

Glen Major Study Area 2008

Terrestrial Biological Inventory and Assessment

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1.0 Introduction

This report describes the Glen Major Study Area 2008 in the context of the Terrestrial Natural Heritage Program of the Toronto and Region Conservation Authority (TRCA). The question that the report addresses is ***“How does the area surveyed at the Glen Major site fit within the regional natural system, and how should its contribution to this system be protected and maximized?”***

The important message outlined 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. The TRCA has developed a Terrestrial Natural Heritage Systems Strategy for retaining and recovering natural heritage within its jurisdiction that incorporates target-setting at the regional level (TRCA, 2007d). 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. This report is a summary of the field collected data from 2008 (in combination with previous years data) in relation to a specific portion of the Glen Major Complex (see Map 1). Further field inventories are anticipated in following years to fill in data gaps that have been identified in other locations of the Glen Major Complex.

2.0 Inventory Methodology

TRCA has ranked all flora and fauna species within the TRCA jurisdiction using a system that identifies the species' resilience in the face of a changing Toronto landscape. This system ranks species from L5 (very resilient) to L1 (very sensitive), with an extra category (L+) for non-native species. Species that are ranked L1 to L3 are considered to be of regional concern. Species that are ranked as L4 are considered to be of concern within urban areas. Each fauna rank (other than L+) is the sum of seven scoring criteria: local occurrence, continent-wide population trend, local population trend, area sensitivity, mobility restriction, habitat dependence and sensitivity to development. Flora ranks are the sum of scores from the following criteria: local occurrence, local population trend, habitat dependence and sensitivity to development.

The biological inventory of the Glen Major study area included species (flora and fauna) according to the TRCA data collection methodology (TRCA, 2007c).

2.1 Flora Survey

Floral surveys for the 2008 field-season were conducted on the 6th, 14th, 23rd, 26th, 28th of May, on the 8th, 10th of July and on the 4th and 8th of September. Flora

data collected in 2001 and 2002 were also incorporated into this report (see Appendix 1). Flora surveys were conducted using printouts of the 2005 digital ortho photos showing study area boundaries. The flora survey recorded all species present that were observed during the course of this study as part of an overall species list and all species of regional concern (L1 to L3) were mapped along with an approximate number of individuals. In addition, the location of invasive species was recorded using a Trimble GPS unit. The standard list of TRCA invasive plants is included in Appendix 2. Due to the size of the study area not all habitats were surveyed equally. Air photos were reviewed before beginning ground-truthed surveys to determine the best possible routes to maximize coverage of sensitive native and invasive species. Trail systems were targeted for identifying and mapping locations of invasive species. Sand barrens and wetlands were also surveyed for regionally rare species.

2.2 Fauna Survey

Fauna data for the 2008 field-season were collected on April 17th, 18th, 20th, 21st, and on twelve dates between 5th June and 8th July. The spring surveys searched primarily for frog species of regional concern but recorded incidentally the presence of any early spring nocturnal bird species (owls and American woodcocks). The summer surveys were concerned primarily with the mapping of breeding bird species of regional concern. Songbirds are surveyed in June/July in order to obtain breeding bird data and to exclude migrants. The methodology for identifying confirmed and possible breeding birds follows Cadman *et al.* (1987). All species considered possible breeding species were noted on a site checklist, and all L1 to L3 species (Species of Regional Concern) were mapped on ortho-photos (see Appendix 3 for the full fauna species list).

3.0 Results and Discussion of the Glen Major Study Area

3.1 Site Location; Floristic and Physiographic Regions

The Glen Major forest complex is located in the north-eastern reaches of the Duffins Watershed, in the township of Uxbridge, in Durham Region. The TRCA has conducted surveys through much of the complex over the past decade (2001, 2002, 2007, etc.) but this current document refers only to that area surveyed in the 2008 field-season. The 2008 study area lies largely on TRCA property, on the either side of Concession 6, north of the Uxbridge-Pickering Townline (Map 1). The largest non-TRCA owned portion is in the north-west corner of the study area, an area of mature deciduous forest owned by Pleasure Valley. This property is run as a recreation facility, primarily providing horse-riding opportunities on an extensive network of private trails. The site is embedded in an entirely rural landscape with a small number of extensive estate

homes along the roads that bisect (Concession 6) and flank (Regional Road 1) the study area. For the purpose of this report the study area is restricted to the property blocks as shown on Map 1, but it is important to note that this area is part of the most extensive tract of forested land in the entire TRCA jurisdiction, accommodating the region's largest area of interior forest (over 900 metres from edge in places).

The Glen Major forest complex is situated on the Oak Ridges Moraine and as such is part of a provincially significant corridor of natural cover that stretches from South-west Ontario east into the lower portion of Central Ontario. The significance of such a massive wildlife corridor across the landscape will increase as patches of natural cover in Southern Ontario become even more fragmented and isolated.

3.2 Flora Findings for the Glen Major Study Area

3.2.1 Flora Species Representation

Compared to other inland habitats in the Toronto jurisdiction, the overall species biodiversity was relatively high with 643 flora species in total found within the study area. The high diversity of flora is due to the relatively large size and contiguous configuration of the natural cover along with the diverse vegetation communities that are present. Of the 643 species recorded 188 species are non-native to the TRCA jurisdiction.

A total of 640 flora species occur naturally on site, while 3 are found in plantings. Non-natives comprise 29% (188) of the total naturally-occurring species. Most of the non-natives are species of recently-disturbed areas and only a fraction of these are really invasive.

3.2.2 Flora Species of Concern

Almost all of the 192 flora species of concern were associated with specific vegetation communities. These species are highly sensitive to changes in their respective communities and are highly habitat dependent (Appendix 1). A number of L1 species (both very rare and habitat dependent) were discovered during the course of these surveys. These species include: spotted coral-root (*Corallorhiza maculata*), downy rattlesnake-plantain (*Goodyera pubescens*), stiff club-moss (*Lycopodium annotinum*), one-sided pyrola (*Orthilia secunda*), wood-betony (*Pedicularis canadensis*), bog buckbean (*Menyanthes trifoliata*), round-leaved sundew (*Drosera rotundifolia*), rose pogonia (*Pogonia ophioglossoides*) and pitcher-plant (*Sarracenia purpurea*). For example, the latter four of these species are dependant on kettle peatland communities in the Toronto jurisdiction. Kettle peat-lands are very rare in the Toronto jurisdiction and are sensitive to changes in hydrogeology and nutrient inputs that are usually associated with changing landuse on nearby surrounding lands.

Small areas of organic mixed swamp were surveyed that contained many habitat dependent species. These species included: withe-rod (*Viburnum cassinoides*), woodland horsetail (*Equisetum sylvaticum*), winterberry holly (*Ilex verticillata*), goldthread (*Coptis trifolia*), cinnamon fern (*Osmunda cinnamomea*), fringed sedge (*Carex crinita*) and wintergreen (*Gaultheria procumbens*).

The deciduous forests support many spring ephemerals such as broad-leaved spring beauty (*Claytonia caroliniana*), cut-leaved toothwort (*Cardamine concatenata*), squirrel corn (*Dicentra canadensis*) and Dutchman's breeches (*Dicentra cucullaria*). Glen Major is noted for a diversity of woodland sedges such as Back's sedge (*Carex backii*), slender wood sedge (*Carex digitalis*), Hitchcock's sedge (*Carex hitchcockiana*) and plantain-leaved sedge (*Carex plantaginea*). The richer and moister forests contained flora species such as white trillium (*Trillium grandiflorum*), bloodroot (*Sanguinaria canadensis*), Canada violet (*Viola canadensis*) and dwarf scouring rush (*Equisetum scorpioides*).

The dry, sandy soils of the Oak Ridges Moraine at Glen Major support some species with sand barren or prairie affinities. Of particular interest is creeping juniper (*Juniperus horizontalis*), which was found on a sandy dry slope at Glen Major in 2008. This was the first record of this species in the Toronto jurisdiction as there are few suitable habitats that occur in the jurisdiction. Creeping juniper is a pioneer species and is usually found in dry places and rocky soils, where other plants do not close the canopy. Creeping juniper is secure in Ontario with a provincial rank of 5 and a global rank of G5 (NHIC, 2008). There was only one plant discovered and it is believed a bird dispersed the seed, as there are apparently no close populations of this species. There are no ornamental escapes in the vicinity or any other evidence that the creeping juniper was planted. Other species of sand barren or prairie include round-headed bush clover (*Lespedeza capitata*) and little bluestem (*Schizachyrium scoparium*). Alterations of disturbance regimes can lead to extirpations of these species through displacement by exotics, changes in natural succession, trails and anthropogenic land uses. Fire and drought usually benefit these sand barren and prairie species as it prevents the establishment of trees, shrubs and more aggressive herbaceous species that can out-compete and displace these rare species.

Some of the open areas with a history of agriculture, especially pasture, grade into the sand barren habitats. Species of concern that are specialists of successional habitat include uncommon hawthorns such as *Crataegus macrosperma* and *C. chrysoarpa*, and Canada plum (*Prunus nigra*).

Almost all of the flora species of concern are also sensitive to development, scoring 3 or more for this criterion (Appendix 1). The impacts are indirect, emanating from the surrounding land use or matrix influence. These species tend to be concentrated in the less-disturbed mature forests, organic wetlands, and some of the sand barrens. Areas that have a history of land use disturbance, including agriculture, have fewer sensitive species. Several disturbances are important to consider.

Hydrological changes from nearby development can include drying or flooding due to increased drainage or stormwater inputs. This would affect most wetland species at Glen Major, especially those of undisturbed organic wetlands, but this appears to be not an immediate threat at this time.

Air pollution or changes to soil through nutrient-laden runoff alter the habitat and affect less-competitive wetland plants such as certain sedges (e.g. *Carex canescens* and *C. diandra*). These may be replaced by more aggressive species that can take advantage of increased silt and nutrient loading, such as reed canary grass (*Phalaris arundinacea*).

Field observations indicate that there is a sizable deer population at this site as the majority of the forests observed had noticeable deer browse. Woodland plants such as red trillium (*Trillium erectum*), white trillium, Canada yew (*Taxus canadensis*) and tree regeneration are in decline in a number of places due to over-browsing. American ginseng (*Panax quinquefolius*) is an endangered species in Canada, which occurs at Glen Major, is adversely affected by deer browse. This ginseng population was found in previous field inventories and was rechecked during the 2008 field season even though it was outside the study area boundary. There are 1-2 plants that occur at Pleasure Valley. The population is small so it is difficult to know for sure if this is in fact a result of deer browse or if it is a result of some other influence as monitoring of this plant population only began a couple of years ago. Many invasive species such as dog strangling vine (*Cynanchum rossicum*) and garlic mustard (*Alliaria petiolata*) are avoided by deer, encouraging their spread.

Butternut (*Juglans cinerea*), an endangered species, was also encountered at Glen Major in a number of places. Butternut canker, (*Sirococcus clavigignenti-juglandacearum*) most likely an introduced fungal pathogen, is a serious threat to butternut populations in North America and has killed up to 80% of the butternut population in some areas of the United States (Thompson *et al.*, 2006). Most of the trees were infected by the canker with only a few healthy specimens (as described by the MNR Butternut health protocol) encountered in 2008.

Increased access and recreational uses such as new trails, mountain biking, etc. increases trampling and soil compaction. Flora species that are determinate in growth like trillium spp., starflower (*Trientalis borealis*) and American ginseng are susceptible to trampling. Mature forests that support such flora are particularly vulnerable to trail users and other disturbances.

Some species of flora are collected for food, medicinal use and as garden plants. For example wild leek (*Allium tricoccum*) is often collected for food, American ginseng for medicinal use and wild blue phlox (*Phlox divaricata*) for garden use which could be contributing to their rarity.

Species that are considered rare according to the *local occurrence* criterion are found in fewer than seven of the 44 10x10 km grid squares that cover the TRCA jurisdiction. The large size and intact habitat at Glen Major supports some

notable rare species which are known in only 1-3 places in the TRCA jurisdiction such as creeping juniper. Pleasure Valley contained many rare flora species such as American ginseng, golden corydalis (*Corydalis aureus*) and wild blue phlox but also had heavy infestations of invasives along the horse trails.

3.2.3 Invasive Exotics

Invasive alien flora species are plants from another geographical region that out-compete and displace native species. It is well documented that invasive alien plant species pose a serious threat to the stability and diversity of natural ecosystems worldwide (Ladd and Cappucino, 2005). Disturbance caused by development and increases in recreational uses also facilitates the spread of invasive species. It is well documented that invasive species are correlated to disturbances (Mack and D'Antonio 1998; Nuzzo, 1999). Trail systems provide a corridor for the invasion of invasives into other habitats as well as create seed banks. Glen Major has extensive trail systems that are found throughout this tract. Many invasive species such as garlic mustard, dog-strangling vine and common buckthorn (*Rhamnus cathartica*) seem to have an affinity for these trails and other disturbances. Most of the garlic mustard and dog strangling vine were found on or besides the trails although they were not restricted to it. As shown on Map 4, many of the invasive species points fell upon the trails.

Many native species, especially when subjected to other stresses, do not compete well with invasives. On many occasions the native flora is replaced by these invasives. Of the 188 non-native species present at Glen Major many have naturalized, do not form dense stands and are inhabitants of recently disturbed areas. Sweet-white clover (*Melilotus alba*) is an example of a species that is found in dense stands in recently disturbed areas although it eventually becomes displaced by other more aggressive species such as tall goldenrod (*Solidago altissima*) and dog strangling vine. Of the 188 non-native plants found only a selection were mapped with the Trimble GPS unit (Appendix 2). The species that were mapped are the most invasive and widespread at Glen Major. The seven most commonly encountered invasives include: common buckthorn (102 records), dog-strangling vine (90 records), garlic mustard (38 records), creeping thistle (*Cirsium arvense*) (35 records), sweet-white clover (21 records), multiflora rose (*Rosa multiflora*) (14 records) and Manitoba maple (*Acer negundo*) (9 records). The four species that are currently or potentially the most serious are described below, which include: dog strangling vine, garlic mustard, common buckthorn, and Manitoba maple (*Acer negundo*). For a full list of all invasive species mapped refer to Appendix 2 and management

Dog strangling vine

Dog-strangling vine or pale swallow-wort is a member of the milkweed family (Asclepiadaceae) and is a major threat to natural areas in the Great lakes basin (Ladd and Cappucino, 2005). It has been considered a serious threat to the native flora and fauna in the Great lakes basin for several decades (Pringle, 1973; Ladd and Cappucino, 2005).

It is usually found on calcareous soils and many areas infested with this plant are disturbed. It has also been observed invading “pristine” natural areas such as mature forests. In Ontario and Quebec dog-strangling vine occurs primarily on shallow soils over limestone bedrock, glacial till, silty and sandy loams, deep loams of upland woods and rocky or clay loam (DiTommaso *et al.*, 2005). In the TRCA jurisdiction, dog-strangling vine has been recorded in forest (deciduous, mixed, coniferous), successional (thicket, hedgerow, savannah, cultural woodland), plantation (deciduous, mixed, coniferous), cultural meadow, wetland (swamp, meadow marsh, shallow marsh) and dynamic habitats (beach, sand dune, bluff, sand barren, tallgrass prairie, savannah and woodland). Dog strangling vine is found in most vegetative communities at Glen Major except wet areas such as marshes, swamps, etc. Most of the occurrences were found along trails, disturbed areas such as old farms fields and pine plantations. It also occurred sporadically in mature maple forest, especially where there were forest canopy gaps. Most of the areas where dog strangling vine occurred, there were many individuals and in some cases forming a dense monoculture.

Dog-strangling vine causes deleterious effects on the reproduction of the monarch butterfly (*Danaus plexippus*) (DiTommaso and Losey, 2003; Mattila and Otis, 2003; DiTommaso *et al.*, 2005).

Garlic mustard

The preferred habitat of garlic mustard is open, mesic deciduous woodlands; this is also the habitat of many native woodland plants (Drayton and Primack, 1999). Some native species which grow in mesic forests that are particularly vulnerable to localized extinction from garlic mustard invasion are; wild ginger (*Asarum canadense*), Jack-in- the-pulpit (*Arisaema triphyllum*), *Trillium spp.*, trout lily (*Erythronium americanum*), hepatica (*Anemone acutiloba* and *americana*), two- leaved toothwort (*Cardamine diphylla*) and oak seedlings (Meekins and McCarthy, 1999). In Glen Major it is usually found in dense stands along trails, logging roads and recently disturbed areas. Some mature woodlots that did not appear to be disturbed also had heavy infestations of this plant. In addition this plant was uncommon in pine plantations. According to Nuzzo (1999) garlic mustard’s spread is facilitated by disturbances.

Besides the displacement of native flora, certain fauna are feeling the impacts of the garlic mustard invasion as well. The West Virginia white (*Pieris virginiensis*) and the mustard white butterfly (*Pieris oleracea*) will often use garlic mustard for oviposting; this practice is not beneficial as the larvae seldom reach the 4th instar (Nuzzo, 2000).

Garlic mustard reproduces in a sexual fashion only, without means of vegetative spread in Ontario (Nuzzo, 1999). In Europe where it is native there are reports of vegetative reproduction occurring. It exhibits the trait of autogamy (self fertilization) so that one plant could start an entire population (Meekins and McCarthy, 1999).

Garlic mustard is non-mycorrhizal, as are most members of the Brassicaceae family (Roberts and Anderson, 2001). Garlic mustard appears to secrete fungicidal oils from its roots that poison mycorrhizae around it which can offer them a competitive advantage compared to natives that have mycorrhizal connections (Roberts and Anderson 2001).

Common Buckthorn

Buckthorns are dioecious, the female buckthorn produces copious amounts of dark purple berries that are dispersed by birds and other fauna. Common buckthorn has high germination rates: 85% for a North American population and 90–100% in Europe (Knight *et al.*, 2007). The leaves stay green much longer than on other native trees and shrubs in the region. These strategies most likely confers them a competitive advantage over many natives.

Common buckthorn has invaded many different vegetation communities at Glen Major but seems to have an affinity for disturbed, fertile, and moist areas. Buckthorn was not observed in seasonally inundated wetlands or extremely dry soils like prairie or sand barrens. It can tolerate partially flooded conditions, drought and shade, although it is less vigorous when in full shade. Common buckthorn exhibits the most growth in full sun (Knight *et al.*, 2007). According to a study by Stewart and Graves (2004) it grew faster than the other shrubs it was compared with. It is hypothesized that the phenology of common buckthorn could be advantageous in North American deciduous forest understories, as it photosynthesizes while the canopy is leafless as it leafs out earlier and loses its leaves later than native species. (Knight *et al.*, 2007). The wide habitat tolerance, photosynthetic capacity and lack of natural enemies have probably contributed to its successful invasion.

Manitoba Maple

Manitoba Maple can form dense stands from root sprouts and seed. Manitoba maple is dioecious with the female tree producing many samaras. The double samara seeds are wind distributed continuously over the winter until spring, which can aid in its ability to colonize many different areas. Like common buckthorn male trees are less a priority for removal.

It prefers moist sites although it is not restricted to them and is found on all soil types. It has intermediate shade tolerance. At Glen Major it was found in most sites except dry sand barrens and prairies. It was also absent from vegetation communities with saturated or inundated wet soils. It was not observed seeding into mature forests with at least a 60% canopy closure. It was found reproducing in gaps in the forest where there was blow down or other disturbances. It did not seem to have an affinity for trails like garlic mustard and dog strangling vine, although it was present at a few. There were nine Manitoba maple points taken with the Trimble GPS which is considerably less than the garlic mustard, dog strangling vine and common buckthorn. This species has a propensity to spread and could be a more serious concern in the future if existing trees are left.

3.3 Fauna Findings at the Glen Major Study Area

3.3.1 Fauna Species Representation

The fauna checklist compiled from the 2008 survey lists 119 species as possible, probable or confirmed breeders within the study area. The Glen Major complex has been identified as having the highest fauna species diversity in the TRCA jurisdiction.

Note that winter wren (*Troglodytes troglodytes*), an L3 species previously reported from the south west corner of the study area in a survey conducted in 1998, has not been included in the current species totals since in 2008 the species was recorded just off-site (close to the site of the 1998 observation).

3.3.2 Fauna Species of Concern

Of the total 118 species found, there are 49 species that are considered to be species of regional concern, ranked as L1 to L3. Fauna surveys at the study area reported a total of 39 L1- L3 bird species: eight L2 species (including barred owl, *Strix varia*; red-shouldered hawk, *Buteo lineatus*; and hooded warbler, *Wilsonia citrina*) and 31 L3 species (including yellow-bellied sapsucker, *Sphyrapicus varius*; Blackburnian warbler, *Dendroica fusca*; ovenbird, *Seiurus aurocapillus*; and brown creeper, *Certhia americana*). In addition, there were two mammal species of concern (porcupine, *Erethizon dorsatum*; and hairy-tailed mole, *Parascalops breweri*) and eight herpetofauna of concern (including eastern newt, *Notophthalmus viridescens*; common snapping turtle, *Chelydra serpentina*; and grey tree-frog, *Hyla versicolor*). Sharp-shinned hawk (*Accipiter striatus*) was added as a breeding species on the strength of a record in the area from 1999, bringing the total number of fauna species to 119, with 50 species of regional concern. Two of these species are listed as threatened under the federal Species at Risk Act (SARA, 2008) (golden-winged warbler, *Vermivora chrysoptera*; and hooded warbler). Locations of these breeding fauna species are depicted on Map 3; Appendix 3 lists all of the fauna species reported from the study area, together with their associated ranks and scores.

Local occurrence is one of seven scoring criteria for fauna and is based on TRCA data and information from the Natural Heritage Information Centre (NHIC, 2007) of the Ontario Ministry of Natural Resources (MNR). Using local occurrence as a measure of regional rarity, any species that is reported as a probable or confirmed breeder in fewer than ten of the forty-four 10 km squares in the TRCA jurisdiction is considered regionally rare (i.e. scores 3-5 points for this criterion). A total of 17 species of regional concern (i.e. ranked L1 – L3) that are considered regionally rare were reported from the study area in 2008, with six of these species having been reported from fewer than 5 of the 44 10km squares that encompass the jurisdiction: barred owl, yellow-bellied sapsucker,

golden-winged warbler, magnolia warbler (*Dendroica magnolia*), black-throated blue warbler (*Dendroica caerulescens*), and hooded warbler.

Hooded warbler (listed as threatened under SARA, 2008) is of particular interest given that the 8 territorial males that were discovered in the Pleasure Valley portion of the study area constitute a new population for the region, and doubles the number of territories reported for the entire region over the past decade. Furthermore, whereas several of the previous reports of hooded warbler for the jurisdiction potentially involved one-off breeding attempts, the 8 territorial males at Pleasure Valley in 2008 constitute a seemingly thriving established population of this species. Hooded warblers have shown a very impressive recovery as a breeding species in the Carolinian woodlands of south-western Ontario and in very recent years appear to be making advances into less traditional forest habitats further to the north and east, with a new population discovered in the Ganaraska Forest in 2007. Pleasure Valley's population bolsters the colonisation efforts of this beautiful addition to the region's forest avifauna.

To some extent, the discovery of 4 territorial golden-winged warblers (listed as threatened under SARA, 2008) is perhaps even more significant than the new population of hooded warblers, since this is a species that is showing a persistent decline across its entire continental range. The extremely high concentration of its sister species – blue-winged warbler - in the area suggests that the habitat needs of these two very similar species is well met within the study area boundaries. As is the case with flora, most regionally rare fauna species have other associated factors that explain their vulnerability and need to be taken into account in conservation strategies.

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, crows, squirrels, raccoons, and house cats); parasitism (from the facilitating of brown-headed cowbird access, a species which prefers more open, edge-type habitat); competition (for nest-cavities with bird species such as house sparrows and Eurasian starlings); flushing (causing disturbance and abandonment of nest); sensitivity to pesticides. It should also be noted that many of the negative impacts associated with urbanization can be transferred from distant urban areas by intensification of public use of any area of natural cover.

Fauna species are considered to have a high sensitivity to development if they score 3 or more points (out of a possible five) for this criterion. At the 2008 Glen

Major study area, all but one of the 50 species of concern score three or more points for this criterion and are therefore considered sensitive to one or more of the impacts associated with development or intensification of public use. These species are currently at this site because the largely natural matrix does not produce any of the negative impacts associated with more urban or suburban matrices. However, it is important to understand that negative matrix influences are not solely associated with the proximity of urban and suburban developments; many of the negative influences 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.

The tendency for increased public use and residential estate management to be accompanied by the clearing and tidying of woodlands and thickets in the vicinity would dramatically disrupt species that are dependent on such scrub cover for nesting or foraging, and certainly many of the more sensitive species have such specific requirements.

Many of the bird species found in the study area nest low in the ground vegetation and as such 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 hikers, bikers and dogs) resulting in abandonment and failed breeding attempts. Such sensitive bird species include several warbler species all of which are neotropical migrants and, as such, already effected by the tremendous pressures associated with the increasingly perilous migrations undertaken every year (e.g. ovenbird, black-and-white warbler, *Mniotilta varia*; blue-winged warbler, *Vermivora pinus*; Nashville warbler, *Vermivora ruficapilla*; and hooded warbler). Other ground-foraging and ground-nesting fauna species (porcupine, eastern newt, and snapping turtle) are likewise severely affected by any increase in pedestrian or dog traffic within their habitat.

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, a site being a one-hectare circle (Gutzwiller, 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 (University of New South Wales, 2007).

One of the most significant features of the Glen Major avifauna is the presence of several territorial pairs of large avian predators. The 2008 study area held 3 pairs of barred owls, 3 pairs of broad-winged hawks (*Buteo platypterus*), and 2, possibly three pairs of red-shouldered hawks. These records bolster the Glen Major forest complex's standing as the most productive raptor habitat in the region. No doubt, the success of these extremely sensitive species in the area is

due in large part to the large tracts of forest providing plenty of opportunities for such species that require minimal human disturbance at the nest.

Area sensitivity is a scoring criterion that can be closely related to the latter 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).

Thirty-five of the fauna species of regional concern that were identified are considered area sensitive. Three of the L2 species – the aforementioned large avian predators (barred owl, broad-winged and red-shouldered hawks) - score the maximum 5 points, requiring more than 100 ha of natural habitat. The Glen Major forest complex is one of the few areas in the entire jurisdiction that satisfy these requirements, having extensive intact areas of relatively high quality forest – consequently, Glen Major is the only area in the jurisdiction where all three of these highly area sensitive species occur in close proximity to each other.

Species' patch-size constraints are due to a variety of factors including foraging requirements and the need for isolation within a habitat block at times of 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.

Patch Isolation Sensitivity in fauna measures the over all 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 *Patch Isolation Sensitivity* (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 expose them to roadkill). 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 reforestation of intervening lands) we are able to positively influence the populations of such species, improving their foraging and dispersal potential.

At the 2008 Glen Major study area there are 13 fauna species that have been scored as sensitive to patch isolation (3 or more points). Several of these high-

scoring species will readily cross open ground but, in so doing, expose themselves to potentially fatal encounters with predators and vehicular traffic. This is particularly true of snapping turtles that move seasonally between their aquatic foraging habitat and terrestrial breeding habitat; and similarly for amphibian species such as wood frog (*Rana sylvatica*) and spring peeper (*Pseudacris crucifer*), moving between spring breeding pools and more upland summer/winter habitats.

Species such as snapping turtle have effectively been extirpated from much of the natural cover within the urbanized portions of the jurisdiction, but are still thriving in rural areas. As long as wetland habitat exists within the agricultural rural areas, and obstacles such as heavily used roads do not proliferate, it appears that snapping turtles are still able to successfully find appropriate nesting locations. Populations of snapping turtles, within the more urbanized portion of the jurisdiction will be unlikely to sustain themselves if access to breeding habitat and opportunities for recruitment from healthier neighbouring populations is not available.

Fauna species that score greater than three points under the *Habitat Dependence* criterion are considered habitat specialists. These species exhibit a combination of very specific habitat requirements that range from the microhabitat (e.g. decaying logs, aquatic vegetation), through requirements for particular moisture conditions, vegetation structure or spatial landscape structures, to preferences for certain community series and macro-habitat types. 25 of the fauna species that occur at the 2008 Glen Major study area are considered habitat specialists with six species such as ovenbird scoring four out of a possible five points. In the case of ovenbird, the condition of the forest floor is of particular importance, since the species nests and forages at ground level, the nest being placed just below the surface of the leaf litter.

Representation is essentially the presence or absence of a species at a site. However, beyond mere representation of single species is the idea that a natural system can be considered as a healthy functioning system if there is an association of several species thriving within that system. Each habitat type supports particular species associations. As the quality of the habitat patch improves so will the representation of flora and fauna species within that habitat. In this way representative bio-diversity is an excellent measure of the health of a natural system. The presence of so many habitat dependent species, in particular species that are dependent on forest, indicates that the forest habitat at Glen Major is functioning very well. Several of the other less habitat specific scrub and open-habitat species are also well-represented with multiple occurrences of grasshopper sparrow, eastern towhee, brown thrasher and clay-coloured sparrow.

4.0 Recommendations

The recommendations for the 2008 Glen Major study area are given in relation to 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 site within the regional context, followed by specific recommendations.

4.1 Summary

Located in the extreme north-east of the Duffins Watershed, connected to and integrated with one of the largest areas of continuous natural cover in the region, the site is buffered from negative urban and suburban matrix influences both by its sheer size and by the surrounding matrix of agriculture and natural cover. Much of the land on the site has been cleared for lumber at various times over the past century and this has produced a highly varied landscape with a mosaic of different quality and different aged forests. In some areas the deciduous forest is mature but supports a rather poor understory, whereas other areas have maintained thick understorey of raspberry and dogwood. Some of the coniferous plantations have been managed as fairly extreme monocultures whereas others are being allowed to establish a more mixed character with more extensive ground flora and understory. Such a variety in the forest structure across the site gives rise to an especially high diversity of breeding birds and flora species, although more moist and swamp forest types are lacking (thus the absence of species such as Canada warbler, *Wilsonia Canadensis*; white-throated sparrow, *Zonotrichia albicollis*; and winter wren and low numbers of species such as black-and-white warbler).

Another consideration when looking at the fauna representation across the site is the uneven intensity of use across the study area. The block of forest and meadow habitat to the east of Concession 6 is heavily used by dog-walkers and bikers, with an extremely extensive and tortuous trail network throughout much of the site. Likewise, an extensive trail system exists in the southern portion of the study area lands to the west of Concession 6, while the northern section is run as a private horse-riding facility where, although there's an extensive trail system, use of the trails is strictly managed. Contrasting and comparing these three seemingly distinct zones of use is an interesting exercise but conclusions can only be drawn very tentatively since other factors such as habitat quality and type are also uneven across the site.

4.2 Site Recommendations

The following table illustrates the contributions made by the study area toward the quality distribution and quantity indicators, along with site-specific recommendations for potential improvements. It is important when considering the indicators in Table 1, to keep in mind the varying degrees of interdependence between them. These indicators have been selected as a means for describing important aspects of a natural system, a system that exists as a whole, encompassing a network of closely related and inter-dependent factors. It would be incorrect and misleading to view any one of these indicators in isolation from the others.

Table 1: Summary and Recommendations for the 2008 Glen Major Study Area by Indicator

INDICATOR	2008 GLEN MAJOR STUDY AREA SUMMARY		RECOMMENDATIONS
Quality Distribution	Size, Shape, & Forest Interior	35 area-sensitive fauna species, three of which require in excess of 100 ha of natural cover.	Design trail routes to avoid the more extensive areas of interior habitat, thus allowing adequate isolation from disturbance for the large raptors that nest in the area.
	Matrix Influence	<p>Matrix surrounding the site is largely natural and agricultural.</p> <ul style="list-style-type: none"> • 49 of the 50 fauna species of regional concern are scored as sensitive to development. 	<ul style="list-style-type: none"> • Manage trails and trail use to limit damage to species and habitats • Prevent further invasive species spread into higher-quality natural areas. Manage dog-strangling vine, common buckthorn, garlic mustard and Manitoba maple. • Encourage stewardship from local residents and trail users. • Retain and restore natural cover on adjacent properties <p>TRCA region can retain range of flora, fauna, and community types if we protect the diverse parts of the jurisdiction such as this.</p>
Quantity	<p>Based on 2008 ground truthing, the study area contains 676 ha of natural cover. This contributes 5.7% to the total natural cover within the Duffins watershed. Of this, 545 ha is forest, 120 ha is meadow, and 11 ha is wetland.</p> <p>The site is located on the Oak Ridges Moraine, which has a relatively high % natural cover remaining compared to other physiographic regions in the TRCA jurisdiction.</p>		<ul style="list-style-type: none"> • Maintain natural cover <ul style="list-style-type: none"> - Vegetation communities and flora and fauna species will then have opportunities to maintain current populations. • Maintain/enhance continuous links of natural habitat between habitat patches on site and those beyond the site boundaries. • Caution should be exercised over positioning of restoration projects since much of the more open habitat (meadow and successional) is of considerable importance for several scarce species.

4.2.1 Quality Distribution Recommendations

Optimize Patch Size & Shape, Forest Interior

The larger a habitat block, the more resilient the associated fauna and flora communities are to developments within the landscape or to increased user pressure. It is unlikely that the quality of the habitat patches at the landscape scale on the Glen Major site can be improved. At the landscape level this site already scores very high for patch quality, and it needs to be considered that increase in forest patch size will have potentially damaging impact on important non-forest habitat. However, there are many actions that can be taken at the site level that will improve the fauna, flora and over all ecosystem function throughout the study area.

Minimize Negative Matrix Influence

Matrix Influence, emanating from Uxbridge and from rural residential developments, is unlikely to alter in the foreseeable future. However, there are opportunities for negative influences generally associated with human activities to affect ecosystems at some distance from the urban or suburban matrix; a network of trails is one way in which such influences can be introduced into otherwise undisturbed habitats.

Trails:

In order to reduce the negative influences associated with a trail system it is recommended that stakeholders become involved in the management of trail use on the TRCA properties, fostering a better understanding of how certain activities can be detrimental and damaging to the natural ecosystem.

Managing the increased user pressure on the trail system throughout the Glen Major Forest complex is going to require diligence and persistence. It is important to set the ground rules for sustainable and environmentally friendly use as early as possible so as to avoid the establishing of traditions and customs within the various user groups. Once a particular user group has been allowed to use an area in a particular way for more than a couple of seasons it becomes extremely difficult to alter that perceived “tradition”. With this in mind it is of paramount importance that any newly acquired properties are managed appropriately from the outset, and that any novel use of a natural area is appraised, evaluated and managed as early as possible. For example, the issue of night-riding has recently been presented as a new opportunity at Glen Major. Having been judged potentially problematic for the many nocturnal and crepuscular fauna species at Glen Major, it has been decided to prohibit this activity on the trail systems on the TRCA properties at Glen Major. It is important to engage the biking community early on so as to ensure that the community understands that management is acting in the best interests of the natural system at Glen Major. If night-riding is allowed to establish at Glen Major with no

apparent enforcement of regulations prohibiting the activity then, in due course, this activity will be considered acceptable by certain user groups.

Off-leash dogs:

An activity engaged in by a fairly large number of trail users at Glen Major is off-leash dog-walking. This may appear to be a somewhat harmless activity when amounting to one or two isolated occurrences, however, when there are frequent instances (which is the case at the present time) of off-leash dogs running through a natural area, severe impacts occur on the fauna species community. The compounding of this activity over the course of a very short breeding season on ground-nesting birds such as ruffed grouse, ovenbird and whip-poor-will can be devastating and sometimes at the expense of losing local populations of these species.

Although signs have been placed at the various trail-heads, it is evident that these signs are being ignored, and off-leash dog-walking has become, if not the norm then, generally accepted by many of the users at Glen Major. Enforcement of by-laws regulating such practices is difficult in a site as remote as Glen Major and unfortunately, there is already a rather long history and therefore an ingrained tradition of off-leash dogs in the area and it may be difficult to recruit help from local stewards. Nevertheless, a network of interpretive signs, detailing the fauna diversity within the property, and emphasizing the threatened status of species such as golden-winged warbler, together with TRCA staff working as interpretive naturalists, may garner a higher degree of understanding and appreciation of the property which in turn would foster more respectful use of the property.

Invasive Species:

It is recommended that a trail plan study at Glen Major be developed and that the proliferation of informal trails be addressed and halted, along with the closing of existing trails that are not identified as being part of the trail network. Since it appears that there is a direct correlation between trails and invasive species, addressing one of the main points of entry for these species would be advantageous with any hopes in managing for invasive alien species at this location. It is recommended that dog strangling vine, garlic mustard, common buckthorn and Manitoba maple be removed and that a strategic approach for the management of these species in this area be identified and acted upon. Again, the idea of public education on the matter of invasive species is of utmost importance. Identifying the impacts of various user groups going off trail or having dogs off leash applies to invasive species management as well as the other impacts listed earlier. This will minimize soil disturbance in natural areas and therefore slow the spread of invasives.

A few areas in Glen Major forest have been selectively logged in the past. The sites which have been selectively logged have a higher percentage of non-native plants than similar forests that are undisturbed. The skidder trails were covered in a myriad of invasive plant species. These recently disturbed areas then act as

a seed source, which in turn can spread to other sites further exacerbating the problem. Selective logging could be carried out in the winter when the ground is frozen and the skidders will have less of a disturbance on the soils. Large gaps in the forest canopy can also create an ideal place for the invasion of invasives and therefore selective logging should only create small gaps. This forestry practice should slow the spread of invasives. Before an area is considered for tree harvest an inventory of all the flora and fauna should be undertaken so no sensitive species are affected by this activity. Forests with preexisting invasive species under stories and herbaceous layers should be targeted for tree harvest before forests which are less disturbed. An additional pathway for invasion by exotics is through fill (soil) projects. These projects are not recommended to occur as the risks to native biodiversity are too high.

Stewardship:

It is important to act early in fostering an attitude of care and respect for the local natural system (and in the surrounding landscape) among visitors and local stakeholders. Encouraging increased natural cover in adjacent lands can further enhance the matrix. Landowner stewardship could inform neighbouring landowners on the value of natural cover and how to be a steward of the area (education on invasive species etc). Community involvement in this local natural area could ensure that some human impacts on the communities and species would be diminished.

4.2.2 Quantity Recommendations

Increase Natural Cover to Achieve Quality Distribution Targets

The more natural cover we retain at the study area and vicinity, the better it can support a healthy level of biodiversity, but only if the public use of the area is properly managed. Currently, the study area accommodates a high number of flora and fauna species that are of regional concern. Management of the site's habitat characteristics – e.g. increasing the variety of habitat types by creating or restoring wetlands and swamps - could result in recruitment of further species of concern but this might be at the price of diminishing the high degree of representation of species such as blue-winged warbler (29 territories), eastern towhee (24 territories) and Nashville warbler (37 territories) that are dependent on more open, early successional, shrub habitat.

Improve Connectivity To Nearby Habitat

Reforestation of open habitats surrounding this site would increase local natural cover, and contribute to the total regional natural cover. This aspect of habitat connectivity has immense implications at both the watershed and regional levels. Connectivity through natural cover along such corridors as the Oak Ridges Moraine should be maintained and enhanced to improve the opportunities for dispersal of breeding and migrating fauna. The placement of restored habitat can be planned so as to maximize its benefits to habitat quality

and distribution, as well as to connectivity and to the protection of existing populations of species of concern.

4.2.3. Management for Species at Risk

Two species of birds found during the 2008 fauna surveys are listed as threatened under the Species at Risk Act (SARA, 2008). Both of these species are present in high enough numbers to be considered highly significant populations within the TRCA region.

Golden-Winged Warbler: this species thrives in young growth reforestation projects. Unfortunately, this habitat is, by its nature, ephemeral and it is possible that unless such habitat found at Glen Major is managed specifically to create a rotation of early successional habitat-types the international decline of this species will continue unchecked. Selective felling of trees within the forest creates openings in the forest canopy which then allows a shrub understory to establish – raspberry, dogwood, tree saplings – which provides nesting opportunities for both golden-winged and blue-winged warblers. The clearings used by both golden- and blue-winged warblers tend to be more extensive and it is possible that judicious logging may need to be incorporated into the management of the Glen Major area. Such logging should be part of a larger management plan for the entire area, striving to maintain a diverse mix of both intact mature forest and early successional forest habitat across the landscape, resulting in adequate representation of these two extreme habitat types, thus duplicating historic situations when fire incidents were frequent enough to maintain a constant presence of early successional habitat in the landscape. Great care should be taken in these management procedures since the artificial gaps will also be ideal circumstances for the seeding of invasive plants (garlic mustard, dog-strangling vine, buckthorn). Therefore, it is proposed that any such management be undertaken following a strict protocol which will diminish the chances of such invasives being introduced into the gaps and clearings.

Unfortunately, golden-winged warbler also faces a somewhat less surmountable obstacle to recovery: blue-winged warblers. This closely related species, which breeds in very similar habitat, is also experiencing a continental decline, but appears to be increasing locally as populations edge northwards (Atlas of the Breeding Birds of Ontario, 2007). Where the ranges of these two species overlap there is a considerable degree of hybridization, with blue-winged warbler, the dominant species, swamping the more recessive golden-winged genotypes. There appears to be no practical solution to this problem. Nevertheless, provision of appropriate habitat will increase opportunities for both species, both species having been shown to be declining across their eastern North American range.

Habitat management for golden-winged warbler (and blue-winged warbler) will provide nesting opportunities for several species that are likewise experiencing continental declines as early to mid successional shrub habitat succeeds to mature forest. Species such as black-billed cuckoo (*Coccyzus erythrophthalmus*), brown thrasher (*Toxostoma rufum*), clay-coloured sparrow (*Spizella pallida*) and

eastern towhee (*Pipilo erythrophthalmus*) are already benefiting from the presence of the very same habitat at the 2008 Glen Major site that is currently supporting the region's highest density of golden-winged (4 territories) and blue-winged warblers (30 territories).

Hooded Warbler: in contrast to golden-winged warbler, hooded warbler is showing a significant increase and expansion of population to the north and east of the species' traditional breeding area in the Carolinian zone. Possible factors in this expansion and increase are given as an increase in the forest cover across eastern North America in the past two decades, together with maturation of conifer plantations in parts of the species' range (resulting in opening of the canopy and subsequent increase in understory vegetation). Finally, there is some suggestion that the northward expansion may be facilitated by climate change (Atlas of the Breeding Birds of Ontario, 2007).

Since hooded warbler habitat requirements are in keeping with the current trend of over all reforestation in southern Ontario, and since the species' more specific requirement for small canopy openings to encourage establishment of understory shrubs is in keeping with naturally occurring events, it is quite possible that the existing population currently restricted to Pleasure Valley will spread into other parts of the Glen Major complex. This will perhaps depend on the level of human disturbance along trails criss-crossing a large proportion of the forest but it is interesting to note that where the species is most abundant (St. Williams Forest, Haldimand-Norfolk), there is a high degree of trail use that does not appear to be effecting territory choice for this species (Jon McCracken, pers.com.).

When the forest on TRCA property in the south-east corner of the study area is compared to the similarly sized Pleasure Valley forest in the north-west corner, the TRCA survey shows considerable differences. Whether due to the low intensity use of the trail system at Pleasure Valley where dogs are restricted because of the horse-riding, or due to a difference in the quality of the understory at the two forest patches, the Pleasure Valley portion holds significantly higher numbers of hooded warblers, black-throated blue warblers, American redstarts (*Setophaga ruticilla*), chestnut-sided warblers (*Dendroica pensylvanica*) and veerys (*Catharus fuscescens*). It is possible that copying some of the understory features existing at Pleasure Valley into the structure of the forest on the TRCA property will result in the recruitment of these missing species. Several of these species nest low in shrub understory – raspberry, maple saplings, dogwood - in mature deciduous forest. Their habit of nesting at heights of less than 1 metre means that they are particularly susceptible to ground-borne disturbance (e.g. off-leash dogs playing through forest understory).

Finally, for both golden-winged and hooded warbler, it is recommended that a series of interpretive signs be posted along trails through their preferred habitats. These are two of the more spectacular-looking songbirds in Ontario, and an interpretive sign including photographs of these species would be an effective tool in recruiting support for appropriate trail use.

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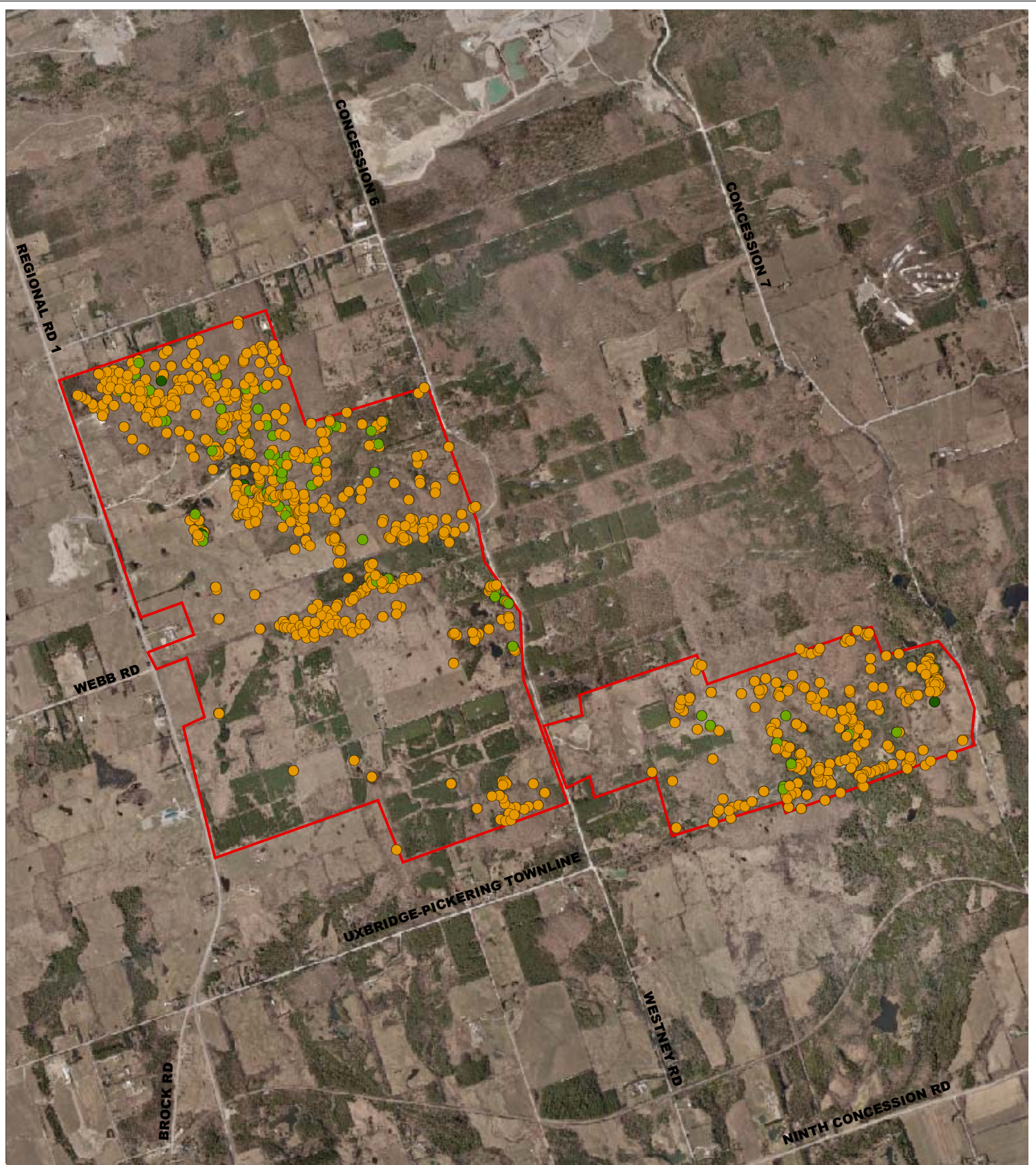

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Date: November 2008
Orthophoto: Spring 2008, First Base Solutions Inc.

Map 1:
Glen Major Study Area

Legend

 **Study Area**



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0 200 400 800 1,200 1,600 Meters

Date: November 2008
 Orthophoto: Spring 2008, First Base
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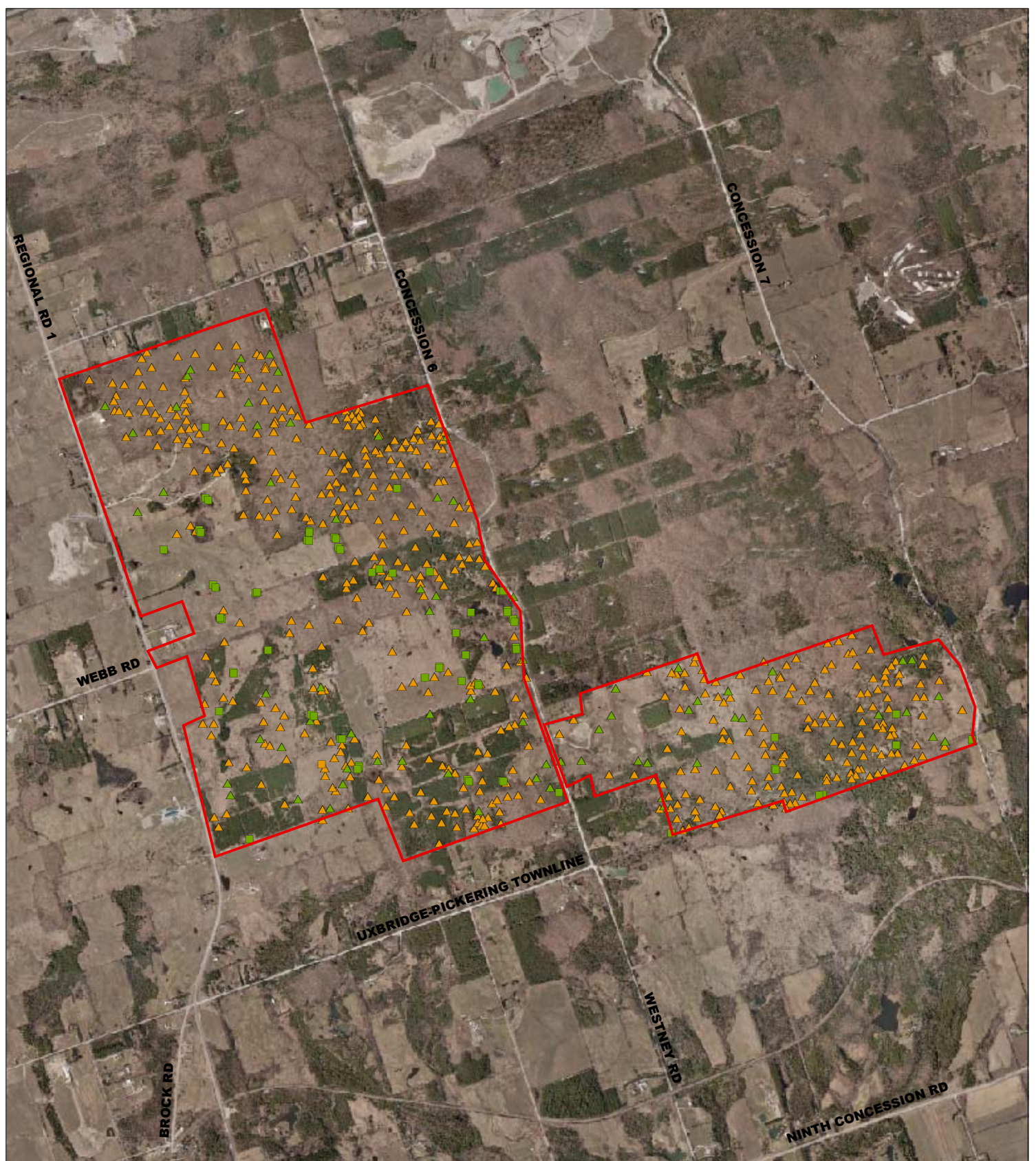
Map 2: Location of Flora Species of Concern

Legend

Flora Species of Concern (L1-L3)

- L1
- L2
- L3

Glen Major Study Area






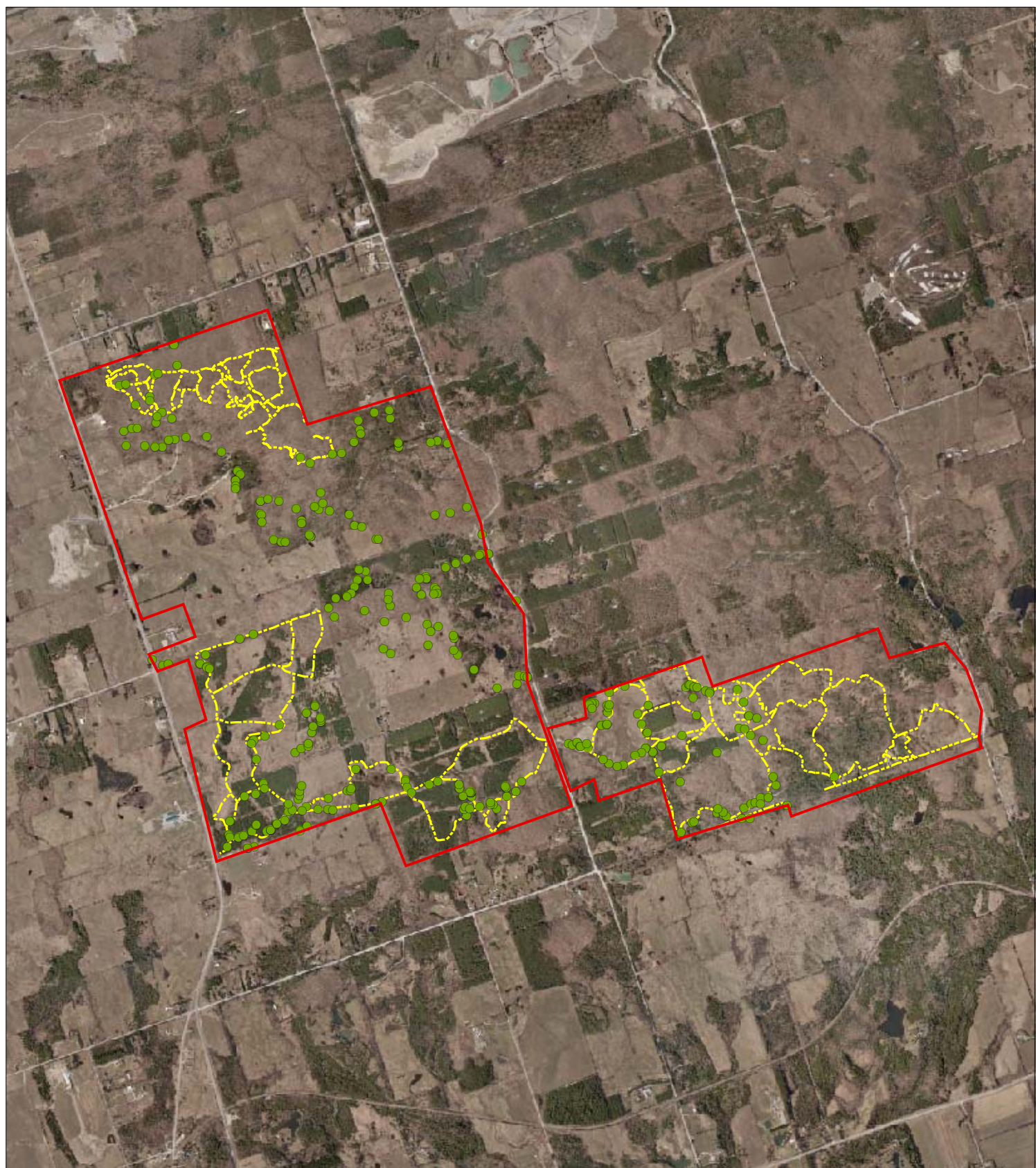

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 Orthophoto: Spring 2008, First Base Solutions Inc.

Map 3: Location of Fauna Species of Concern

Legend

Fauna Species of Concern		Frog Species of Concern
▲ L1		■ L1
▲ L2		■ L2
▲ L3		■ L3
 Glen Major Study Area		




 TORONTO AND REGION
Conservation
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Date: November 2008
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Map 4: Glen Major Trails and Invasive Species

Legend

-  Invasive Species
-  Glen Major Trails
-  Glen Major Study Area

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank	
		1 - 5	5	1 - 5	5	0 - 5	5	0 - 5	5	2001-02	2008
<i>Corallorhiza maculata</i>	spotted coral-root		5		5		5		5	L1	X
<i>Drosera rotundifolia</i>	round-leaved sundew		4		5		5		5	L1	X
<i>Goodyera pubescens</i>	downy rattlesnake-plantain		4		5		5		5	L1	X
<i>Juniperus horizontalis</i>	creeping juniper									L1?	X
<i>Lycopodium annotinum</i>	stiff club-moss		4		5		5		5	L1	X
<i>Menyanthes trifoliata</i>	bog buckbean		4		5		5		5	L1	X
<i>Orthilia secunda</i>	one-sided pyrola		4		5		5		5	L1	X
<i>Pedicularis canadensis</i>	wood-betony		4		5		5		5	L1	X
<i>Pogonia ophioglossoides</i>	rose pogonia		5		4		5		5	L1	X
<i>Sarracenia purpurea</i>	pitcher-plant		4		5		5		5	L1	X
<i>Botrychium dissectum</i>	cut-leaved grape fern		3		4		5		5	L2	X
<i>Botrychium virginianum</i>	rattlesnake fern		3		5		4		5	L2	X
<i>Calla palustris</i>	water arum		3		5		4		5	L2	X
<i>Carex aquatilis</i>	water sedge		3		4		5		5	L2	X
<i>Chimaphila umbellata</i> ssp. <i>cisatlantica</i>	pipisewwa		4		4		5		5	L2	X
<i>Coptis trifolia</i> ssp. <i>groenlandica</i>	goldthread		2		5		5		5	L2	X
<i>Cornus canadensis</i>	bunchberry		3		5		5		5	L2	X
<i>Dennstaedtia punctilobula</i>	hay-scented fern		4		4		5		4	L2	X
<i>Diphasiastrum digitatum</i>	crowfoot club-moss		3		4		5		5	L2	X
<i>Dulichium arundinaceum</i>	three-way sedge		3		4		5		5	L2	X
<i>Elymus trachycaulus</i>	slender wheat grass		5		4		4		5	L2	X
<i>Gaultheria procumbens</i>	wintergreen		3		5		4		5	L2	X
<i>Glyceria canadensis</i>	rattlesnake grass		3		4		5		5	L2	X
<i>Gnaphalium obtusifolium</i>	fragrant cudweed		4		4		5		4	L2	X
<i>Huperzia lucidula</i>	shining club-moss		3		5		5		5	L2	X
<i>Kalmia polifolia</i>	bog laurel		4		5		5		4	L2	X
<i>Lycopodium dendroideum</i>	round-branched ground-pine		2		5		5		5	L2	X
<i>Moneses uniflora</i>	one-flowered pyrola		3		5		5		5	L2	X
<i>Muhlenbergia glomerata</i>	marsh wild timothy		5		3		4		5	L2	X
<i>Nemopanthus mucronatus</i>	mountain holly		4		3		5		5	L2	X
<i>Osmunda claytoniana</i>	interrupted fern		3		5		5		5	L2	X
<i>Osmunda regalis</i> var. <i>spectabilis</i>	royal fern		2		5		5		5	L2	X
<i>Oxalis acetosella</i> ssp. <i>montana</i>	pink wood sorrel		4		4		5		4	L2	X
<i>Panax quinquefolius</i>	ginseng		4		5		4		5	L2	X

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank		
		1 - 5	Distribution	1 - 5	Trend	0 - 5	Dependence	0 - 5	Development	TRCA 2008	2001-02	2008
<i>Panicum linearifolium</i>	narrow-leaved panic grass	4		3		5		5		L2	X	
<i>Phlox divaricata</i>	wild blue phlox	4		4		4		4		L2	X	X
<i>Pinus resinosa</i>	red pine	2		5		5		5		L2	xp	X
<i>Platanthera hyperborea</i>	northern green orchis	3		4		5		5		L2	X	
<i>Polypodium virginianum</i>	rock polypody	4		4		5		5		L2	X	
<i>Potamogeton zosteriformis</i>	flat-stemmed pondweed	3		5		5		5		L2	X	
<i>Potentilla palustris</i>	marsh cinquefoil	3		5		4		4		L2	X	
<i>Pyrola asarifolia</i>	pink pyrola	3		4		5		5		L2	X	
<i>Schizachyrium scoparium</i>	little bluestem	4		4		5		5		L2	X	
<i>Thelypteris noveboracensis</i>	New York fern	4		4		5		5		L2	X	
<i>Triadenum fraseri</i>	marsh St. Johnswort	3		5		4		4		L2	X	
<i>Utricularia vulgaris</i>	common bladderwort	3		4		5		5		L2	X	
<i>Vaccinium oxycoccos</i>	small cranberry	4		5		5		5		L2	X	
<i>Viburnum cassinoides</i>	with-rod	4		4		5		4		L2	X	X
<i>Abies balsamea</i>	balsam fir	2		3		4		4		L3	X	
<i>Adiantum pedatum</i>	northern maidenhair fern	2		3		5		5		L3	X	X
<i>Agrostis scabra</i>	ticklegrass	3		3		4		4		L3	X	
<i>Alopecurus aequalis</i>	short-awned foxtail	3		4		5		5		L3	X	
<i>Anaphalis margaritacea</i>	pearly everlasting	3		4		4		4		L3	X	X
<i>Anemone acutiloba</i>	sharp-lobed hepatica	2		4		4		4		L3	X	X
<i>Anemone cylindrica</i>	long-fruited thimbleweed	3		4		3		3		L3	X	
<i>Anemone quinquefolia</i> var. <i>quinquefolia</i>	wood-anemone	2		4		3		3		L3	X	
<i>Aquilegia canadensis</i>	wild columbine	2		4		3		3		L3	X	X
<i>Arabis glabra</i>	tower mustard	4		4		4		4		L3	X	X
<i>Aralia racemosa</i> ssp. <i>racemosa</i>	spikenard	2		4		4		4		L3	X	X
<i>Brachyelytrum erectum</i>	bearded short-husk	3		5		3		3		L3	X	
<i>Bromus ciliatus</i>	fringed brome grass	2		4		4		4		L3	X	
<i>Calystegia spithamea</i> ssp. <i>spithamea</i>	low bindweed	4		4		4		4		L3	X	X
<i>Campanula aparinoides</i>	marsh bellflower	3		4		5		5		L3	X	
<i>Cardamine concatenata</i>	cut-leaved toothwort	2		3		5		5		L3	X	X
<i>Carex albursina</i>	white bear sedge	2		3		5		5		L3	X	X
<i>Carex alopecoidea</i>	foxtail wood sedge	2		3		5		5		L3	X	
<i>Carex backii</i>	Back's sedge	4		3		4		4		L3	X	X
<i>Carex brevior</i>	short-fruited sedge	3		3		4		4		L3	X	X

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Scientific Name	Common Name	Local		Population		Habitat		Sensitivity to		Rank		
		Distribution	1 - 5	Trend	1 - 5	Dependance	0 - 5	Development	0 - 5	TRCA	2001-02	2008
<i>Carex brunnescens</i> ssp. <i>brunnescens</i>	brownish sedge		3		3		4		4	L3	X	
<i>Carex canescens</i> ssp. <i>canescens</i>	silvery sedge		3		4		5		4	L3	X	
<i>Carex cephalophora</i>	oval-headed sedge		3		3		4		4	L3	X	
<i>Carex comosa</i>	bristly sedge		3		3		5		4	L3	X	X
<i>Carex crinita</i>	fringed sedge		2		4		4		4	L3	X	X
<i>Carex diandra</i>	lesser panicled sedge		3		4		5		4	L3	X	
<i>Carex digitalis</i>	slender wood sedge		4		4		4		3	L3	X	
<i>Carex disperma</i>	two-seeded sedge		2		3		5		4	L3	X	
<i>Carex eburnea</i>	bristle-leaved sedge		3		4		4		4	L3	X	
<i>Carex hitchcockiana</i>	Hitchcock's sedge		3		3		5		3	L3	X	
<i>Carex interior</i>	fen star sedge		2		4		4		4	L3	X	
<i>Carex leptalea</i> ssp. <i>leptalea</i>	bristle-stalked sedge		2		3		5		4	L3	X	
<i>Carex leptoneuria</i>	few-nerved wood sedge		2		4		4		4	L3	X	
<i>Carex lupulina</i>	hop sedge		2		4		4		4	L3	X	X
<i>Carex muhlenbergii</i> var. <i>muhlenbergii</i>	Muhlenberg's sedge		4		4		4		4	L3	X	
<i>Carex plantaginea</i>	plantain-leaved sedge		2		4		5		4	L3	X	X
<i>Carex platyphylla</i>	broad-leaved sedge		3		4		4		3	L3	X	X
<i>Carex scoparia</i>	pointed broom sedge		4		2		5		3	L3	X	
<i>Carex trisperma</i> var. <i>trisperma</i>	three-seeded sedge		4		3		5		4	L3	X	
<i>Carex tuckermanii</i>	Tuckerman's sedge		2		4		4		4	L3	X	
<i>Carex utriculata</i>	beaked sedge		2		3		4		4	L3	X	
<i>Carex vesicaria</i>	inflated sedge		3		3		5		4	L3	X	
<i>Celastrus scandens</i>	American bittersweet		2		4		3		5	L3	X	X
<i>Chamaedaphne calyculata</i>	leatherleaf		3		4		4		4	L3	X	
<i>Chenopodium capitatum</i>	strawberry-bite		5		4		4		4	L3	X	
<i>Chrysosplenium americanum</i>	golden saxifrage		3		3		5		4	L3	X	
<i>Cicuta bulbifera</i>	bulblet-bearing water-hemlock		2		3		5		4	L3	X	
<i>Cinna latifolia</i>	nodding wood reed		3		3		5		3	L3	X	X
<i>Circaea alpina</i>	smaller enchanter's nightshade		2		4		5		4	L3	X	
<i>Claytonia caroliniana</i>	broad-leaved spring beauty		2		4		5		5	L3	X	X
<i>Clintonia borealis</i>	bluebead lily		2		5		4		5	L3	X	X
<i>Corydalis aurea</i> ssp. <i>aurea</i>	golden corydalis		5		4		4		4	L3	X	X
<i>Crataegus chrysoarpa</i>	fire-berry hawthorn		4		3		4		4	L3	X	
<i>Crataegus macrosperma</i>	variable hawthorn		5		2		4		4	L3	X	X

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Scientific Name	Common Name	Local		Population		Habitat		Sensitivity to		Rank		
		Distribution	1 - 5	Trend	1 - 5	Dependance	0 - 5	Development	0 - 5	TRCA	2001-02	2008
<i>Cypripedium calceolus var. parviflorum</i>	smaller yellow lady's slipper		3		4		4		5	L3	X	
<i>Cystopteris tenuis</i>	Mackay's fragile fern		2		4		5		5	L3	X	X
<i>Deparia acrostichoides</i>	silvery glade fern		3		4		5		4	L3	X	
<i>Desmodium glutinosum</i>	pointed-leaved tick-trefoil		3		4		4		5	L3	X	X
<i>Dicentra canadensis</i>	squirrel-corn		2		4		5		4	L3	X	X
<i>Dicentra cucullaria</i>	Dutchman's breeches		2		4		4		5	L3		X
<i>Dryopteris clintoniana</i>	Clinton's wood fern		2		4		5		4	L3	X	X
<i>Dryopteris cristata</i>	crested wood fern		2		4		4		4	L3	X	
<i>Dryopteris filix-mas</i>	male fern		5		2		5		3	L3	X	
<i>Eleocharis acicularis</i>	needle spike-rush		4		2		4		5	L3	X	
<i>Eleocharis intermedia</i>	matted spike-rush		5		2		4		4	L3	X	
<i>Epilobium leptophyllum</i>	narrow-leaved willow-herb		2		5		4		4	L3	X	
<i>Equisetum fluviatile</i>	water horsetail		2		4		5		4	L3	X	
<i>Equisetum pratense</i>	thicket horsetail		3		4		5		3	L3	X	
<i>Equisetum scirpoides</i>	dwarf scouring rush		2		4		5		5	L3	X	X
<i>Equisetum sylvaticum</i>	woodland horsetail		2		3		5		4	L3	X	X
<i>Galium boreale</i>	northern bedstraw		4		4		4		3	L3	X	
<i>Galium lanceolatum</i>	wild licorice		4		5		4		3	L3	X	
<i>Galium tinctorium</i>	stiff marsh bedstraw		4		4		4		3	L3	X	
<i>Glyceria borealis</i>	northern manna grass		3		3		5		5	L3	X	
<i>Glyceria septentrionalis</i>	eastern manna grass		2		3		5		4	L3	X	
<i>Gymnocarpium dryopteris</i>	oak fern		2		3		5		5	L3	X	X
<i>Hamamelis virginiana</i>	witch-hazel		2		4		4		4	L3	X	
<i>Helianthus divaricatus</i>	woodland sunflower		5		3		4		4	L3	X	
<i>Hydrocotyle americana</i>	marsh pennywort		2		4		4		4	L3	X	
<i>Hydrophyllum canadense</i>	Canada waterleaf		2		3		5		4	L3	X	
<i>Hypericum punctatum</i>	spotted St. Johnswort		4		4		4		3	L3	X	
<i>Ilex verticillata</i>	winterberry		2		4		4		5	L3	X	X
<i>Iris versicolor</i>	blue flag		2		5		4		5	L3	X	
<i>Juglans cinerea</i>	butternut		1		5		4		4	L3	X	X
<i>Juniperus communis</i>	common juniper		2		3		4		5	L3	X	X
<i>Larix laricina</i>	tamarack		2		4		4		4	L3	X	
<i>Lemna trisulca</i>	star duckweed		2		4		5		3	L3	X	
<i>Lespedeza capitata</i>	round-headed bush-clover		5		2		4		5	L3	X	X

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Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank	
		1 - 5	1 - 5	1 - 5	1 - 5	0 - 5	0 - 5	2001-02	2008		
<i>Lobelia inflata</i>	Indian tobacco	3	4	4	4	4	4	L3			X
<i>Lobelia siphilitica</i>	great blue lobelia	2	3	3	3	4	4	L3			X
<i>Lonicera canadensis</i>	fly honeysuckle	2	4	4	4	4	4	L3			X
<i>Lonicera hirsuta</i>	hairy honeysuckle	3	4	4	4	4	4	L3			X
<i>Lysimachia terrestris</i>	swamp candles	4	4	4	4	4	4	L3			X
<i>Lysimachia thyrsoiflora</i>	tufted loosestrife	3	3	3	3	4	4	L3			X
<i>Maianthemum trifolium</i>	three-leaved false Solomon's seal	3	4	4	4	5	5	L3			X
<i>Medeola virginiana</i>	Indian cucumber-root	2	5	5	4	4	4	L3			X
<i>Menispermum canadense</i>	moonseed	2	4	4	4	4	4	L3			X
<i>Milium effusum</i>	wood millet	3	5	5	5	5	5	L3			X
<i>Mitchella repens</i>	partridgeberry	2	4	4	4	4	4	L3			X
<i>Mitella diphylla</i>	mitrewort	2	3	3	3	4	4	L3			X
<i>Mitella nuda</i>	naked mitrewort	2	4	4	4	5	5	L3			X
<i>Monotropa hypopithys</i>	pinesap	2	4	4	4	5	5	L3			X
<i>Monotropa uniflora</i>	Indian-pipe	2	4	4	4	5	5	L3			X
<i>Nuphar variegata</i>	bullhead lily	3	4	4	4	5	5	L3			X
<i>Oryzopsis asperifolia</i>	white-fruited mountain-rice	2	4	4	4	4	4	L3			X
<i>Osmunda cinnamomea</i>	cinnamon fern	2	4	4	4	5	5	L3			X
<i>Phegopteris connectilis</i>	northern beech fern	3	3	3	3	5	5	L3			X
<i>Picea glauca</i>	white spruce	1	5	5	5	4	4	L3			X
<i>Poa alsodes</i>	grove meadow grass	3	3	3	3	5	5	L3			X
<i>Poa languida</i>	languid spear grass	5	2	2	2	4	4	L3			X
<i>Poa saltuensis</i>	bushy spear grass	4	3	3	3	5	5	L3			X
<i>Polygonum cilinode</i>	fringed black bindweed	4	4	4	4	4	4	L3			X
<i>Polystichum acrostichoides</i>	Christmas fern	1	3	3	3	5	5	L3			X
<i>Potamogeton foliosus</i>	leafy pondweed	2	3	3	3	5	5	L3			X
<i>Potamogeton natans</i>	floating pondweed	2	4	4	4	5	5	L3			X
<i>Prenanthes alba</i>	white wood lettuce	3	4	4	4	4	4	L3			X
<i>Prunus nigra</i>	Canada plum	2	4	4	4	4	4	L3			X
<i>Pyrola elliptica</i>	shinleaf	2	4	4	4	4	4	L3			X
<i>Ribes triste</i>	swamp red currant	2	4	4	4	4	4	L3			X
<i>Sagittaria cuneata</i>	arum-leaved arrowhead	3	4	4	4	5	5	L3			X
<i>Salix lucida</i>	shining willow	2	4	4	4	5	5	L3			X
<i>Scirpus cyperinus</i>	woolly bulrush	2	3	3	3	4	4	L3			X

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		Distribution	1 - 5	Trend	1 - 5	Dependence	0 - 5	Development	0 - 5	TRCA	2001-02
<i>Shepherdia canadensis</i>	buffalo-berry		3	4	4	5	4	L3		X	
<i>Silene antirrhina</i>	sleepy catchfly		4	3	3	4	4	L3		X	
<i>Sisyrinchium montanum</i>	blue-eyed grass		2	3	3	4	4	L3		X	X
<i>Sparganium emersum</i> ssp. <i>emersum</i>	green-fruited bur-reed		2	3	3	5	4	L3		X	
<i>Sparganium eurycarpum</i>	great bur-reed		2	4	4	5	4	L3		X	
<i>Sphenopholis intermedia</i>	slender wedge grass		3	3	3	4	4	L3		X	
<i>Spirodela polyrhiza</i>	greater duckweed		2	4	4	5	3	L3		X	
<i>Sporobolus cryptandrus</i>	sand dropseed		3	3	3	5	3	L3		X	
<i>Streptopus roseus</i>	rose twisted-stalk		2	4	4	4	4	L3		X	X
<i>Taxus canadensis</i>	Canada yew		2	4	4	4	4	L3		X	X
<i>Teucrium canadense</i> ssp. <i>canadense</i>	wood-sage		3	3	3	4	4	L3		X	
<i>Trientalis borealis</i> ssp. <i>borealis</i>	star-flower		2	4	4	4	4	L3		X	X
<i>Uvularia grandiflora</i>	large-flowered bellwort		1	4	4	5	5	L3		X	X
<i>Vaccinium myrtilloides</i>	velvet-leaf blueberry		3	4	4	4	4	L3		X	
<i>Vallisneria americana</i>	tape-grass		3	4	4	5	4	L3		X	
<i>Verbena stricta</i>	hoary vervain		3	5	5	4	4	L3		X	X
<i>Veronica scutellata</i>	marsh speedwell		3	2	2	5	4	L3		X	
<i>Viburnum acerifolium</i>	maple-leaved viburnum		2	3	3	4	4	L3		X	X
<i>Viola blanda</i>	sweet white violet		3	4	4	4	4	L3		X	X
<i>Viola canadensis</i>	Canada violet		3	4	4	4	4	L3		X	X
<i>Viola rostrata</i>	long-spurred violet		2	4	4	4	4	L3		X	X
<i>Wolffia borealis</i>	dotted water-meal		3	4	4	5	2	L3		X	
<i>Acer rubrum</i>	red maple		2	4	4	1	5	L4		X	X
<i>Acer saccharinum</i>	silver maple		1	2	2	5	3	L4		X	X
<i>Acer saccharum</i> ssp. <i>nigrum</i>	black maple		2	3	3	4	2	L4		X	X
<i>Acer spicatum</i>	mountain maple		2	3	3	4	4	L4		X	X
<i>Actaea pachypoda</i>	white baneberry		2	3	3	4	4	L4		X	X
<i>Allium tricoccum</i>	wild leek		1	3	3	4	4	L4		X	X
<i>Amelanchier arborea</i>	downy serviceberry		3	2	2	4	4	L4		X	X
<i>Amelanchier laevis</i>	smooth serviceberry		2	2	2	4	3	L4		X	X
<i>Antennaria howellii</i> ssp. <i>howellii</i>	field or Howell's pussytoes		4	2	2	3	2	L4		X	X
<i>Apocynum androsaemifolium</i>	spreading dogbane		2	3	3	2	4	L4		X	X
<i>Asarum canadense</i>	wild ginger		2	3	3	4	3	L4		X	X
<i>Asclepias incarnata</i> ssp. <i>incarnata</i>	swamp milkweed		1	3	3	4	4	L4		X	X

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		1 - 5	1 - 5	1 - 5	1 - 5	0 - 5	0 - 5	0 - 5	0 - 5	2001-02	2008
<i>Aster macrophyllus</i>	big-leaved aster	2	3	2	3	2	4	L4	X	X	X
<i>Betula alleghaniensis</i>	yellow birch	1	4	1	4	3	5	L4	X	X	X
<i>Betula papyrifera</i>	paper birch	1	4	1	4	2	4	L4	X	X	X
<i>Bidens tripartitus</i>	three-parted beggar's-ticks	3	2	3	2	4	2	L4	X	X	X
<i>Boehmeria cylindrica</i>	false nettle	2	4	2	4	4	3	L4	X	X	X
<i>Calamagrostis canadensis</i>	Canada blue joint	1	3	1	3	4	4	L4	X	X	X
<i>Caltha palustris</i>	marsh marigold	2	4	2	4	3	4	L4	X	X	X
<i>Cardamine diphylla</i>	broad-leaved toothwort	2	3	2	3	4	4	L4	X	X	X
<i>Cardamine pensylvanica</i>	bitter cress	3	2	3	2	4	4	L4	X	X	X
<i>Cardamine x maxima</i>	hybrid toothwort	3	3	3	3	3	3	L4	X	X	X
<i>Carex arctata</i>	nodding wood sedge	2	4	2	4	2	2	L4	X	X	X
<i>Carex communis</i>	fibrous-rooted sedge	2	4	2	4	3	3	L4	X	X	X
<i>Carex deweyana</i>	Dewey's sedge	2	4	2	4	3	3	L4	X	X	X
<i>Carex gracillima</i>	graceful sedge	2	3	2	3	4	2	L4	X	X	X
<i>Carex hirtifolia</i>	hairy wood sedge	2	3	2	3	4	3	L4	X	X	X
<i>Carex hystericina</i>	porcupine sedge	2	3	2	3	2	2	L4	X	X	X
<i>Carex intumescens</i>	bladder sedge	2	4	2	4	4	4	L4	X	X	X
<i>Carex lacustris</i>	lake-bank sedge	2	3	2	3	3	3	L4	X	X	X
<i>Carex laxiflora</i>	loose-flowered sedge	3	3	3	3	4	4	L4	X	X	X
<i>Carex peckii</i>	Peck's sedge	3	3	3	3	4	4	L4	X	X	X
<i>Carex pedunculata</i>	early-flowering sedge	2	3	2	3	3	3	L4	X	X	X
<i>Carex pensylvanica</i>	Pennsylvania sedge	2	4	2	4	3	4	L4	X	X	X
<i>Carex projecta</i>	necklace sedge	3	2	3	2	4	3	L4	X	X	X
<i>Carex pseudo-cyperus</i>	pseudocyperus sedge	2	3	2	3	3	4	L4	X	X	X
<i>Carex retrorsa</i>	retorse sedge	2	3	2	3	3	4	L4	X	X	X
<i>Carex scabrata</i>	rough sedge	2	3	2	3	4	3	L4	X	X	X
<i>Carex sprengei</i>	long-beaked sedge	2	4	2	4	4	2	L4	X	X	X
<i>Carex stricta</i>	tussock sedge	2	3	2	3	3	4	L4	X	X	X
<i>Carex tenera</i>	straw sedge	2	3	2	3	3	3	L4	X	X	X
<i>Carex tribuloides</i>	blunt broom sedge	3	2	3	2	4	3	L4	X	X	X
<i>Carpinus caroliniana ssp. virginiana</i>	blue beech	1	3	1	3	4	3	L4	X	X	X
<i>Carya cordiformis</i>	bitternut hickory	2	4	2	4	4	2	L4	X	X	X
<i>Caulophyllum thalictroides</i>	long-styled blue cohosh	2	3	2	3	4	4	L4	X	X	X
<i>Cornus rugosa</i>	round-leaved dogwood	2	4	2	4	4	3	L4	X	X	X

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local		Population		Habitat		Sensitivity to		Rank	
		Distribution	1 - 5	Trend	1 - 5	Dependence	0 - 5	Development	0 - 5	TRCA	2001-02
<i>Corylus cornuta</i>	beaked hazel		2	4	4	3	4	L4	X	X	X
<i>Crataegus macracantha</i>	long-spined hawthorn		2	2	2	4	3	L4			X
<i>Crataegus submollis</i>	Emerson's hawthorn		3	3	3	4	4	L4	X	X	X
<i>Cuscuta gronovii</i>	swamp dodder		3	3	3	3	3	L4	X		
<i>Cystopteris bulbifera</i>	bulblet fern		2	3	3	4	4	L4	X		
<i>Danthonia spicata</i>	poverty oat grass		2	4	4	3	3	L4	X		
<i>Diervilla lonicera</i>	bush honeysuckle		2	3	3	2	4	L4	X		X
<i>Dryopteris intermedia</i>	evergreen wood fern		2	4	4	4	4	L4	X		
<i>Dryopteris marginalis</i>	marginal wood fern		2	3	3	3	3	L4	X		
<i>Dryopteris x triplioidea</i>	confusing hybrid wood fern		5	2	2	3	3	L4	X		
<i>Eleocharis obtusa</i>	blunt spike-rush		3	2	2	5	2	L4	X		
<i>Elymus canadensis</i>	Canada wild rye		3	2	2	5	3	L4	X		X
<i>Elymus hystrix</i>	bottle-brush grass		2	3	3	4	4	L4	X		X
<i>Elymus riparius</i>	riverbank wild rye		2	2	2	4	4	L4	X		
<i>Epifagus virginiana</i>	beech-drops		2	3	3	5	2	L4	X		X
<i>Epilobium coloratum</i>	purple-leaved willow-herb		2	3	3	4	2	L4	X		
<i>Equisetum variegatum ssp. variegatum</i>	variegated scouring-rush		2	2	2	5	4	L4	X		
<i>Eupatorium perfoliatum</i>	boneset		1	3	3	4	4	L4	X		
<i>Fagus grandifolia</i>	American beech		1	4	4	3	4	L4	X		X
<i>Festuca subverticillata</i>	nodding fescue		3	2	2	4	4	L4	X		
<i>Fraxinus nigra</i>	black ash		2	4	4	4	4	L4	X		
<i>Galium aparine</i>	cleavers		3	3	3	4	4	L4	X		
<i>Galium asprellum</i>	rough bedstraw		3	2	2	4	2	L4	X		X
<i>Glyceria grandis</i>	tall manna grass		2	3	3	4	4	L4	X		X
<i>Juncus effusus ssp. solutus</i>	soft rush		2	4	4	4	4	L4	X		
<i>Juncus nodosus</i>	knotted rush		2	2	2	5	3	L4	X		
<i>Juncus torreyi</i>	Torrey's rush		2	3	3	4	4	L4	X		
<i>Lactuca canadensis</i>	wild lettuce		3	3	3	2	2	L4	X		
<i>Lycopus americanus</i>	cut-leaved water-horehound		2	4	4	3	3	L4	X		
<i>Lycopus uniflorus</i>	northern water-horehound		2	3	3	3	3	L4	X		
<i>Maianthemum canadense</i>	Canada mayflower		1	4	4	1	1	L4	X		X
<i>Mimulus ringens</i>	square-stemmed monkey-flower		2	3	3	3	3	L4	X		
<i>Monarda fistulosa</i>	wild bergamot		3	3	3	2	2	L4	X		X
<i>Osmorhiza claytonii</i>	woolly sweet cicely		2	3	3	4	4	L4	X		X

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local		Population		Habitat		Sensitivity to		Rank	2008
		Distribution	1 - 5	Trend	1 - 5	Dependance	0 - 5	Development	0 - 5		
<i>Panicum acuminatum</i> var. <i>acuminatum</i>	hairy panic grass		2		3		3		3	L4	X
<i>Penthorum sedoides</i>	ditch stonecrop		3		2		4		3	L4	X
<i>Physalis heterophylla</i>	clammy ground-cherry		3		2		3		3	L4	X
<i>Pinus strobus</i>	white pine		1		4		3		4	L4	X
<i>Polygonatum pubescens</i>	dowry Solomon's seal		2		4		2		5	L4	X
<i>Polygonum amphibium</i>	water smartweed		2		3		4		4	L4	X
<i>Polygonum pennsylvanicum</i>	Pennsylvania smartweed		3		2		4		3	L4	X
<i>Populus grandidentata</i>	large-toothed aspen		2		3		4		3	L4	X
<i>Potamogeton pectinatus</i>	sago pondweed		2		2		5		3	L4	X
<i>Prunella vulgaris</i> ssp. <i>lanceolata</i>	heal-all or self-heal (native)		4		2		3		2	L4	X
<i>Prunus pennsylvanica</i>	pin cherry		2		4		3		3	L4	X
<i>Pteridium aquilinum</i> var. <i>latiusculum</i>	eastern bracken		2		4		2		4	L4	X
<i>Quercus macrocarpa</i>	Bur oak		2		4		3		3	L4	X
<i>Quercus rubra</i>	red oak		1		4		2		4	L4	X
<i>Rorippa palustris</i> ssp. <i>fernaldiana</i>	Fernald's marsh cress		3		2		4		2	L4	X
<i>Rorippa palustris</i> ssp. <i>hispida</i>	hispid marsh cress		3		2		4		2	L4	X
<i>Rosa blanda</i>	smooth wild rose		2		3		3		4	L4	X
<i>Rubus pubescens</i>	dwarf raspberry		2		3		3		3	L4	X
<i>Rudbeckia hirta</i>	black-eyed Susan		1		4		4		3	L4	X
<i>Sagittaria latifolia</i>	common arrowhead		1		2		5		4	L4	X
<i>Salix discolor</i>	pussy willow		2		3		4		3	L4	X
<i>Salix petiolaris</i>	slender willow		2		3		5		3	L4	X
<i>Sanicula marilandica</i>	sanicle		3		3		3		3	L4	X
<i>Schizachne purpurascens</i> ssp. <i>purpurascens</i>	purple melic grass		2		3		3		3	L4	X
<i>Scirpus microcarpus</i>	barber-pole bulrush		2		2		4		3	L4	X
<i>Scirpus validus</i>	soft-stemmed bulrush		2		2		5		3	L4	X
<i>Sium suave</i>	water-parsnip		3		2		4		4	L4	X
<i>Smilax hispida</i>	bristly greenbrier		3		3		3		3	L4	X
<i>Solidago rugosa</i> ssp. <i>rugosa</i>	rough-stemmed goldenrod		3		3		2		3	L4	X
<i>Spiraea alba</i>	wild spiraea		2		4		4		3	L4	X
<i>Stachys palustris</i>	marsh hedge-nettle		3		3		4		3	L4	X
<i>Thelypteris palustris</i> var. <i>pubescens</i>	marsh fern		2		4		2		4	L4	X
<i>Thuja occidentalis</i>	white cedar		1		4		1		5	L4	X
<i>Tiarella cordifolia</i>	foam-flower		1		3		3		4	L4	X

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local		Population		Habitat		Sensitivity to		Rank	
		Distribution	Distribution	Trend	Trend	Dependence	Dependence	Development	Development	TRCA	TRCA
		1 - 5	1 - 5	1 - 5	1 - 5	0 - 5	0 - 5	0 - 5	0 - 5	2008	2008
<i>Trillium erectum</i>	red trillium	1	4	4	3	5	L4		X		X
<i>Trillium grandiflorum</i>	white trillium	1	3	3	4	5	L4		X		X
<i>Tsuga canadensis</i>	eastern hemlock	1	4	4	3	5	L4		X		X
<i>Typha latifolia</i>	broad-leaved cattail	1	4	4	4	4	L4		X		X
<i>Veronica americana</i>	American speedwell	2	3	3	4	4	L4		X		X
<i>Waldsteinia fragarioides</i>	barren strawberry	2	4	4	4	3	L4		X		X
<i>Wolffia columbiana</i>	columbia water-meal	2	4	4	5	2	L4		X		X
<i>Acer saccharum</i> ssp. <i>saccharum</i>	sugar maple	1	3	3	0	2	L5		X		X
<i>Achillea millefolium</i> ssp. <i>lanulosum</i>	woolly yarrow	2	2	2	0	1	L5		X		X
<i>Actaea rubra</i>	red baneberry	2	3	3	1	3	L5		X		X
<i>Agrimonia gryposepala</i>	agrimony	2	2	2	0	2	L5		X		X
<i>Alisma plantago-aquatica</i>	water-plantain	2	2	2	4	2	L5		X		X
<i>Ambrosia artemisiifolia</i>	common ragweed	2	1	1	3	0	L5		X		X
<i>Amphicarpaea bracteata</i>	hog-peanut	2	2	2	2	2	L5		X		X
<i>Anemone canadensis</i>	Canada anemone	2	2	2	2	2	L5		X		X
<i>Anemone virginiana</i>	common thimbleweed	2	3	3	0	3	L5		X		X
<i>Apocynum cannabinum</i>	hemp dogbane	2	2	2	2	2	L5		X		X
<i>Aralia nudicaulis</i>	wild sarsaparilla	2	3	3	1	4	L5		X		X
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	1	3	3	2	3	L5		X		X
<i>Asclepias syriaca</i>	common milkweed	2	2	2	0	2	L5		X		X
<i>Aster cordifolius</i>	heart-leaved aster	2	1	1	0	2	L5		X		X
<i>Aster ericoides</i> ssp. <i>ericoides</i>	heath aster	2	1	1	2	1	L5		X		X
<i>Aster lanceolatus</i> ssp. <i>lanceolatus</i>	panicled aster	1	2	2	3	1	L5		X		X
<i>Aster lateriflorus</i> var. <i>lateriflorus</i>	calico aster	2	2	2	3	2	L5		X		X
<i>Aster novae-angliae</i>	New England aster	1	2	2	2	1	L5		X		X
<i>Aster puniceus</i> var. <i>puniceus</i>	swamp aster	2	2	2	2	2	L5		X		X
<i>Athyrium filix-femina</i> var. <i>angustum</i>	northeastern lady fern	2	3	3	1	3	L5		X		X
<i>Bidens cernuus</i>	nodding bur-marigold	2	2	2	3	3	L5		X		X
<i>Bidens frondosus</i>	common beggar's-ticks	2	1	1	4	0	L5		X		X
<i>Calystegia sepium</i>	hedge bindweed	3	2	2	3	2	L5		X		X
<i>Carex bebbii</i>	Bebb's sedge	2	2	2	3	3	L5		X		X
<i>Carex blanda</i>	common wood sedge	2	2	2	1	2	L5		X		X
<i>Carex cristatella</i>	crested sedge	2	2	2	4	1	L5		X		X
<i>Carex granularis</i>	meadow sedge	2	2	2	1	3	L5		X		X

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank	
		1 - 5	1 - 5	1 - 5	1 - 5	0 - 5	0 - 5	0 - 5	0 - 5	2001-02	2008
<i>Carex radiata</i>	straight-styled sedge	2	2	2	2	2	2	2	2	L5	X
<i>Carex rosea</i>	curly-styled sedge	2	2	2	2	3	3	2	2	L5	X
<i>Carex stipata</i>	awl-fruited sedge	2	2	3	3	2	2	3	3	L5	X
<i>Carex vulpinoidea</i>	fox sedge	2	2	2	2	4	4	1	1	L5	X
<i>Cicuta maculata</i>	spotted water-hemlock	2	2	2	2	2	2	2	2	L5	X
<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	enchanter's nightshade	2	2	1	1	1	1	1	1	L5	X
<i>Clematis virginiana</i>	virgin's bower	2	2	2	2	2	2	3	3	L5	X
<i>Clinopodium vulgare</i>	wild basil	3	3	3	3	1	1	3	3	L5	X
<i>Coryza canadensis</i>	horse-weed	3	3	1	1	2	2	0	0	L5	X
<i>Cornus alternifolia</i>	alternate-leaved dogwood	2	2	2	2	2	2	1	1	L5	X
<i>Cornus foemina</i> ssp. <i>racemosa</i>	grey dogwood	2	2	2	2	4	4	2	2	L5	X
<i>Cornus stolonifera</i>	red osier dogwood	1	1	2	2	0	0	3	3	L5	X
<i>Crataegus punctata</i>	dotted hawthorn	2	2	2	2	3	3	3	3	L5	X
<i>Cryptotaenia canadensis</i>	honeysuckle	2	2	2	2	4	4	1	1	L5	X
<i>Desmodium canadense</i>	showy tick-trefoil	2	2	2	2	3	3	3	3	L5	X
<i>Dryopteris carthusiana</i>	spinulose wood fern	2	2	3	3	2	2	2	2	L5	X
<i>Echinocystis lobata</i>	wild cucumber	2	2	2	2	3	3	1	1	L5	X
<i>Eleocharis erythropoda</i>	creeping spike-rush	2	2	2	2	4	4	1	1	L5	X
<i>Elymus virginicus</i> var. <i>virginicus</i>	Virginia wild rye	2	2	2	2	3	3	2	2	L5	X
<i>Epilobium ciliatum</i> ssp. <i>ciliatum</i>	sticky willow-herb	2	2	2	2	2	2	2	2	L5	X
<i>Equisetum arvense</i>	field horsetail	1	1	2	2	1	1	1	1	L5	X
<i>Equisetum hyemale</i> ssp. <i>affine</i>	scouring rush	2	2	2	2	2	2	2	2	L5	X
<i>Erigeron annuus</i>	daisy fleabane	2	2	2	2	0	0	1	1	L5	X
<i>Erigeron philadelphicus</i> ssp. <i>philadelphicus</i>	Philadelphia fleabane	2	2	2	2	0	0	1	1	L5	X
<i>Erigeron strigosus</i>	rough fleabane	3	3	2	2	1	1	1	1	L5	X
<i>Erythronium americanum</i> ssp. <i>americanum</i>	yellow trout-lily	2	2	3	3	3	3	2	2	L5	X
<i>Eupatorium maculatum</i> ssp. <i>maculatum</i>	spotted Joe-Pye weed	2	2	2	2	3	3	3	3	L5	X
<i>Eupatorium rugosum</i>	white snakeroot	2	2	2	2	2	2	1	1	L5	X
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	2	2	1	1	4	4	1	1	L5	X
<i>Fragaria vesca</i> ssp. <i>americana</i>	woodland strawberry	3	3	2	2	2	2	2	2	L5	X
<i>Fragaria virginiana</i>	wild strawberry	2	2	2	2	0	0	2	2	L5	X
<i>Fraxinus americana</i>	white ash	1	1	2	2	0	0	3	3	L5	X
<i>Fraxinus pennsylvanica</i> var. <i>pennsylvanica</i>	red ash	2	2	2	2	2	2	3	3	L5	X
<i>Fraxinus pennsylvanica</i> var. <i>subintegerrima</i>	green ash	2	2	2	2	2	2	3	3	L5	X

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank	
		1 - 5	1 - 5	1 - 5	1 - 5	0 - 5	0 - 5	0 - 5	0 - 5	2001-02	2008
<i>Galium palustre</i>	marsh bedstraw	2	2	2	3					X	X
<i>Galium triflorum</i>	sweet-scented bedstraw	2	2	2	2					X	X
<i>Geum aleppicum</i>	yellow avens	2	3	3	2					X	X
<i>Geum canadense</i>	white avens	2	2	2	1					X	X
<i>Glyceria striata</i>	fowl manna grass	2	2	2	1					X	X
<i>Hackelia virginiana</i>	Virginia stickseed	2	2	2	0					X	X
<i>Heracleum lanatum</i>	cow-parsnip	3	2	2	3					X	X
<i>Hydrophyllum virginianum</i>	Virginia waterleaf	2	2	2	1					X	X
<i>Impatiens capensis</i>	orange touch-me-not	1	2	2	0					X	X
<i>Juglans nigra</i>	black walnut	2	1	1	2					X	X
<i>Juncus articulatus</i>	jointed rush	2	2	2	4					X	X
<i>Juncus dudleyi</i>	Dudley's rush	2	2	2	3					X	X
<i>Juncus tenuis</i>	path rush	2	2	2	1					X	X
<i>Juniperus virginiana</i>	red cedar	2	1	1	4					X	X
<i>Laportea canadensis</i>	wood nettle	2	3	3	2					X	X
<i>Leersia oryzoides</i>	rice cut grass	2	2	2	3					X	X
<i>Lemna minor</i>	common duckweed	2	2	2	4					X	X
<i>Lysimachia ciliata</i>	fringed loosestrife	2	2	2	2					X	X
<i>Matantherum racemosum</i> ssp. <i>racemosum</i>	false Solomon's seal	2	3	3	2					X	X
<i>Matantherum stellatum</i>	starry false Solomon's seal	2	2	2	1					X	X
<i>Matteuccia struthiopteris</i> var. <i>pensylvanic</i>	ostrich fern	1	2	2	2					X	X
<i>Mentha arvensis</i> ssp. <i>borealis</i>	wild mint	2	2	2	3					X	X
<i>Muhlenbergia mexicana</i> var. <i>mexicana</i>	common muhly grass	3	2	2	0					X	X
<i>Oenothera biennis</i>	common evening-primrose	2	1	1	1					X	X
<i>Onoclea sensibilis</i>	sensitive fern	2	3	3	1					X	X
<i>Ostrya virginiana</i>	ironwood	2	3	3	2					X	X
<i>Panicum capillare</i>	panic grass	3	1	1	4					X	X
<i>Parthenocissus inserta</i>	thicket creeper	1	2	2	0					X	X
<i>Phryma leptostachya</i>	lopseed	2	2	2	3					X	X
<i>Pilea pumila</i>	dwarf clearweed	2	2	2	1					X	X
<i>Plantago rugelii</i>	red-stemmed plantain	2	2	2	0					X	X
<i>Poa palustris</i>	fowl meadow-grass	2	2	2	3					X	X
<i>Podophyllum peltatum</i>	May-apple	1	3	3	3					X	X
<i>Polygonum lapathifolium</i> var. <i>lapathifolium</i>	pale smartweed	2	1	1	4					X	X

Appendix 1: List of Flora Species Found in Glen Major Study Area in 2001, 2002 and 2008

Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank	
		1 - 5	Distribution	1 - 5	Trend	0 - 5	Dependence	0 - 5	Development	2001-02	2008
<i>Populus balsamifera</i> ssp. <i>balsamifera</i>	balsam poplar	1		2		3		2	L5	X	X
<i>Populus deltoides</i>	cottonwood	2		1		4		1	L5	X	
<i>Populus tremuloides</i>	trembling aspen	1		3		1		3	L5	X	X
<i>Prenanthes altissima</i>	tall wood lettuce	2		3		2		2	L5	X	X
<i>Prunus serotina</i>	black cherry	2		2		0		2	L5	X	X
<i>Prunus virginiana</i> ssp. <i>virginiana</i>	choke cherry	1		2		0		1	L5	X	X
<i>Ranunculus abortivus</i>	kidney-leaved buttercup	2		3		1		2	L5	X	X
<i>Ranunculus recurvatus</i> var. <i>recurvatus</i>	hooked buttercup	2		3		2		3	L5	X	
<i>Ranunculus sceleratus</i>	Cursed Crowfoot	2		2		3		2	L5	X	
<i>Rhus radicans</i> ssp. <i>rydbergii</i>	poison ivy (shrub form)	2		2		0		2	L5	X	X
<i>Rhus typhina</i>	staghorn sumach	2		1		2		2	L5	X	X
<i>Ribes americanum</i>	wild black currant	2		3		2		2	L5	X	
<i>Ribes cynosbati</i>	prickly gooseberry	2		3		2		2	L5	X	X
<i>Rubus allegheniensis</i>	common blackberry	2		3		0		1	L5	X	X
<i>Rubus idaeus</i> ssp. <i>melanolasius</i>	wild red raspberry	1		1		0		1	L5	X	X
<i>Rubus occidentalis</i>	wild black raspberry	2		1		0		1	L5	X	
<i>Rubus odoratus</i>	purple-flowering raspberry	2		2		2		2	L5	X	X
<i>Salix eriocephala</i>	narrow heart-leaved willow	2		1		3		1	L5	X	X
<i>Salix exigua</i>	sandbar willow	2		1		5		2	L5	X	X
<i>Sambucus canadensis</i>	common elderberry	2		3		2		2	L5	X	X
<i>Sambucus racemosa</i> ssp. <i>pubens</i>	red-berried elder	2		3		2		2	L5	X	X
<i>Sanguinaria canadensis</i>	bloodroot	2		3		0		3	L5	X	X
<i>Scirpus atrovirens</i>	black-fruited bulrush	2		2		4		2	L5	X	X
<i>Scutellaria galericulata</i>	common skullcap	3		2		3		2	L5	X	X
<i>Scutellaria lateriflora</i>	mad-dog skullcap	2		2		3		3	L5	X	
<i>Smilax herbacea</i>	carion-flower	3		3		2		2	L5	X	X
<i>Solidago altissima</i>	tall goldenrod	1		2		0		0	L5	X	X
<i>Solidago caesia</i>	blue-stemmed goldenrod	2		2		4		2	L5	X	X
<i>Solidago canadensis</i> var. <i>canadensis</i>	Canada goldenrod	2		2		0		1	L5	X	X
<i>Solidago flexicaulis</i>	zig-zag goldenrod	2		1		3		2	L5	X	X
<i>Solidago gigantea</i>	late goldenrod	2		1		1		1	L5	X	X
<i>Solidago nemoralis</i> ssp. <i>nemoralis</i>	grey goldenrod	2		2		2		2	L5	X	X
<i>Thalictrum dioicum</i>	early meadow rue	2		3		3		2	L5	X	X
<i>Thalictrum pubescens</i>	tall meadow rue	2		3		2		2	L5	X	X

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Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank		
		1 - 5	Distribution	1 - 5	Trend	0 - 5	Dependence	0 - 5	Development	TRCA 2008	2001-02	2008
<i>Tilia americana</i>	basswood	1		4		2		3	L5	X		X
<i>Ulmus americana</i>	white elm	1		4		0		2	L5	X		X
<i>Urtica dioica ssp. gracilis</i>	American stinging nettle	2		3		2		2	L5	X		X
<i>Verbena hastata</i>	blue vervain	2		2		4		2	L5	X		
<i>Verbena urticifolia</i>	white vervain	2		2		2		2	L5	X		X
<i>Viburnum lentago</i>	nannyberry	2		3		1		2	L5	X		X
<i>Viola conspersa</i>	dog violet	2		2		0		2	L5	X		X
<i>Viola pubescens</i>	stemmed yellow violet	2		3		1		2	L5	X		X
<i>Viola sororia</i>	common blue violet	2		2		0		2	L5	X		X
<i>Vitis riparia</i>	riverbank grape	1		1		0		0	L5	X		X
<i>Xanthium strumarium</i>	clotbur	3		1		4		0	L5	X		
<i>Dryopteris x boottii</i>	Boott's wood fern	5							LH	X		
<i>Cynoglossum boreale</i>	northern hound's tongue	5		5		3		4	LX	X		
<i>Acer platanoides</i>	Norway maple	3		0		0		0	L+	X		
<i>Achillea ptarmica</i>	sneezeweed yarrow	5		0		0		0	L+	X		
<i>Aegopodium podagraria</i>	goutweed	4		0		0		0	L+	X		
<i>Aesculus hippocastanum</i>	horse-chestnut	4		0		0		0	L+	X		
<i>Agrostis gigantea</i>	redtop	3		0		0		0	L+	X		
<i>Ajuga reptans</i>	common bugle	5		0		0		0	L+	X		
<i>Alliaria petiolata</i>	garlic mustard	2		0		0		0	L+	X		X
<i>Alnus glutinosa</i>	European alder	4		0		0		0	L+	X		
<i>Alopecurus pratensis</i>	meadow foxtail	5		0		0		0	L+	X		
<i>Amaranthus retroflexus</i>	red-root pigweed	4		0		0		0	L+	X		
<i>Anthemis cotula</i>	stinking mayweed	5		0		0		0	L+	X		
<i>Arctium lappa</i>	great burdock	3		0		0		0	L+	X		X
<i>Arctium minus ssp. minus</i>	common burdock	3		0		0		0	L+	X		X
<i>Arenaria serpyllifolia</i>	thyme-leaved sandwort	5		0		0		0	L+	X		
<i>Artemisia vulgaris</i>	common mugwort	4		0		0		0	L+	X		
<i>Asparagus officinalis</i>	asparagus	4		0		0		0	L+	X		X
<i>Barbarea vulgaris</i>	winter cress	3		0		0		0	L+	X		
<i>Berberis thunbergii</i>	Japanese barberry	4		0		0		0	L+	X		X
<i>Brassica nigra</i>	black mustard	5							L+	X		
<i>Brassica oleracea</i>	kale	5							L+	X		
<i>Bromus inermis ssp. inermis</i>	smooth brome grass	3		0		0		0	L+	X		X

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Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank		
		1 - 5	Distribution	1 - 5	Trend	0 - 5	Dependence	0 - 5	Development	TRCA 2008	2001-02	2008
<i>Festuca arundinacea</i>	tall fescue	5								L+	X	
<i>Festuca pratensis</i>	meadow fescue	3		0		0		0		L+		X
<i>Festuca rubra ssp. rubra</i>	red fescue	3		0		0		0		L+		X
<i>Galeopsis tetrahit</i>	hemp-nettle	4		0		0		0		L+	X	
<i>Galinsoga parviflora</i>	small-flowered galinsoga	5								L+	X	
<i>Galium mollugo</i>	white bedstraw	3		0		0		0		L+	X	
<i>Galium verum</i>	yellow bedstraw	4		0		0		0		L+	X	
<i>Geum urbanum</i>	urban avens	3		0		0		0		L+		X
<i>Glechoma hederacea</i>	creeping Charlie	3		0		0		0		L+	X	
<i>Glyceria maxima</i>	giant manna grass	5								L+	X	
<i>Hemerocallis fulva</i>	orange day-lily	4		0		0		0		L+	X	
<i>Hesperis matronalis</i>	dame's rocket	2		0		0		0		L+	X	
<i>Hieracium aurantiacum</i>	orange hawkweed	4		0		0		0		L+	X	
<i>Hieracium caespitosum ssp. caespitosum</i>	yellow hawkweed	3		0		0		0		L+	X	
<i>Hieracium pilosella</i>	mouse-ear hawkweed	5		0		0		0		L+	X	
<i>Hordeum jubatum ssp. jubatum</i>	squirrel-tail barley	4		0		0		0		L+	X	
<i>Hypericum perforatum</i>	common St. Johnswort	3		0		0		0		L+	X	
<i>Inula helenium</i>	elecampane	3		0		0		0		L+	X	
<i>Ipomoea hederacea</i>	ivy-leaved morning-glory	5								L+	X	
<i>Ipomoea purpurea</i>	common morning-glory	5								L+	X	
<i>Iris pseudacorus</i>	yellow flag	4		0		0		0		L+	X	
<i>Juncus compressus</i>	round-fruited rush	4		0		0		0		L+	X	
<i>Kochia scoparia</i>	summer-cypress	5		0		0		0		L+	X	
<i>Lactuca serriola</i>	prickly lettuce	3		0		0		0		L+	X	
<i>Larix decidua</i>	European larch	4		0		0		0		L+	X	
<i>Lathyrus latifolius</i>	everlasting pea	4		0		0		0		L+	X	
<i>Leontodon autumnalis ssp. autumnalis</i>	fall hawkbit	5								L+	X	
<i>Leonurus cardiaca ssp. cardiaca</i>	motherwort	3		0		0		0		L+	X	
<i>Linaria vulgaris</i>	butter-and-eggs	3		0		0		0		L+		
<i>Lithospermum officinale</i>	Eurasian gromwell	4		0		0		0		L+	X	
<i>Lolium perenne</i>	perennial rye	4		0		0		0		L+	X	
<i>Lonicera morrowii</i>	Morrow's honeysuckle	3		0		0		0		L+	X	
<i>Lonicera tatarica</i>	Tartarian honeysuckle	4		0		0		0		L+	X	
<i>Lonicera x bella</i>	shrub honeysuckle	3		0		0		0		L+	X	

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Scientific Name	Common Name	Local Distribution		Population Trend		Habitat Dependence		Sensitivity to Development		Rank	
		1 - 5	1 - 5	1 - 5	1 - 5	0 - 5	0 - 5	0 - 5	0 - 5	TRCA 2001-02	2008
<i>Lonicera xylosteum</i>	European fly honeysuckle		4		0		0		0	L+	X
<i>Lotus corniculatus</i>	bird's foot trefoil		3		0		0		0	L+	X
<i>Lysimachia nummularia</i>	moneywort		4		0		0		0	L+	X
<i>Lythrum salicaria</i>	purple loosestrife		3		0		0		0	L+	X
<i>Malus pumila</i>	apple		2		0		0		0	L+	X
<i>Malva moschata</i>	musk mallow		5		0		0		0	L+	X
<i>Malva neglecta</i>	common mallow		5		0		0		0	L+	X
<i>Matricaria matricarioides</i>	pineappleweed		5		0		0		0	L+	X
<i>Medicago lupulina</i>	black medick		3		0		0		0	L+	X
<i>Medicago sativa ssp. sativa</i>	alfalfa		3		0		0		0	L+	X
<i>Melilotus alba</i>	white sweet clover		3		0		0		0	L+	X
<i>Melilotus officinalis</i>	yellow sweet clover		3		0		0		0	L+	X
<i>Mentha spicata</i>	spear mint		4		0		0		0	L+	X
<i>Morus alba</i>	white mulberry		4		0		0		0	L+	X
<i>Myosotis scorpioides</i>	true forget-me-not		3		0		0		0	L+	X
<i>Myosoton aquaticum</i>	giant chickweed		5							L+	X
<i>Nasturtium microphyllum</i>	small-leaved watercress		4		0		0		0	L+	X
<i>Nepeta cataria</i>	catnip		3		0		0		0	L+	X
<i>Papaver orientale</i>	oriental poppy		5							L+	X
<i>Pastinaca sativa</i>	wild parsnip		4		0		0		0	L+	X
<i>Phleum pratense</i>	timothy grass		3		0		0		0	L+	X
<i>Picea abies</i>	Norway spruce		5		0		0		0	L+	X
<i>Pinus banksiana</i>	Jack pine		5		0		0		0	L+	X
<i>Pinus sylvestris</i>	Scots pine		3		0		0		0	L+	X
<i>Plantago lanceolata</i>	English plantain		4		0		0		0	L+	X
<i>Plantago major</i>	common plantain		3		0		0		0	L+	X
<i>Poa compressa</i>	Canada blue grass		3		0		0		0	L+	X
<i>Poa nemoralis</i>	woodland spear grass		4		0		0		0	L+	X
<i>Poa pratensis ssp. pratensis</i>	Kentucky blue grass		3		0		0		0	L+	X
<i>Poa trivialis</i>	rough blue grass		5							L+	X
<i>Polygonum persicaria</i>	lady's thumb		3		0		0		0	L+	X
<i>Populus alba</i>	white poplar (including cultivars)		4		0		0		0	L+	X
<i>Potentilla argentea</i>	silvery cinquefoil		5		0		0		0	L+	X
<i>Potentilla recta</i>	sulphur cinquefoil		3		0		0		0	L+	X

Appendix 2: List of Mapped Invasive Species

Scientific Name	Common Name	Occurrences
<i>Acer negundo</i>	Manitoba maple	9
<i>Acer platanoides</i>	Norway maple	0
<i>Aegopodium podagraria</i>	goutweed or herb-Gerard	0
<i>Alliaria petiolata</i>	Garlic mustard	38
<i>Betula pendula</i>	European white birch	0
<i>Celastrus orbiculatus</i>	oriental or Asiatic bittersweet	0
<i>Centaurea maculosa</i>	spotted knapweed	1
<i>Cirsium arvense</i>	creeping (Canada) thistle	0
<i>Convallaria majalis</i>	lily-of-the-valley	0
<i>Coronilla varia</i>	crown vetch	0
<i>Cynanchum rossicum</i>	dog-strangling vine	90
<i>Elaeagnus angustifolia</i>	Russian olive	3
<i>Elaeagnus umbellata</i>	autumn olive	3
<i>Euonymus europaea</i>	European spindle-tree	0
<i>Galium verum</i>	yellow bedstraw	1
<i>Geum urbanum</i>	urban avens	3
<i>Glyceria maxima</i>	giant manna grass	0
<i>Hesperis matronalis</i>	dame's rocket	1
<i>Hydrocharis morsus-ranae</i>	European frog-bit	0
<i>Impatiens glandulifera</i>	Himalayan balsam	0
<i>Lonicera morrowii</i>	Morrow's honeysuckle	0
<i>Lonicera tatarica</i>	Tartarian honeysuckle	4
<i>Lonicera x bella</i>	shrub honeysuckle	4
<i>Lonicera xylosteum</i>	European fly honeysuckle	0
<i>Lythrum salicaria</i>	purple loosestrife	3
<i>Melilotus alba</i>	white sweet clover	21
<i>Myriophyllum spicatum</i>	Eurasian water-milfoil	0
<i>Phalaris arundinacea</i>	reed canary grass	8
<i>Phragmites australis</i>	common reed	2
<i>Pinus sylvestris</i>	Scots pine	2
<i>Polygonum cuspidatum</i>	Japanese knotweed	3
<i>Potamogeton crispus</i>	curly pondweed	0
<i>Rhamnus cathartica</i>	common buckthorn	102
<i>Rhamnus frangula</i>	glossy buckthorn	0
<i>Robinia pseudoacacia</i>	black locust	3
<i>Rosa multiflora</i>	multiflora rose	14
<i>Scilla siberica</i>	Siberian squill	0
<i>Typha angustifolia</i>	narrow-leaved cattail	0
<i>Typha x glauca</i>	hybrid cattail	1
<i>Ulmus pumila</i>	Siberian elm	0
<i>Urtica dioica</i> ssp. <i>dioica</i>	European stinging nettle	0
<i>Vinca minor</i>	periwinkle	1

Appendix 3: Fauna Species List for 2008 Glen Major Study Area.

Common Name	Code	Scientific Name	LO	PTn	PTt	AS	PIS	HD	StD	+	TS	L-Rank	2008
Survey Species: species for which the TRCA protocol effectively surveys.													
Birds													
barred owl	BADO	<i>Strix varia</i>	4	2	3	5	2	3	4	1	24	L2	X
black and white warbler	BAWW	<i>Mniotilta varia</i>	1	3	2	4	2	2	5	1	20	L2	X
blue-winged warbler	BWBA	<i>Vermivora pinus</i>	3	3	2	3	1	2	5	1	20	L2	X
broad-winged hawk	BWHA	<i>Buteo platypterus</i>	3	2	3	5	1	4	3	1	22	L2	X
golden-winged warbler	GWWA	<i>Vermivora chrysoptera</i>	4	3	3	3	1	2	5	1	22	L2	X
grasshopper sparrow	GRSP	<i>Ammodramus savannarum</i>	3	4	3	2	2	3	3	0	20	L2	X
hooded warbler	HOWA	<i>Wilsonia citrina</i>	4	1	1	4	1	3	5	1	20	L2	X
red-shouldered hawk	RSHA	<i>Buteo lineatus</i>	3	2	3	5	1	4	3	1	22	L2	X
American redstart	AMRE	<i>Setophaga ruticilla</i>	1	2	2	3	1	2	4	0	15	L3	X
American woodcock	AMWO	<i>Scolopax minor</i>	0	2	3	3	2	2	4	0	16	L3	X
black-billed cuckoo	BBCU	<i>Coccyzus erythrophthalmus</i>	0	3	2	3	1	3	3	0	15	L3	X
Blackburnian warbler	BLBW	<i>Dendroica fusca</i>	3	1	2	3	1	4	4	0	18	L3	X
black-throated blue warbler	BTBW	<i>Dendroica caerulescens</i>	4	2	2	3	1	3	4	0	19	L3	X
black-throated green warbler	BTNW	<i>Dendroica virens</i>	1	4	2	3	1	3	4	0	18	L3	X
blue-headed vireo	BHVI	<i>Vireo solitarius</i>	3	2	2	3	1	2	3	0	16	L3	X
bobolink	BOBO	<i>Dolichonyx oryzivorus</i>	0	3	3	3	1	1	5	1	17	L3	X
brown creeper	BRCR	<i>Certhia americana</i>	1	2	2	3	2	2	4	0	16	L3	X
brown thrasher	BRTH	<i>Toxostoma rufum</i>	0	3	3	2	2	1	4	0	15	L3	X
chestnut-sided warbler	CSWA	<i>Dendroica pensylvanica</i>	2	2	2	3	1	1	4	0	15	L3	X
clay-coloured sparrow	CCSP	<i>Spizella pallida</i>	3	3	2	2	1	1	4	0	16	L3	X
eastern towhee	EATO	<i>Pipilo erythrophthalmus</i>	2	3	2	2	2	1	4	0	16	L3	X
magnolia warbler	MAWA	<i>Dendroica magnolia</i>	4	2	2	2	1	3	3	0	17	L3	X
mourning warbler	MOWA	<i>Oporornis philadelphia</i>	0	3	2	2	2	2	4	0	15	L3	X
Nashville warbler	NAWA	<i>Vermivora ruficapilla</i>	2	1	2	2	1	2	5	1	16	L3	X
northern harrier	NOHA	<i>Circus cyaneus</i>	2	3	2	4	1	3	3	0	18	L3	X
northern waterthrush	NOWA	<i>Seiurus noveboracensis</i>	1	2	2	3	1	4	5	1	19	L3	X
ovenbird	OVEN	<i>Seiurus aurocapillus</i>	0	2	3	4	2	4	4	0	19	L3	X
pileated woodpecker	PIWO	<i>Dryocopus pileatus</i>	0	2	2	4	1	3	3	0	15	L3	X
pine warbler	PIWA	<i>Dendroica pinus</i>	1	2	2	4	1	3	3	0	16	L3	X
red-headed woodpecker	RHWO	<i>Melanerpes erythrocephalus</i>	3	3	4	2	1	2	2	0	17	L3	X
scarlet tanager	SCTA	<i>Piranga oiivacea</i>	1	2	2	4	1	3	4	0	17	L3	X
sedge wren	SEWR	<i>Cistothorus platensis</i>	3	2	2	3	3	1	4	0	18	L3	X

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Common Name	Code	Scientific Name	LO	PTn	PTt	AS	PIS	HD	STD	+	TS	L-Rank	2008
sharp-shinned hawk	SSHA	<i>Accipiter striatus</i>	1	2	2	4	1	3	3	0	16	L3	X
veery	VEER	<i>Catharus fuscescens</i>	1	3	2	3	1	2	5	1	18	L3	X
Virginia Rail	VIRA	<i>Rallus limicola</i>	0	2	2	2	3	2	4	0	15	L3	X
wild turkey	WITU	<i>Meleagris gallopavo</i>	2	1	0	4	3	4	3	0	17	L3	X
wood thrush	WOTH	<i>Hylocichla mustelina</i>	0	3	2	3	2	2	4	0	16	L3	X
yellow-bellied sapsucker	YBSA	<i>Sphyrapicus varius</i>	4	2	2	2	1	3	3	0	17	L3	X
yellow-billed cuckoo	YBCU	<i>Coccyzus americanus</i>	2	3	2	3	1	3	3	0	17	L3	X
yellow-rumped warbler	YRWA	<i>Dendroica coronata</i>	3	1	2	3	1	2	4	0	16	L3	X
alder flycatcher	ALFL	<i>Empidonax alhorum</i>	1	2	2	1	1	2	4	0	13	L4	X
American kestrel	AMKE	<i>Falco sparverius</i>	2	2	2	1	1	2	0	0	10	L4	X
bank swallow	BANS	<i>Riparia riparia</i>	1	3	2	1	1	3	3	0	14	L4	X
barn swallow	BARS	<i>Hirundo rustica</i>	0	2	3	1	1	2	1	0	10	L4	X
common yellowthroat	COYE	<i>Geothlypis trichas</i>	0	2	2	1	2	1	4	0	12	L4	X
Cooper's hawk	COHA	<i>Accipiter cooperii</i>	0	2	1	4	1	3	2	0	13	L4	X
eastern bluebird	EABL	<i>Sialia sialis</i>	3	2	2	2	1	2	2	0	14	L4	X
eastern kingbird	EAKI	<i>Tyrannus tyrannus</i>	0	4	2	2	1	1	3	0	13	L4	X
eastern meadowlark	EAME	<i>Sturnella magna</i>	0	3	2	3	1	1	3	0	13	L4	X
eastern wood-pewee	EAWP	<i>Contopus virens</i>	0	4	2	2	1	1	3	0	13	L4	X
field sparrow	FISP	<i>Spizella pusilla</i>	0	3	2	2	1	1	4	0	13	L4	X
great-crested flycatcher	GCFL	<i>Myiarchus crinitus</i>	0	2	2	3	1	2	2	0	12	L4	X
great-horned owl	GHOW	<i>Bubo virginianus</i>	1	2	2	2	2	1	2	0	12	L4	X
grey catbird	GRCA	<i>Dumetella carolinensis</i>	0	2	2	1	1	1	3	0	10	L4	X
hairy woodpecker	HAWO	<i>Picoides villosus</i>	0	2	2	3	1	2	2	0	12	L4	X
indigo bunting	INBU	<i>Passerina cyanea</i>	0	2	2	1	1	2	4	0	12	L4	X
least flycatcher	LEFL	<i>Empidonax minimus</i>	1	4	2	2	1	1	3	0	14	L4	X
northern flicker	NOFL	<i>Colaptes auratus</i>	0	3	2	1	1	2	3	0	12	L4	X
purple finch	PUFI	<i>Carpodacus purpureus</i>	3	4	2	1	1	0	1	0	12	L4	X
red-breasted nuthatch	RBNU	<i>Sitta canadensis</i>	0	1	2	3	1	1	2	0	10	L4	X
red-eyed vireo	REVI	<i>Vireo olivaceus</i>	0	2	2	2	1	1	3	0	11	L4	X
rose-breasted grosbeak	RBGR	<i>Pheucticus ludovicianus</i>	0	2	2	3	1	2	3	0	13	L4	X
ruby-throated hummingbird	RTHU	<i>Archilochus colubris</i>	1	2	2	1	1	2	2	0	11	L4	X
savannah sparrow	SAVS	<i>Passerculus sandwichensis</i>	0	3	2	1	1	1	4	0	12	L4	X
swamp sparrow	SWSP	<i>Melospiza georgiana</i>	0	1	2	1	2	1	5	1	13	L4	X
tree swallow	TRES	<i>Tachycineta bicolor</i>	0	2	2	1	1	2	2	0	10	L4	X

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Common Name	Code	Scientific Name	LO	PTn	PTt	AS	PIS	HD	STD	+	TS	L-Rank	2008
turkey vulture	TUVU	<i>Cathartes aura</i>	4	1	1	1	1	2	1	0	11	L4	X
white-breasted nuthatch	WBNU	<i>Sitta carolinensis</i>	0	2	2	3	1	2	2	0	12	L4	X
American Crow	AMCR	<i>Corvus brachyrhynchos</i>	0	1	2	1	1	0	0	0	5	L5	X
American goldfinch	AMGO	<i>Carduelis tristis</i>	0	2	2	1	1	0	1	0	7	L5	X
American robin	AMRO	<i>Turdus migratorius</i>	0	1	2	1	1	0	1	0	6	L5	X
Baltimore oriole	BAOR	<i>Icterus galbula</i>	0	2	2	1	1	0	1	0	7	L5	X
black-capped chickadee	BCCH	<i>Parus atricapillus</i>	0	1	2	1	1	0	1	0	6	L5	X
blue jay	BLJA	<i>Cyanocitta cristata</i>	0	4	2	1	1	0	1	0	9	L5	X
brown-headed cowbird	BHCO	<i>Molothrus ater</i>	0	2	2	1	1	0	1	0	7	L5	X
Canada goose	CANG	<i>Branta canadensis</i>	0	1	1	1	2	1	0	0	6	L5	X
cedar waxwing	CEDW	<i>Bombycilla cedrorum</i>	0	1	2	1	1	0	1	0	6	L5	X
chipping sparrow	CHSP	<i>Spizella passerina</i>	0	2	2	1	1	0	2	0	8	L5	X
common grackle	COGR	<i>Quiscalus quiscula</i>	0	3	2	1	1	0	1	0	8	L5	X
downy woodpecker	DOWO	<i>Picoides pubescens</i>	0	3	2	1	1	1	1	0	9	L5	X
eastern phoebe	EAPH	<i>Sayornis phoebe</i>	0	2	2	1	1	2	1	0	9	L5	X
house wren	HOWR	<i>Troglodytes aedon</i>	0	2	2	1	2	1	1	0	9	L5	X
killdeer	KILL	<i>Charadrius vociferus</i>	0	2	2	1	2	0	2	0	9	L5	X
mallard	MALL	<i>Anas platyrhynchos</i>	0	2	2	1	2	0	1	0	8	L5	X
mourning dove	MODO	<i>Zenaida macroura</i>	0	2	2	1	1	0	0	0	6	L5	X
northern cardinal	NOCA	<i>Cardinalis cardinalis</i>	0	2	2	1	1	1	2	0	9	L5	X
northern mockingbird	NOMO	<i>Mimus polyglottos</i>	0	2	0	1	1	1	1	0	6	L5	X
orchard oriole	OROR	<i>Icterus spurius</i>	2	2	1	1	1	0	1	0	8	L5	X
red-tailed hawk	RTHA	<i>Buteo jamaicensis</i>	0	2	2	2	1	1	1	0	9	L5	X
red-winged blackbird	RWBL	<i>Agelaius phoeniceus</i>	0	2	2	1	1	0	2	0	8	L5	X
song sparrow	SOSP	<i>Melospiza melodia</i>	0	2	2	1	2	0	2	0	9	L5	X
warbling vireo	WAVI	<i>Vireo gilvus</i>	0	1	2	1	1	1	2	0	8	L5	X
yellow warbler	YWAR	<i>Dendroica petechia</i>	0	1	2	1	1	1	3	0	9	L5	X
European starling	EUST	<i>Sturnus vulgaris</i>										L+	X
house sparrow	HOSP	<i>Passer domesticus</i>										L+	X
ring-necked pheasant	RINP	<i>Phasianus colchicus</i>										L+	X
Herpetofauna													
grey treefrog	TGTF	<i>Hyla versicolor</i>	1	3	3	3	4	2	5	1	22	L2	X
northern spring peeper	SPPE	<i>Pseudacris crucifer crucifer</i>	0	2	3	3	4	3	5	1	21	L2	X

Appendix 4: Control Methods for Invasive Species

Dog strangling vine (*Cynanchum rossicum*)

There are no known biological controls for dog strangling vine at the present time, aside from some possible competition provided by allelopathic trees such as black walnut (*Juglans nigra*) and possibly butternut (TRCA, 2008). In many cases, threatened native ecosystem remnants may not have time to wait for a suitable biological control, and immediate action is warranted. A combination of mechanical, chemical, and barrier planting methods, depending on the site conditions, is recommended as outlined below:

- a. Where infestations of dog-strangling vine are very small and isolated, digging the whole plant including the root crown is effective. The root crown must be removed and allowed to dry out to prevent possible re-establishment.
- b. Light infestations, or those where native plants are intermingled with dog-strangling vine, should be given the wick treatment twice during the growing season with a moderately high concentration of glyphosate or similar herbicide
- c. To protect plants of special conservation concern that are in danger of being overwhelmed by heavy dog-strangling vine infestations, use the same wick application approach. A small “zone of protection” would be provided. This would be a temporary measure to preserve the native plant populations until more effective means (probably biological control) can be found.
- d. Heavy but isolated populations that are more-or-less monotypic could be sprayed with 2% glyphosate or equivalent twice per growing season (in June and August). This should be done for three years. The site should then be planted with appropriate natives and monitored to prevent reinvasion by dog-strangling vine or other invasives.

Christensen (1998) conducted experiments in a population near Toronto, ON to evaluate the effectiveness of glyphosate herbicide control on dog-strangling vine. Repeated applications of 5% glyphosate were necessary to limit the regrowth of dog-strangling vine the following year (Christensen, 1997). One to three applications were made in mid-June, early August, late August and/or in early September. Only those plots receiving applications in June plus early or late August, or in June plus early August and early September, had a reduction in cover greater than 90% the following year. Single applications of glyphosate did not provide control that was deemed satisfactory. There is a risk of other invasives replacing the dog-strangling vine if no native seed source is present to recapture the site.

Garlic mustard (*Alliaria petiolata*)

Garlic mustard should be removed as soon as it is discovered. Eradication efforts would be most successful in a small, younger stand than an older population with many individuals and a large seed bank (Drayton and Primack, 1999). Garlic mustard can be controlled by pulling the plants at any time. If this approach is not practical a weed-eater can be used to cut the plants at the base as they are in flower. This method should be done before seeds set in mid May to early June. Unfortunately garlic mustard is widespread at Glen Major. Even if the plants are removed the seeds can persist in the seed bank for a long time. These treatments may need to be repeated for up to ten years to deplete the seed bank and the next generation of plants. If plants are removed native plants such as zigzag goldenrod (*Solidago flexicaulis*), mayapple (*Podophyllum peltatum*), and bloodroot (*Sanguinaria canadensis*) can be planted into the

affected areas. Once these plants close the canopy it is less likely that garlic mustard will reinvade. If hand pulling is too time consuming glyphosate can be applied to the plants before they set seed.

Common buckthorn (*Rhamnus cathartica*)

Common buckthorn should be removed before the berries are ripe on the female trees. Male buckthorn can be removed at any time as it is less a priority. Small seedlings can be hand pulled while saplings can be dug. Larger specimens can be girdled or cut down but often they will resprout vigorously from the stump. Painting stumps with a glyphosate based herbicide will prevent the shrub from resprouting. Another method that can be used that does not involve tree cutting is the basal bark method with Garlon 4 being painted on the bark.

Manitoba maple (*Acer negundo*)

There are a number of different ways to control Manitoba maple. Seedlings and saplings can be dug up with a spade. Larger specimens can be girdled as long as they are not close to a trail. Larger trees can be cut down with a chainsaw, although they resprout vigorously. After the tree is cut a small amount of glyphosate can be painted on the stump. This should prevent resprouting as this tree is very susceptible to this chemical.