Thicket	0.3	2.5	0.0	2.5	L5
*CUT1-b	*Buckthorn Deciduous Thicket		2.5	0.0	2.5	L+
CUT1-c	Exotic Deciduous Thicket	7.7	2.0	0.0	2.0	L+
CUH1-A	Treed Hedgerow	2.8	1.5	0.0	1.5	L5
CUH1-d	Exotic Shrub Hedgerow	0.4	3.5	0.0	3.5	L+
CUS1-1	Hawthorn Successional Savannah	3.7	2.0	0.0	2.0	L5
CUS1-A1	Native Deciduous Successional Savannah	8.7	1.5	0.0	1.5	L5
CUS1-A2	White Pine Successional Savannah	0.7	2.5	1.0	3.5	L4
CUS1-b	Exotic Successional Savannah	5.8	2.0	0.0	2.0	L+
*CUW1-A1	*White Cedar Successional Woodland		2.5	1.0	3.5	L4
CUW1-A2	White Pine Successional Woodland	4.6	2.5	1.0	3.5	L4
CUW1-A3	Native Deciduous Successional Woodland	21.8	1.0	0.0	1.0	L5
CUW1-b	Exotic Successional Woodland	5.3	1.5	0.0	1.5	L+
CUW1-D	Hawthorn Successional Woodland	8.0	2.5	0.0	2.5	L5
<b>Wetland</b>						
*SWC1-2	*White Cedar - Conifer Mineral Coniferous Swamp		3.5	2.0	5.5	L3
SWC2-2	Hemlock Mineral Coniferous Swamp	0.4	3.5	2.0	5.5	L3
SWM1-1	White Cedar - Hardwood Mineral Mixed Swamp	0.7	2.5	2.0	4.5	L4
SWM4-1	White Cedar - Hardwood Organic Mixed Swamp	3.3	2.0	3.0	5.0	L3
SWD1-2	Bur Oak Mineral Deciduous Swamp	0.7	3.5	2.0	5.5	L3
SWD2-1	Black Ash Mineral Deciduous Swamp	0.5	2.5	2.0	4.5	L4
SWD2-2	Red (Green) Ash Mineral Deciduous Swamp	0.2	2.5	2.0	4.5	L4
SWD3-2	Silver Maple Mineral Deciduous Swamp	2.2	2.5	2.0	4.5	L4
SWD3-4	Manitoba Maple Mineral Deciduous Swamp	0.7	3.0	1.0	4.0	L4
SWD4-1	Willow Mineral Deciduous Swamp	2.3	2.0	1.0	3.0	L4
SWD4-3	Paper Birch - Poplar Mineral Deciduous Swamp	1.2	2.0	2.0	4.0	L4
SWD5-1	Black Ash Organic Deciduous Swamp	0.6	3.0	3.0	6.0	L3

**Appendix 1: Vegetation Communities at Living City Campus 1998-2005**

ELC Code	Vegetation Type (* indicates present as inclusion and/or complex only)	Tot. area # ha	Scores			Local Rank (2012-08)
			Local Occur.	Geophy. Requir.	Total Score	
SWD6-2	Silver Maple Organic Deciduous Swamp	0.4	3.5	3.0	6.5	L2
SWT2-2	Willow Mineral Thicket Swamp	0.3	2.0	2.0	4.0	L4
SWT3-7	Winterberry Organic Thicket Swamp	0.1	3.5	4.0	7.5	L2
MAM2-2	Reed Canary Grass Mineral Meadow Marsh	4.4	1.0	1.0	2.0	L+
MAM2-3	Red-top Mineral Meadow Marsh	0.002	3.0	0.0	3.0	L4
MAM2-5	Narrow-leaved Sedge Mineral Meadow Marsh	0.1	3.0	2.0	5.0	L3
*MAM2-6	*Broad-leaved Sedge Mineral Meadow Marsh		3.0	2.0	5.0	L3
MAM2-7	Horsetail Mineral Meadow Marsh	0.1	3.0	2.0	5.0	L3
MAM2-9	Jewelweed Mineral Meadow Marsh	0.1	2.5	1.0	3.5	L4
MAM2-10	Forb Mineral Meadow Marsh	1.0	2.0	1.0	3.0	L4
*MAM2-a	*Common Reed Mineral Meadow Marsh		3.0	0.0	3.0	L+
MAM2-C	Rush Mineral Meadow Marsh	0.2	3.5	2.0	5.5	L3
*MAM2-E	*Bulrush Mineral Meadow Marsh		4.0	1.0	5.0	L3
MAM3-2	Reed Canary Grass Organic Meadow Marsh	0.5	3.5	2.0	5.5	L+
MAM3-9	Forb Organic Meadow Marsh	0.2	3.0	3.0	6.0	L3
MAS2-1A	Broad-leaved Cattail Mineral Shallow Marsh	1.6	2.0	1.0	3.0	L4
MAS2-1b	Narrow-Leaved Cattail Mineral Shallow Marsh	1.0	2.0	0.0	2.0	L+
*MAS2-2	*Bulrush Mineral Shallow Marsh		3.0	1.0	4.0	L4
MAS2-4	Broad-leaved Sedge Mineral Shallow Marsh	0.2	3.5	2.0	5.5	L3
MAS2-8	Rice Cut-grass Mineral Shallow Marsh	0.2	3.5	1.0	4.5	L4
MAS2-d	Reed Canary Grass Mineral Shallow Marsh	0.1	3.0	1.0	4.0	L+
MAS2-G	Manna Grass Mineral Shallow Marsh	0.1	4.0	1.0	5.0	L3
MAS3-1A	Broad-leaved Cattail Organic Shallow Marsh	4.1	2.5	3.0	5.5	L3
MAS3-1b	Narrow-leaved Cattail Organic Shallow Marsh	0.2	3.0	1.0	4.0	L+
*MAS3-4	*Broad-leaved Sedge Organic Shallow Marsh		4.0	3.0	7.0	L2
<b>Aquatic</b>						
SAS1-1	Pondweed Submerged Shallow Aquatic	0.03	2.0	2.0	4.0	L4
SAS1-3	Stonewort Submerged Shallow Aquatic	0.1	2.5	1.0	3.5	L4
*SAM1-2	*Duckweed Mixed Shallow Aquatic		3.0	2.0	5.0	L3
SAM1-4	Pondweed Mixed Shallow Aquatic	0.7	3.0	2.0	5.0	L3
*SAM1-6	*Bladderwort Mixed Shallow Aquatic		4.5	3.0	7.5	L2
SAM1-A	Water Lily - Bullhead Lily Mixed Shallow Aquatic	0.1	3.0	2.0	5.0	L3
*SAF1-1	*Water Lily - Bullhead Lily Floating-leaved Shallow Aquatic		3.5	2.0	5.5	L3
SAF1-3	Duckweed Floating-leaved Shallow Aquatic	0.3	2.5	1.0	3.5	L4

**Appendix 1: Vegetation Communities at Living City Campus 1998-2005**

ELC Code	Vegetation Type (* indicates present as inclusion and/or complex only)	Tot. area # ha	Scores			Local Rank (2012-08)
			Local Occur.	Geophy. Requir.	Total Score	
OAO1	Open Aquatic (deep or riverine unvegetated)	12.7	2.0	0.0	2.0	L5
<b>Dynamic (Beach, Bluff, Barren, Prairie, Savannah)</b>						
*BBO1-3	*Reed Canary Grass Riparian Bar		4.0	2.0	6.0	L3
BBS1-2B	Willow Shrub Riparian Bar	1.0	3.5	1.0	4.5	L4
BLO1	Mineral Open Bluff	0.9	2.5	2.0	4.5	L4
BLS1-c	Exotic Shrub Bluff	0.1	4.0	2.0	6.0	L+
BLT1-B	Deciduous Treed Bluff	0.1	3.0	2.0	5.0	L3
*SBO1-A	*Dry Dropseed Sand Barren		3.5	4.0	7.5	L2
*SBO1-B	*Dry-Fresh Flat-stemmed Bluegrass - Forb Sand Barren		3.5	3.0	6.5	L2
SBS1	Shrub Sand Barren	0.2	3.5	3.0	6.5	L2
<b>Meadow</b>						
CUM1-A	Native Forb Meadow	93.6	1.5	0.0	1.5	L5
CUM1-b	Exotic Cool-season Grass Graminoid Meadow	55.1	1.0	0.0	1.0	L+
CUM1-c	Exotic Forb Meadow	30.0	1.5	0.0	1.5	L+

Appendix 2b: Historic Flora Species pre-1998		Local Occur.	Popn. Trend	Hab. Dep.	Sens. Dev.	Total Score	Rank TRCA (08/2012)	Most Recent Record
Scientific Name	Common Name	1-5	1-5	0-5	0-5	2-20		
<i>Equisetum cf. palustre</i>	marsh horsetail	5	5	5	4	19	L1	1981
<i>Cardamine cf. nymanii</i>	cuckoo-flower	4	4	5	4	17	L2	1981
<i>Phlox divaricata</i>	wild blue phlox	4	4	4	5	17	L2	1983
<i>Antennaria parlinii ssp. fallax</i>	plantain-leaved pussytoes	3	4	3	4	14	L3	1981
<i>Campanula aparinoides</i>	marsh bellflower	3	4	5	4	16	L3	1981
<i>Equisetum cf. pratense</i>	thicket horsetail	3	4	5	3	15	L3	1981
<i>Lonicera canadensis</i>	fly honeysuckle	2	4	4	4	14	L3	1983
<i>Medeola virginiana</i>	Indian cucumber-root	2	5	4	5	16	L3	1983
<i>Sisyrinchium montanum</i>	blue-eyed grass	2	3	4	5	14	L3	1993
<i>Triosteum aurantiacum</i>	wild coffee	3	5	4	3	15	L3	1983
<i>Carex projecta</i>	necklace sedge	3	2	4	3	12	L4	1993

Appendix 3. List of Fauna for the Living City Campus, 2003 - 2012.

Common Name	Code	Scientific Name	count	LO	PTn	PTt	AS	PIS	HD	StD	+	TS	L-Rank
<b>Survey Species: species for which the TRCA protocol effectively surveys.</b>													
<b>Birds</b>													
blue-winged teal	BWTE	<i>Anas discors</i>	historic	4	3	3	3	2	2	3	0	20	L2
blue-winged warbler	BWWA	<i>Vermivora pinus</i>	3	3	3	2	3	1	2	5	1	20	L2
grasshopper sparrow	GRSP	<i>Ammodramus savannarum</i>	1	3	4	3	2	2	3	3	0	20	L2
least bittern	LEBI	<i>Ixobrychus exilis</i>	historic	4	2	3	4	2	3	4	0	22	L2
ruffed grouse	RUGR	<i>Bonasa umbellus</i>	historic	1	3	3	3	2	2	5	1	20	L2
American woodcock	AMWO	<i>Scolopax minor</i>	(11)	0	2	3	3	2	2	4	0	16	L3
black-billed cuckoo	BBCU	<i>Coccyzus erythrophthalmus</i>	2	0	3	2	3	1	3	3	0	15	L3
black-throated green warbler	BTNW	<i>Setophaga virens</i>	2	1	4	2	3	1	3	4	0	18	L3
bobolink	BOBO	<i>Dolichonyx oryzivorus</i>	17	0	3	3	3	1	1	5	1	17	L3
brown creeper	BRCR	<i>Certhia americana</i>	1	1	2	2	3	2	2	4	0	16	L3
brown thrasher	BRTN	<i>Toxostoma rufum</i>	2	0	3	3	2	2	1	4	0	15	L3
chestnut-sided warbler	CSWA	<i>Setophaga pensylvanica</i>	4	2	2	2	3	1	1	4	0	15	L3
clay-coloured sparrow	CCSP	<i>Spizella pallida</i>	3	3	3	2	2	1	1	4	0	16	L3
eastern towhee	EATO	<i>Pipilo erythrophthalmus</i>	2	2	3	2	2	2	1	4	0	16	L3
golden-crowned kinglet	GCKI	<i>Regulus satrapa</i>	2	3	2	2	3	1	3	3	0	17	L3
hooded merganser	HOME	<i>Lophodytes cucullatus</i>	4	2	2	2	4	2	2	2	0	16	L3
marsh wren	MAWR	<i>Cistothorus palustris</i>	2	2	2	2	3	3	3	3	0	18	L3
mourning warbler	MOWA	<i>Geothlypis philadelphia</i>	25	0	3	2	2	2	2	4	0	15	L3
Nashville warbler	NAWA	<i>Oreothlypis ruficapilla</i>	2	2	1	2	2	1	2	5	1	16	L3
northern waterthrush	NOWA	<i>Parkesia noveboracensis</i>	3	1	2	2	3	1	4	5	1	19	L3
ovenbird	OVEN	<i>Seiurus aurocapillus</i>	5	0	2	3	4	2	4	4	0	19	L3
pied-billed grebe	PBGR	<i>Podilymbus podiceps</i>	1	3	2	2	2	1	4	4	0	18	L3
pileated woodpecker	PIWO	<i>Dryocopus pileatus</i>	5	0	2	2	4	1	3	3	0	15	L3
pine warbler	PIWA	<i>Setophaga pinus</i>	39	0	2	2	4	1	3	3	0	15	L3
scarlet tanager	SCTA	<i>Piranga olivacea</i>	14	0	2	2	4	1	3	4	0	16	L3
sedge wren	SEWR	<i>Cistothorus platensis</i>	1	3	2	2	3	3	1	4	0	18	L3
sharp-shinned hawk	SSHA	<i>Accipiter striatus</i>	2	1	2	2	4	1	3	3	0	16	L3
sora	SORA	<i>Porzana carolina</i>	4	1	2	2	2	3	3	4	0	17	L3
Virginia Rail	VIRA	<i>Rallus limicola</i>	7	0	2	2	2	3	3	4	0	16	L3
wild turkey	WITU	<i>Meleagris gallopavo</i>	4	0	1	0	4	3	4	3	0	15	L3
winter wren	WIWR	<i>Troglodytes troglodytes</i>	3	1	2	2	3	2	3	5	1	19	L3
wood thrush	WOTH	<i>Hylocichla mustelina</i>	17	0	3	2	3	2	2	4	0	16	L3
American redstart	AMRE	<i>Setophaga ruticilla</i>	25	0	2	2	3	1	2	4	0	14	L4

Appendix 3. List of Fauna for the Living City Campus, 2003 - 2012.

Common Name	Code	Scientific Name	count	LO	PTn	PTt	AS	PIS	HD	StD	+	TS	L-Rank
bank swallow	BANS	<i>Riparia riparia</i>	colony	1	3	2	1	1	3	3	0	14	L4
barn swallow	BARS	<i>Hirundo rustica</i>	1	0	2	3	1	1	2	1	0	10	L4
belted kingfisher	BEKI	<i>Ceryle alcyon</i>	3	0	3	2	2	1	2	2	0	12	L4
blue-grey gnatcatcher	BGGN	<i>Polioptila caerulea</i>	7	0	1	1	3	1	1	3	0	10	L4
chimney swift	CHSW	<i>Chaetura pelagica</i>	1	1	3	3	1	1	1	1	0	11	L4
cliff swallow	CLSW	<i>Petrochelidon pyrrhonota</i>	colony	1	2	2	1	1	2	1	0	10	L4
common yellowthroat	COYE	<i>Geothlypis trichas</i>	64	0	2	2	1	2	1	4	0	12	L4
Cooper's hawk	COHA	<i>Accipiter cooperii</i>	4	0	2	1	4	1	3	2	0	13	L4
eastern bluebird	EABL	<i>Sialia sialis</i>	5	2	2	2	2	1	2	2	0	13	L4
eastern kingbird	EAKI	<i>Tyrannus tyrannus</i>	19	0	4	2	2	1	1	3	0	13	L4
eastern meadowlark	EAME	<i>Sturnella magna</i>	10	0	3	2	3	1	1	3	0	13	L4
eastern screech-owl	EASO	<i>Megascops asio</i>	3	0	2	2	1	2	3	3	0	13	L4
eastern wood-pewee	EAWP	<i>Contopus virens</i>	25	0	4	2	2	1	1	3	0	13	L4
field sparrow	FISP	<i>Spizella pusilla</i>	39	0	3	2	2	1	1	4	0	13	L4
great-crested flycatcher	GCFL	<i>Myiarchus crinitus</i>	26	0	2	2	3	1	2	2	0	12	L4
great-horned owl	GHOW	<i>Bubo virginianus</i>	3	0	2	2	2	2	1	2	0	11	L4
green heron	GRHE	<i>Butorides virescens</i>	5	0	3	2	2	1	2	4	0	14	L4
grey catbird	GRCA	<i>Dumetella carolinensis</i>	41	0	2	2	1	1	1	3	0	10	L4
hairy woodpecker	HAWO	<i>Picoides villosus</i>	16	0	2	2	3	1	2	2	0	12	L4
indigo bunting	INBU	<i>Passerina cyanea</i>	67	0	2	2	1	1	2	4	0	12	L4
least flycatcher	LEFL	<i>Empidonax minimus</i>	1	0	4	2	2	1	1	3	0	13	L4
northern flicker	NOFL	<i>Colaptes auratus</i>	14	0	3	2	1	1	2	3	0	12	L4
northern rough-winged swallow	NRWS	<i>Stelgidopteryx serripennis</i>	2	0	1	2	1	1	3	2	0	10	L4
red-bellied woodpecker	RBWO	<i>Melanerpes carolinus</i>	1	3	1	2	2	1	1	2	0	12	L4
red-breasted nuthatch	RBNU	<i>Sitta canadensis</i>	13	0	1	2	3	1	1	2	0	10	L4
red-eyed vireo	REVI	<i>Vireo olivaceus</i>	59	0	2	2	2	1	1	3	0	11	L4
rose-breasted grosbeak	RBGR	<i>Pheucticus ludovicianus</i>	22	0	2	2	3	1	2	3	0	13	L4
ruby-throated hummingbird	RTHU	<i>Archilochus colubris</i>	1	0	2	2	1	1	2	2	0	10	L4
savannah sparrow	SAVS	<i>Passerculus sandwichensis</i>	13	0	3	2	1	1	1	4	0	12	L4
spotted sandpiper	SPSA	<i>Actitis macularia</i>	6	0	2	3	1	2	1	4	0	13	L4
swamp sparrow	SWSP	<i>Melospiza georgiana</i>	9	0	1	2	1	2	1	5	1	13	L4
tree swallow	TRES	<i>Tachycineta bicolor</i>	4	0	2	2	1	1	2	2	0	10	L4
turkey vulture	TUVU	<i>Cathartes aura</i>	1	3	1	1	1	1	2	1	0	10	L4
white-breasted nuthatch	WBNU	<i>Sitta carolinensis</i>	11	0	2	2	3	1	2	2	0	12	L4
willow flycatcher	WIFL	<i>Empidonax traillii</i>	2	0	4	2	1	1	1	3	0	12	L4
wood duck	WODU	<i>Aix sponsa</i>	7	0	2	1	3	2	2	4	0	14	L4

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Common Name	Code	Scientific Name	count	LO	PTn	PTt	AS	PIS	HD	StD	+	TS	L-Rank
American Crow	AMCR	<i>Corvus brachyrhynchos</i>	x	0	1	2	1	1	0	0	0	5	L5
American goldfinch	AMGO	<i>Carduelis tristis</i>	x	0	2	2	1	1	0	1	0	7	L5
American robin	AMRO	<i>Turdus migratorius</i>	x	0	1	2	1	1	0	1	0	6	L5
Baltimore oriole	BAOR	<i>Icterus galbula</i>	x	0	2	2	1	1	0	1	0	7	L5
black-capped chickadee	BCCH	<i>Parus atricapillus</i>	x	0	1	2	1	1	0	1	0	6	L5
blue jay	BLJA	<i>Cyanocitta cristata</i>	x	0	4	2	1	1	0	1	0	9	L5
brown-headed cowbird	BHCO	<i>Molothrus ater</i>	x	0	2	2	1	1	0	1	0	7	L5
cedar waxwing	CEDW	<i>Bombycilla cedrorum</i>	x	0	1	2	1	1	0	1	0	6	L5
chipping sparrow	CHSP	<i>Spizella passerina</i>	x	0	2	2	1	1	0	2	0	8	L5
common grackle	COGR	<i>Quiscalus quiscula</i>	x	0	3	2	1	1	0	1	0	8	L5
downy woodpecker	DOWO	<i>Picoides pubescens</i>	x	0	3	2	1	1	1	1	0	9	L5
eastern phoebe	EAPH	<i>Sayornis phoebe</i>	7	0	2	2	1	1	2	1	0	9	L5
house wren	HOWR	<i>Troglodytes aedon</i>	x	0	2	2	1	2	1	1	0	9	L5
killdeer	KILL	<i>Charadrius vociferus</i>	x	0	2	2	1	2	0	2	0	9	L5
mourning dove	MODO	<i>Zenaidura macroura</i>	x	0	2	2	1	1	0	0	0	6	L5
northern cardinal	NOCA	<i>Cardinalis cardinalis</i>	x	0	2	2	1	1	1	2	0	9	L5
orchard oriole	OROR	<i>Icterus spurius</i>	5	1	2	1	1	1	0	1	0	7	L5
red-tailed hawk	RTHA	<i>Buteo jamaicensis</i>	x	0	2	2	2	1	1	1	0	9	L5
red-winged blackbird	RWBL	<i>Agelaius phoeniceus</i>	x	0	2	2	1	1	0	2	0	8	L5
song sparrow	SOSP	<i>Melospiza melodia</i>	x	0	2	2	1	2	0	2	0	9	L5
warbling vireo	WAVI	<i>Vireo gilvus</i>	x	0	1	2	1	1	1	2	0	8	L5
yellow warbler	YWAR	<i>Setophaga petechia</i>	x	0	1	2	1	1	1	3	0	9	L5
European starling	EUST	<i>Sturnus vulgaris</i>	x										L+
trumpeter swan	TRUS	<i>Cygnus buccinator</i>	x										L+
<b>Herpetofauna</b>													
grey treefrog	TGTF	<i>Hyla versicolor</i>	12	0	3	3	3	4	2	5	1	21	L2
striped chorus frog	MICF	<i>Pseudacris triseriata</i>	1	3	3	3	2	4	3	5	1	24	L2
northern spring peeper	SPPE	<i>Pseudacris crucifer crucifer</i>	31	0	2	3	3	4	3	5	1	21	L2
wood frog	WOFR	<i>Lithobates sylvatica</i>	30	0	2	3	3	4	3	5	1	21	L2
eastern red-backed salamander	RBSA	<i>Plethodon cinereus</i>	7	0	2	2	1	4	3	4	0	16	L3
northern leopard frog	LEFR	<i>Lithobates pipiens</i>	9	0	3	2	1	4	2	5	1	18	L3
American toad	AMTO	<i>Anaxyrus americanus</i>	7	0	3	2	1	4	0	4	0	14	L4
green frog	GRFR	<i>Lithobates clamitans</i>	10	0	2	2	1	3	1	4	0	13	L4



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Common Name	Code	Scientific Name	count	LO	PTn	PTt	AS	PIS	HD	StD	+	TS	L-Rank
<b>Incidental Species:</b> species that are reported on as incidental to the TRCA protocol.													
<b>Mammals</b>													
northern flying squirrel	NFSQ	<i>Glaucomys sabrinus</i>	1	3	2	3	3	3	3	4	0	21	L2
porcupine	PORC	<i>Erethizon dorsatum</i>	2	2	2	2	4	4	3	3	0	20	L2
river otter	RIOT	<i>Lutra canadensis</i>	historic	4	2	1	5	3	2	5	2	24	L2
ermine	ERMI	<i>Mustela erminea</i>	historic	4	2	2	3	3	1	3	0	18	L3
hairy-tailed mole	HTMO	<i>Parascalops breweri</i>	historic	4	2	2	1	4	1	4	0	18	L3
meadow jumping mouse	MJMO	<i>Zapus hudsonius</i>	historic	3	2	2	2	3	2	3	0	17	L3
northern short-tailed shrew	NSTS	<i>Blarina brevicauda</i>	1	3	2	2	1	2	2	4	0	16	L3
star-nosed mole	SNMO	<i>Condylura cristata</i>	1	4	2	2	1	4	1	4	0	18	L3
beaver	BEAV	<i>Castor canadensis</i>	3	1	2	1	2	3	1	3	0	13	L4
eastern chipmunk	EACH	<i>Tamias striatus</i>	x	0	2	2	2	3	1	3	0	13	L4
eastern cottontail	EACO	<i>Sylvilagus floridanus</i>	x	0	2	2	1	3	1	2	0	11	L4
mink	MINK	<i>Mustela vison</i>	2	1	2	2	3	3	0	3	0	14	L4
muskrat	MUSK	<i>Ondatra zibethicus</i>	1	0	2	2	1	3	1	3	0	12	L4
red squirrel	RESQ	<i>Tamiasciurus hudsonicus</i>	x	0	2	2	1	3	1	2	0	11	L4
Virginia opossum	VIOP	<i>Didelphis virginiana</i>	2	2	2	1	1	3	1	1	0	11	L4
white-tailed deer	WTDE	<i>Odocoileus virginianus</i>	x	0	2	1	3	2	2	1	0	11	L4
grey squirrel	GRSQ	<i>Sciurus carolinensis</i>	x	0	2	2	1	3	0	0	0	8	L5
raccoon	RACC	<i>Procyon lotor</i>	x	0	2	2	1	3	1	0	0	9	L5
striped skunk	STSK	<i>Mephitis mephitis</i>	x	1	2	2	1	3	0	0	0	9	L5
southern flying squirrel	SFSQ	<i>Glaucomys volans</i>	historic	5	3	3	2	3	3	4	0	23	LX
<b>Herpetofauna</b>													
Jefferson salamander complex	JESA	<i>Ambystoma jeffersonianum</i>	1	4	3	3	3	5	5	5	3	31	L1
yellow-spotted salamander	YSSA	<i>Ambystoma maculatum</i>	3	3	3	3	3	5	4	5	2	28	L1
common snapping turtle	SNTU	<i>Chelydra serpentina</i>	2	0	3	3	1	5	2	5	2	21	L2
red-spotted newt	EANE	<i>Notophthalmus viridescens</i>	5	3	2	2	3	4	3	5	1	23	L2
eastern milksnake	MISN	<i>Lampropeltis triangulum</i>	1	3	3	2	2	4	1	3	0	18	L3
midland painted turtle	MPTU	<i>Chrysemys picta marginata</i>	2	0	2	2	1	5	1	4	1	16	L3
northern red-bellied snake	RBSN	<i>Storeria occipitomaculata</i>	2	3	2	2	2	3	1	5	1	19	L3
eastern gartersnake	EAGA	<i>Thamnophis sirtalis sirtalis</i>	x	0	2	2	1	3	0	3	0	11	L4
<b>Invertebrates</b>													

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Common Name	Code	Scientific Name	count	LO	PTn	PTt	AS	PIS	HD	StD	+	TS	L-Rank
"chimney" crayfish	CHCR	<i>Fallicambarus fodiens</i>	2	1	3	3	1	4	2	5	1	20	L2
<b>LEGEND</b>													
LO = local occurrence		PIS = Patch Isolation Sensitivity			LX = extirpated								
PTn = population trend, continent-wide		STD = sensitivity to development			L+ = non-native/introduced								
PTt = population trend, TRCA		+ = additional points											
HD = habitat dependence		TS = total score											
AS = area sensitivity		L-rank = TRCA Rank, October, 2008											