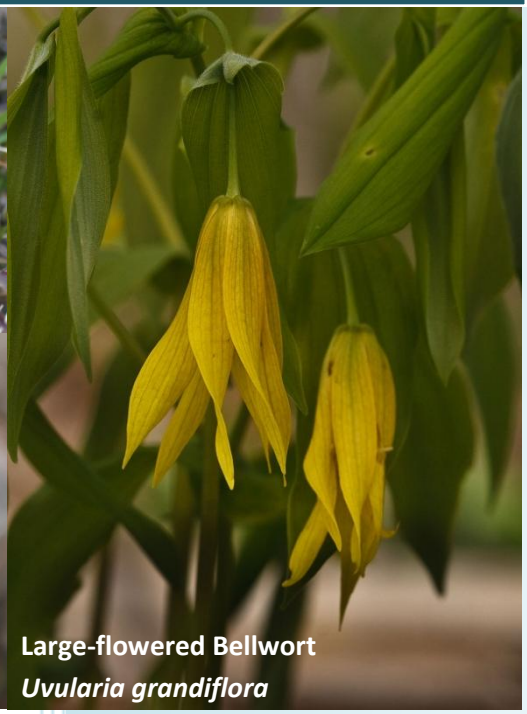
Central Lake Ontario Conservation

2011

Terrestrial Watershed Monitoring Report

Nodding Ladies Tresses
Spiranthes cernua

Slender-leaved Gerardia
Agalinis tenuifolia



Large-flowered Bellwort
Uvularia grandiflora

What we do on the land is mirrored in the water

Working In Partnership:

DURHAM REGION

Conservation ONTARIO
Natural Champions

Report No.: 2012-02MR

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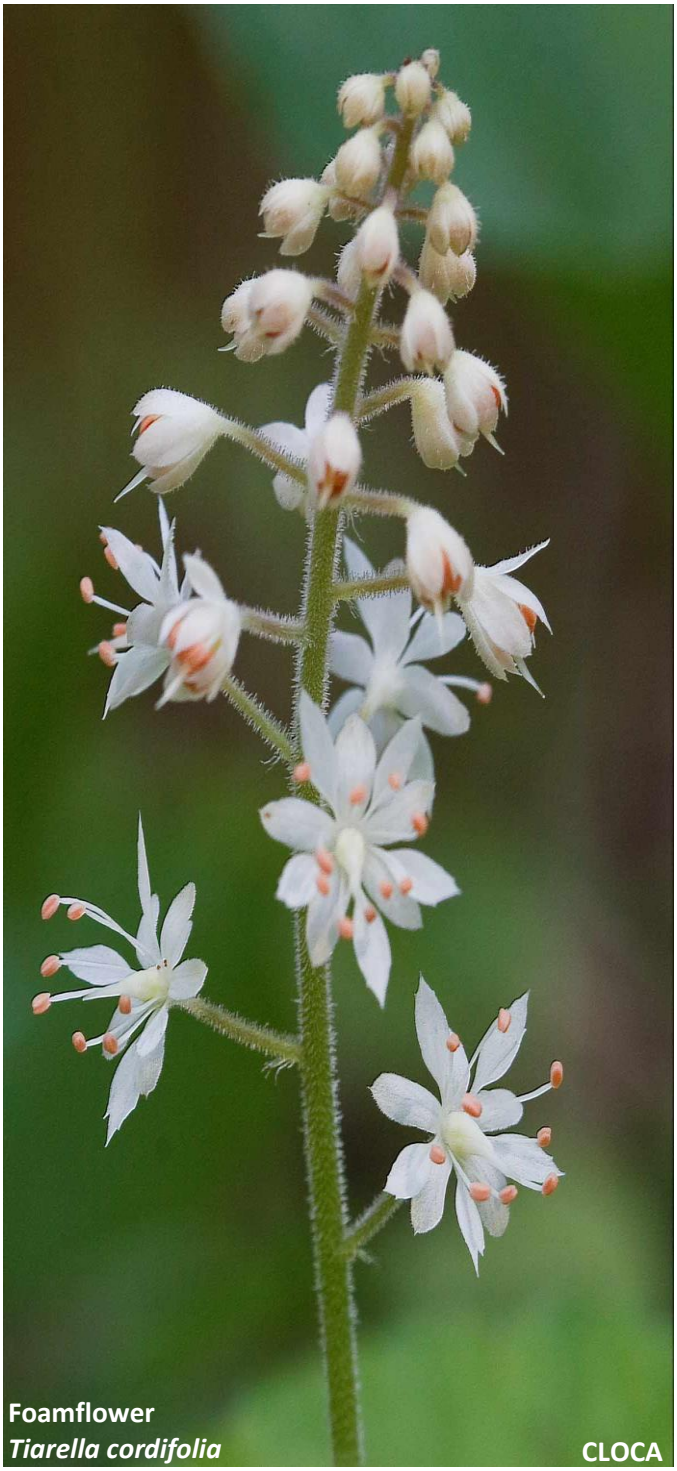
EXECUTIVE SUMMARY



In 2011 Central Lake Ontario Conservation Authority (CLOCA) staff implemented the long-term terrestrial monitoring program within the Pringle Creek watershed, and revisited plot locations within the Bowmanville/Soper Creek Watershed. The program is designed to monitor the ecological integrity of the watersheds, focusing on Forests, Wetlands and Non-forested communities. Five plots were established within Pringle Creek, with an average percent of 74%, 80% and 33% native species richness within each of the system types, respectively.

Special monitoring projects are more refined in scope and will be implemented when the need arises. These projects provide useful information on a variety of programs including the success of stewardship projects, rare plant transplants and hydrological changes in wetlands. Rare and uncommon plants were transplanted at Heber Down Conservation Area, and three of the four species planted were observed. Purple Loosestrife was also observed at Cranberry Marsh Conservation Area to assess the presence of its biological control, the Galerucella beetle. Out of 111 plants assessed, only two showed no evidence of the biological control.

1.0 INTRODUCTION

The Terrestrial Watershed Monitoring Program (TWMP) was developed to help determine and monitor the trends of the ecological integrity of terrestrial natural areas within the Central Lake Ontario Conservation Authority's jurisdiction. CLOCA has used the Parks Canada Agency's Panel (1998) definition of Ecological Integrity, "an ecosystem has integrity when it is deemed characteristic for its natural region, including the composition and abundance of native species and biological communities, rates of changes and supporting processes. In plain language, ecosystems have integrity when they have their native components (plants, animals and other organisms) and processes (such as growth and reproductions) intact."

CLOCA monitors specific ecological indicators within a select group of systems that cover the landscape of CLOCA's jurisdiction. The systems monitored are grouped according to Ecological Land Classification (ELC) categories and are described in Table 1. The indicators measured in each system are represented in Table 2.

Table 1: ELC Classification with corresponding system

Ecosystem Type	ELC Community Series Included
Forested Systems	Cultural Woodlots (CUW), Cultural Plantations (CUP), Deciduous Forests (FOD), Mixed Forests (FOM), Coniferous Forests (FOC)
Non-Coastal Wetland Systems	Deciduous Swamp (SWD), Mixed Swamp (SWM), Coniferous Swamp (SWC)
Non-Forested Systems	Cultural Thicket (CUT), Cultural Meadow (CUM)

Table 2: Ecological indicators by system

Ecosystem Type	Ecological Indicator
Forested Systems	Tree Health; Regeneration; Ground Vegetation; Biodiversity
Non-Forested Systems	Ground Vegetation; Biodiversity
Non-Coastal Wetland Systems	Tree Health; Regeneration; Ground Vegetation; Biodiversity

Alongside the regular Terrestrial Watershed Monitoring Program, special projects are taken on, and are more refined in scope. 2011 saw the start of two new projects, the monitoring of rare and uncommon transplants and an assessment of a biological control introduced at Cranberry Marsh in 1999; as well as the continuation of another project: surficial groundwater monitoring at Heber Down Provincially Significant Wetland.

2.0 TERRESTRIAL WATERSHED MONITORING

In 2011 the Terrestrial Watershed Monitoring program was implemented within the Pringle Creek watershed. In addition, Bowmanville/Soper Creek watershed plots were visited and reassessed following the Terrestrial Monitoring schedule (Figure 1).

While Pringle Creek and Bowmanville/Soper watersheds were assessed in the same year, they are very different in many respects. The Pringle Creek Watershed expands across two physiographic regions within CLOCA's jurisdiction. It is heavily urbanized, falling entirely within the boundaries of the Town of Whitby. Due to it being so urbanized and one of CLOCA's smaller watersheds, CLOCA does not own any land within it and many of the natural areas are confined to the valley lands. The Municipality of Whitby owns and manages some of the natural areas within the watershed, and has allowed CLOCA to establish monitoring plots in these areas. Coverage of the watershed is limited to 4 monitoring plots, due to the limited access to natural areas in the watershed.

On the other hand, Bowmanville/Soper Creek watershed is one of CLOCA's largest watersheds, expanding across all three major physiographic regions. CLOCA owns approximately 1150ha of land within the Bowmanville/Soper watershed, which has allowed for greater coverage in monitoring plots with a total of 17 plots. The Municipality of Clarington also owns many lands within the watershed, and has allowed CLOCA permission to install plots on their lands. These lands are often found in valleys and experience more urban pressures than the Conservation Area (CA) lands, thus providing a more thorough representation of the watershed through CLOCA's terrestrial monitoring program.

PRINGLE CREEK WATERSHED

The Pringle Creek watershed covers an approximate area of 29km^2 and is contained entirely within the Town of Whitby. The headwaters originate in the old glacial Lake Iroquois Beach and the resulting tributaries travel south towards the Lake Iroquois Lacustrine Plain, draining into Lake Ontario through Whitby Harbour.

Approximately 16% of the Pringle Creek watershed is naturally vegetated, which equates to approximately 5km^2 of the entire watershed landscape. Table 3 summarizes the representation of vegetation communities within the watershed. Forested systems and non-forested systems each account for 5% of the watersheds cover, while non-coastal wetlands account for 4%. The remaining 2% of the total watershed cover consists of submergent, emergent, and floating marshes, meadow marshes, cultural savannahs and hedgerows and open bluffs. These are not included in this monitoring program as they cover a small portion of CLOCA's overall landscape and many of the marshes are monitored through the Durham Region Coastal Wetland Monitoring Program (DRCWMP).

Table 3: Natural Cover by ELC Community Class - Pringle Creek Watershed

Monitoring System	ELC Classification	Cover (ha)	Cover as % of total natural area in watershed	% Cover as total land area in watershed
Forested System	FOD, FOC, FOM, CUP, CUW	141.41	30%	5%
Non-Forested System	CUT, CUM	136.66	29%	5%
Non-Coastal Wetlands	SWM, SWD, SWC	121.47	26%	4%
Not included in monitoring program	CUH, MAM, SAM, BLO, MAS, SAS, SWT	67.23	14%	2%
Total			**100%**	**16%**

BOWMANVILLE/SOPER CREEK WATERSHED

The Bowmanville/Soper Creek watershed is located on the east end of CLOCA's jurisdiction. It is contained entirely within the Municipality of Clarington and covers an approximate area of 169km^2. The headwaters of the Bowmanville/Soper watershed are situated within the Oak Ridges Moraine. The resulting tributaries travel south through the old glacial Lake Iroquois Beach towards the Lake Iroquois Lacustrine Plain, draining into Lake Ontario through the Bowmanville Coastal Wetland Complex.

Table 4: Natural Cover by ELC Community Class - Bowmanville/Soper Creek Watershed

Monitoring System	ELC Classification	Cover (ha)	Cover as % of total natural area in watershed	% Cover as total land area in watershed
Forested System	FOD, FOC, FOM, CUP, CUW	3374.10	54%	20%
Non-Forested System	CUT, CUM	1453.82	23%	9%
Non-Coastal Wetlands	SWM, SWD, SWC	914.13	15%	5%
Not included in monitoring program	CUH, CUS, SAF, MAM, SAM, BBO, MAS, BLS, SAS, SWT	500.21	8%	3%
Total			**100%**	**37%**

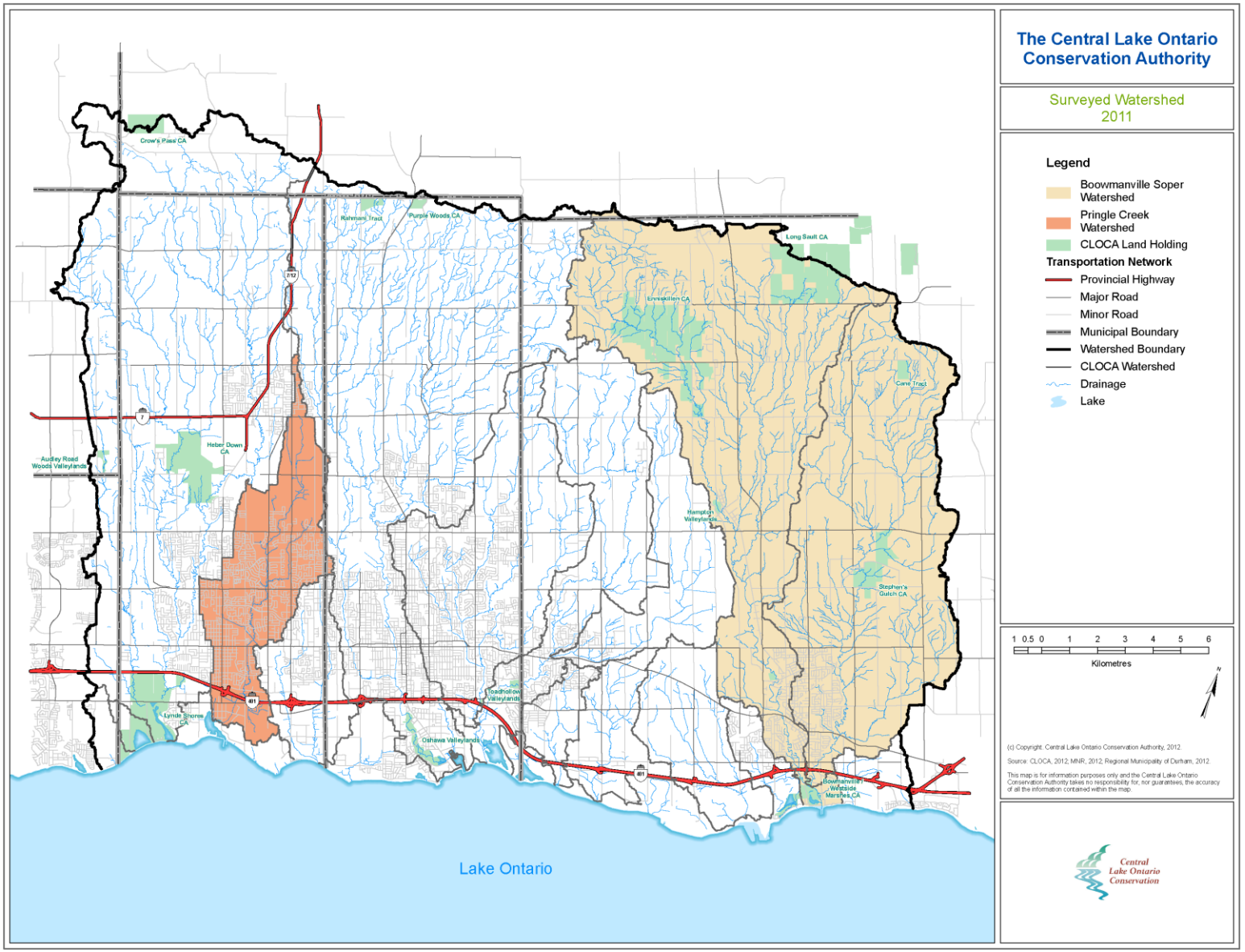


Figure 1: Pringle Creek and Bowmanville/Soper Watershed

Approximately 37% of the Bowmanville/Soper watershed is naturally vegetated, which equates to approximately 62km^2 of the entire watershed landscape. Table 4 summarizes the representation of vegetative communities within the watershed. Forested systems account for 20%, while non-forested systems and non-coastal wetlands account for 9% and 5% respectively. The remaining 3% of the total watershed cover consists of submergent, emergent, and floating shallow marshes, meadow marshes, cultural savannahs, hedgerows and thickets, open and shrub bluffs, and swamp thickets. These are not included in this monitoring protocol as they cover a very small portion of CLOCA's overall landscape and many of the marshes are monitored through the Durham Region Coastal Wetland Monitoring Program (DRCWMP). Figure 2 and Figure 3 shows the location for all the monitoring plots within the Pringle Creek watershed and the Bowmanville/Soper Creek watershed, respectively.

2.1 Forested Systems

Environment Canada (2004) recommends greater than 30% forest cover to ensure a healthy watershed, and CLOCA's goal, through its Natural Heritage System and supplementary watershed plans, strives to achieve a minimum of 30% natural cover throughout our jurisdiction. Many of these forested areas are home to a variety of animal species, and it is vital to ensure the integrity of their habitat is maintained. For this reason, tree health, regeneration, ground vegetation and invasive species were observed.

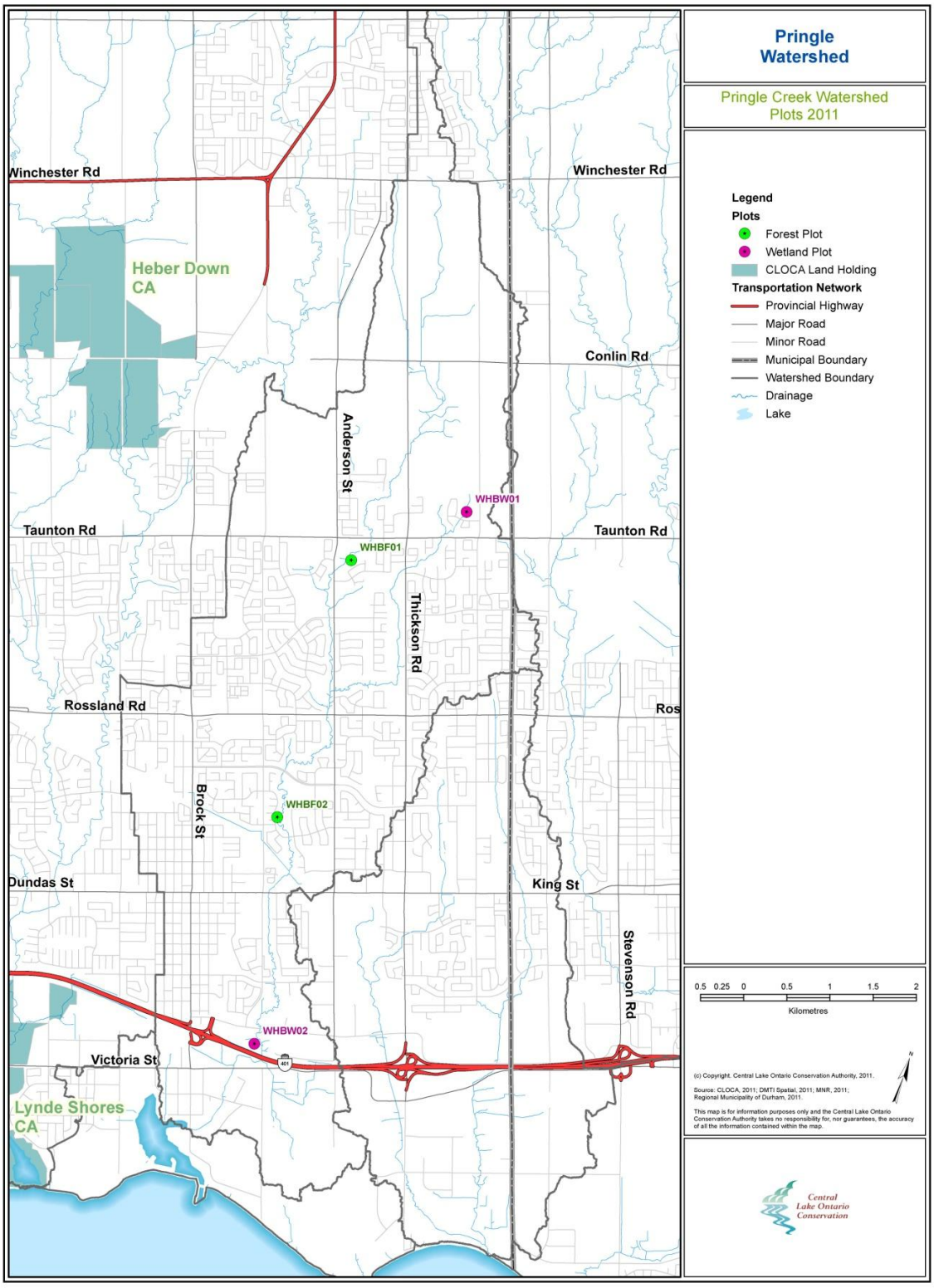


Figure 2: Pringle Creek Watershed Monitoring Locations

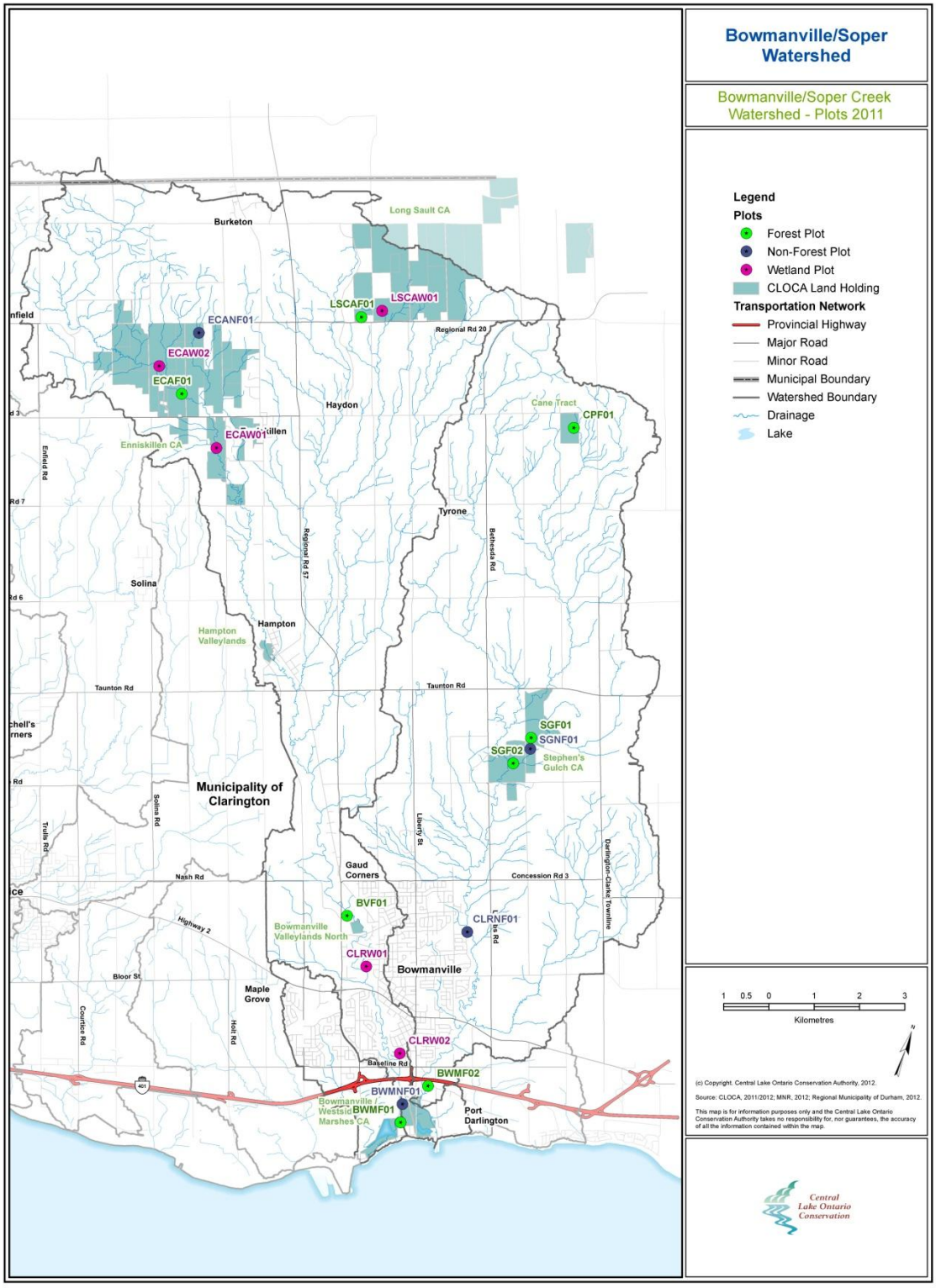


Figure 3: Bowmanville/Soper Creek Watershed Monitoring Locations

PRINGLE CREEK WATERSHED

Forest monitoring plots were established at two locations within the Pringle Creek watershed in 2011. Permission from the Town of Whitby was granted to establish the plots; all plots are 20mx20m. Where possible, plots were established along the main physiographic regions within the watershed, the Lake Iroquois Beach and the Lacustrine Plain. Forests account for 30% of the total natural cover within the Pringle Creek watershed, but only 5% of the entire watershed. The Pringle Creek watershed's natural forest cover is predominantly deciduous forest (FOD) accounting for 9% of the cover, while mixed forests (FOM) make up 8% and coniferous forests (FOC) represent 4% of the natural forest cover; the remaining 9% is accounted for in cultural woodlands (CUW) and cultural plantations (CUP), being 4% and 5% respectively. Due to the urbanized nature of this watershed, many of these forested areas are found within valley systems, and are subject to the pressures of urban growth and human disturbance.

BOWMANVILLE/SOPER CREEK WATERSHED

Eight forest monitoring plots were established in the Bowmanville/Soper Creek watershed in 2009 and lie within the 3 physiographic regions, the Oak Ridges Moraine, the Lake Iroquois Beach and the Lacustrine Plain. Forests account for 54% of the total natural cover of the Bowmanville/Soper Creek watershed, which is approximately 20% of the entire watershed. This watershed has the highest percent natural cover within CLOCA's entire jurisdiction at 37%. Of the forested areas within this watershed, mixed forests (FOM) account for 25% of the total natural cover, while coniferous forests (FOC) account for 10% and deciduous forests (FOD) account for 8%. While the Bowmanville/Soper Creek watershed is seeing the pressures of urban sprawl, 79% of the watershed lands are regulated through the Greenbelt Plan (2005) and the Oak Ridges Moraine Conservation Plan (2002), allowing for preservation of the high percent of natural cover.

2.1.1 Tree Health

Tree size and disturbance history can help in understanding how the forest structure is changing, and when regularly monitored, can often help identify both short-term and long-term stresses on the system. These short-term stresses may include extreme weather, insect defoliation and many other factors. While long-term stresses may be more difficult to isolate and can result from surrounding land use changes, recreational uses, climate change, and an array of other factors.

The now retired Canadian Forest Service (Sajan, 2006) states that average annual mortality rates of 1% to 3% are considered normal, but a red flag should be raised at 5% mortality rates. This threshold will be used when monitoring and analyzing data. If mortality rates exceed this rate recommendations for management will be made. To utilize this threshold, a baseline must be established to measure from and be compared against. At all forest plots, tree health is assessed by observing the species, dbh (diameter at breast height), tree status (dead/alive), stem defects, and crown vigor (amount of defoliation).

While high mortality rates can raise alarm, dying, decaying and dead trees play an integral role in forest ecosystems. Decomposing material can provide habitat and food sources for a variety of animals, including cavity nesters and salamanders, the latter of which are sensitive indicator species; decomposing material is also an important component in nutrient cycling.

PRINGLE CREEK WATERSHED

Table 5 shows the percent mortality rate at each site within the Pringle Creek watershed, keeping in mind that the data presented in the table below represents baseline data and the recommended thresholds will not be applied to this year's data.

Table 5: Forested Plots Tree Health Summary - Pringle Creek Watershed

Site Name	Mortality of Trees (%)	Evidence of Emerald Ash Borer
WHBF01	6%	None
WHBF02	10%	None
Overall	**7%**	

Table 6 below shows the species composition and the percent of non-native species by site number. There are only two tree species present within both of the sites combined, and WHBF02 contains one tree species that is considered non-native. Table 7 shows all the tree species found at the two sites according to importance value.

While Manitoba Maple (*Acer negundo*) is considered native to Canada, it has been planted as an ornamental tree and has naturalized beyond its natural range (Farrar, 2006). It has a tendency to be an aggressive tree, reproducing via an abundance of fruit and sprouting readily from stumps and roots (Farrar, 2006). Manitoba Maple is listed and ranked within Central Lake Ontario Conservation Authority's Invasive Species List (CLOCA, 2010-01MP) as adapted from the Urban Forest Associates Inc. (2004) list of Invasive Exotic Species Rankings for Southern Ontario. It is ranked in the first category, and plants within this category are described as "…aggressive invasive exotic species that can alter and dominate sites and exclude native species. These organisms are a threat to natural areas, as they disperse widely through transport by animals and natural means (water, wind, etc.) …" (CLOCA, 2010-01MP).

Table 6: Forested Plot Tree Species Composition by Site - Pringle Creek Watershed

Site Name	Species Richness	Native	Non-Native	% Non-Native
WHBF01	1	1	0	0%
WHBF02	1	1	1	100%

Table 7: Forested Plot Tree Species by Importance Value - Pringle Creek Watershed

Tree Species		Importance Value
Latin Name	Common Name	
Thuja occidentalis	White Cedar	213.61
*Acer negundo**	Manitoba Maple	86.4

*indicates non-native species

BOWMANVILLE/SOPER CREEK WATERSHED

Table 8 shows the mortality rate of the eight forested sites within the Bowmanville/Soper Creek watershed for 2011 compared to the baseline data documented in 2009. Within some of the sites there have been slight increases in mortality. At one site, a decline in mortality was noted which is likely due to seasonal stress which impacted the timing of leaf-out. BWMF02 showed the greatest increase in mortality. This site is dominated by Manitoba Maple (Acer negundo), and as mentioned before is an aggressive tree. Its seeds are an important source of winter food for birds and small animals, since they persist on the trees through the winter (Farrar, 2006). Manitoba Maples have weak branches, easily broken in the wind; this can increase their susceptibility to disease and decay. No dead Ash trees were observed during the 2011 assessment, however Emerald Ash Borer has been detected in Whitby and Oshawa; spread to the Municipality of Clarington is anticipated.

Table 8: Forested Plots Tree Health Summary - Bowmanville/Soper Creek Watershed

Site Location	Site Name	2009 Mortality (%)	2011 Mortality (%)
Bowmanville Valley CA	BVF01	26%	28%
Bowmanville Westside	BWMF01	5%	5%
Bowmanville Westside	BWMF02	0%	20%
Cane Property	CPF01	0%	0%
Enniskillen CA	ECAF01	19%	13%
Long Sault CA	LSCAF01	8%	8%
Stephen's Gulch CA	SGF01	27%	27%
Stephen's Gulch CA	SGF02	3%	0%
Overall		**15%**	**15%**

Table 9 shows the species composition and the percent of non-native species by site number. Half of the sites do not appear to have any non-native tree species, while the remaining four sites range from 13% to 100% non-native species. Table 10 shows the tree species found in all eight sites according to importance value. Tree health will be observed every five years as the plots are monitored.

Table 9: Forested Plot Tree Species Composition by Site - Bowmanville/Soper Creek Watershed

Site Name	Species Richness	Native	Non-Native	% Non-Native
BVF01	2	2	0	0%
BWMF01	6	6	0	0%
BWMF02	2	0	2	100%
CPF01	2	1	1	50%
ECAF01	3	3	0	0%
LSCAF01	2	2	0	0%
SGF01	3	2	1	33%
SGF02	8	7	1	13%

Table 10: Forested Plot Tree Species by Importance Value - Bowmanville/Soper Creek Watershed

Tree Species		Importance Value
Latin Name	Common Name	
Thuja occidentalis	White Cedar	75.81
*Pinus sylvestris**	Scots Pine	34.95
Pinus resinosa	Red Pine	26.18
Populus tremuloides	Trembling Aspen	24.74
Tsuga Canadensis	Eastern Hemlock	24.66
*Acer negundo**	Manitoba Maple	15.04
Betula papyrifera	White Birch	14.14
Picea glauca	White Spruce	12.04
Betula allegheniensis	Yellow Birch	10.60
Ostrya virginiana	Ironwood	9.68
Fraxinus Americana	White Ash	9.34
Prunus serotina	Black Cherry	8.99
Crataegus spp.	Hawthorn	7.88
Pinus strobus	White Pine	7.81
Fraxinus pennsylvanica	Red Ash	5.01
Juglans nigra	Black Walnut	4.47
Fagus grandifolia	American Beech	4.40
Prunus virginiana	Choke Cherry	4.26

*indicates non-native species

2.1.2 Regeneration

Monitoring the regeneration of saplings is another important feature used to understand the structure and observe the succession of the forest. All tree species and heights are recorded for saplings within 16cm and 200cm in height that lie within the subplot boundaries. Specimens less than 16cm are not recorded as the success rate is too unpredictable and they may not survive the growing season.

PRINGLE CREEK WATERSHED

Figure 4 shows the overall species observed at each site within the regenerating layer of the Forested monitoring plots within the Pringle Creek watershed.

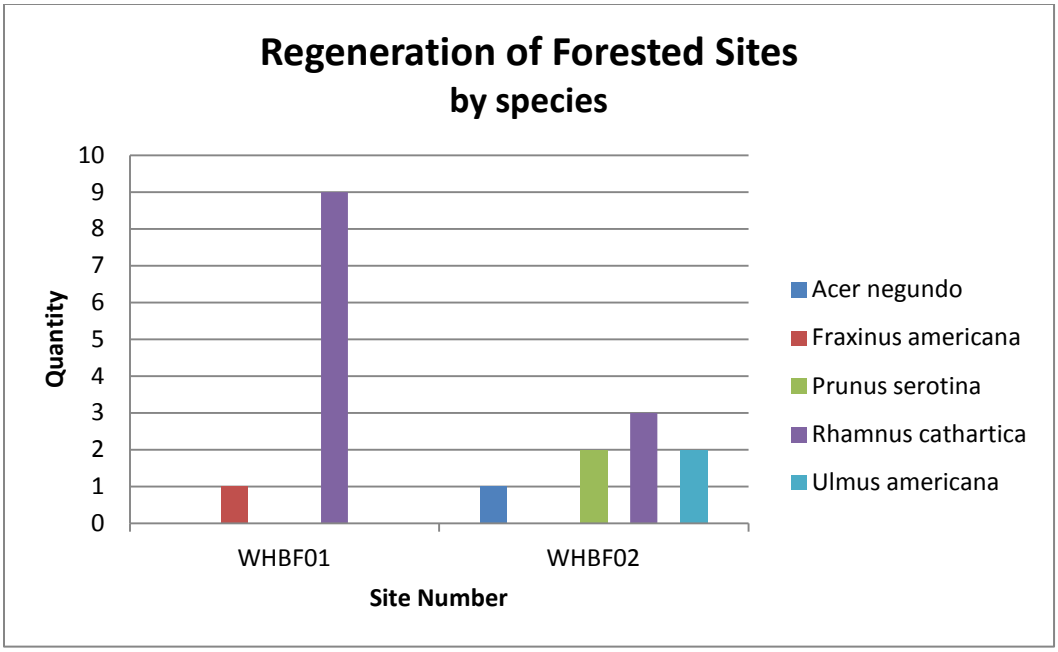


Figure 4: Regeneration of Forested Sites by Species - Pringle Creek Watershed

Both sites had regenerating seedlings large enough to be included in the survey. Common Buckthorn (*Rhamnus cathartica*) was present within both sites, and was the most dominant sapling. Common Buckthorn is a non-native invasive species and is ranked in category 1 on CLOCA's Invasive Species List (CLOCA, 2010-01MP).

Table 11: Regeneration by height classification for Forested Plots - Pringle Creek Watershed

Tree Species	Seedling Height Classes (cm)						Total by Species
	16-35	36-55	56-75	76-95	96-200	>200cm	
Acer negundo	0	0	1	0	0	0	**1**
Fraxinus americana	1	0	0	0	0	0	**1**
Prunus virginiana	0	0	1	0	0	1	**2**
Rhamnus cathartica	7	3	1	0	0	1	**12**
Ulmus americana	0	0	1	0	0	1	**2**
Total by height class	**8**	**3**	**4**	**0**	**0**	**3**	**18**

Table 11 shows the height category by species; the majority of regenerating species fall within the 16cm-35cm category and due to their size are quite vulnerable. Next to Common Buckthorn, Choke Cherry (*Prunus virginiana*) and White Elm (*Ulmus americana*) are the next highest regenerating saplings. Choke Cherry is a common tree that often does not exceed 9m in height and 15cm in diameter (Farrar, 2006). White Elm has a long-standing history of being a city or park tree, however due to the Dutch elm disease outbreak in the late 1960's, many larger trees have been eliminated and many saplings do not reach great sizes; yet some are still able to produce an abundant supply of seed.

BOWMANVILLE/SOPER CREEK WATERSHED

Figure 5 shows the overall species observed at each site within the regenerating layer of the Forested monitoring plots for the Bowmanville/Soper Creek watershed.

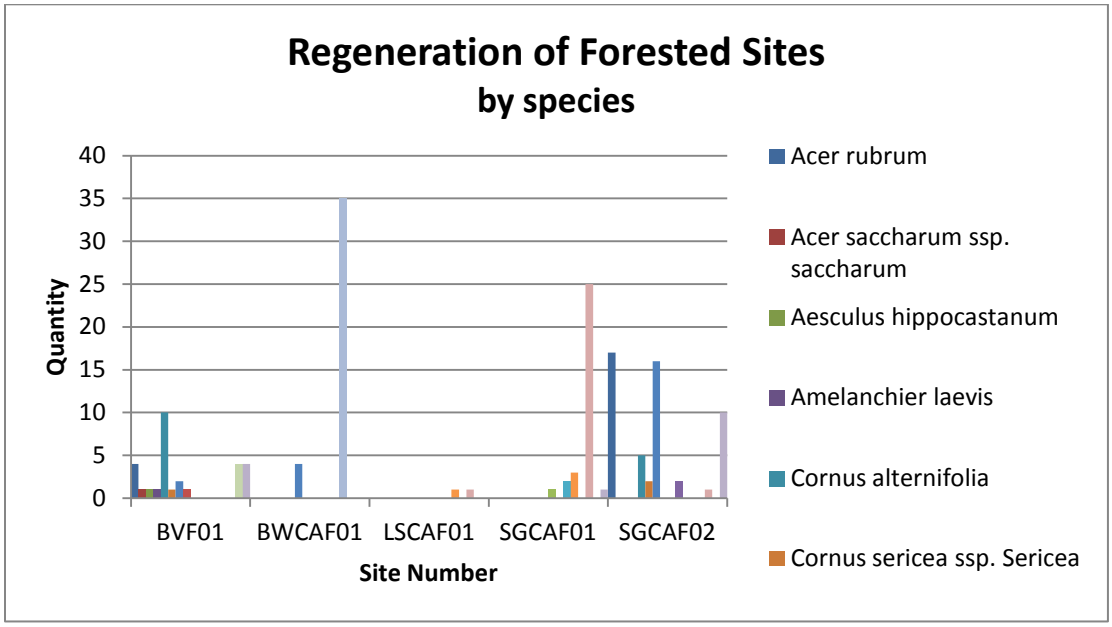


Figure 5: Regeneration of Forested Sites by Species - Bowmanville/Soper Creek Watershed

As in 2009, three sites did not have any regenerating seedlings large enough to include in the survey, the remaining five sites had a wide variety of regenerating species. Choke Cherry (*Prunus virginiana*), White Ash (*Fraxinus americana*), Common Buckthorn (*Rhamnus cathartica*) and Red Maple (*Acer rubrum*) were the most abundant regenerating saplings throughout the five sites. Four of the sixteen recorded species are non-native (as seen in Table 12 and depicted by an asterisk), and all four of these plots are documented with varying degrees of invasiveness. They should continue to be monitored as they are aggressive plant species, as will be discussed below. Many of the saplings observed are still quite small and are vulnerable to many environmental factors.

Table 12: Regeneration by height classification for Forested Plots – Bowmanville/Soper Creek Watershed

Tree Species	Seedling Height Classes (cm)						Total by Species
	16-35	36-55	56-75	76-95	96-200	>200cm	
Acer rubrum	15	4	1	0	1	0	**21**
Acer saccharum ssp.	0	0	0	1	0	0	**1**
*Aesculus hippocastanum**	0	0	0	1	0	0	**1**
Amelanchier laevis	0	0	0	0	0	1	**1**
Cornus alternifolia	10	3	2	0	0	0	**1**
Cornus sericea ssp. Sericea	3	0	0	0	0	0	**1**
Fraxinus Americana	13	8	6	3	1	1	**32**
Fraxinus pennsylvanica	0	0	0	0	0	1	**1**
Fraxinus spp	0	1	0	0	0	0	**1**
Pinus strobus	0	1	1	0	0	0	**1**
*Pinus sylvestris**	0	0	0	0	0	2	**2**
Prunus serotina	0	0	2	0	0	2	**4**
Prunus virginiana	0	2	3	9	8	13	**35**
*Rhamnus cathartica**	19	6	2	0	0	0	**27**
*Sorbus aucuparia**	2	1	1	0	0	0	**4**
Thuja occidentalis	6	9	0	0	0	1	**16**
Total by height class	**68**	**35**	**18**	**14**	**10**	**21**	**166**

*indicates non-native species

2.1.3 Ground Vegetation

Monitoring ground vegetation within a forested system can provide information regarding the phenology (timing of biological events, such as flowering, in relation to changes in season and climate) of the plant; the change in composition and species vulnerability to disturbed landscapes; as well as provide information on the quality of habitat. Ground vegetation is defined as all herbaceous material and ground layer vegetation, including lichens, mosses, fungi and small trailing and rosette plants. It also encompasses woody stemmed material that is less than 1m in height. Ground vegetation can vary depending on many factors, including forest canopy cover, soil substrate, moisture variation and time of year.

PRINGLE CREEK WATERSHED

Table 13 provides a summary of the species composition for each site, and breaks it up between native, non-native and overall species richness. Total species richness is 14 for WHBF01 and 25 for WHBF02. While WHBF02 had a greater richness, it also had a much higher percent of non-native species. As mentioned before, Pringle Creek watershed is highly urbanized and due to those pressures it is not surprising to see a high number of non-native species present.

Table 13: Ground Vegetation data for Forested Plots – Pringle Creek Watershed

Site Name	Total Species Richness	Native Species Richness	Non-native species richness	% Non-native Species
WHBF01	14	12	2	14%
WHBF02	25	15	10	40%
Overall*	**35**	**26**	**9**	**26%**

*Overall species richness counts only unique occurrences; totals have been adjusted for this duplication.

Table 15 shows the non-native species categories and their ranking of invasiveness (CLOCA, 2010-01MP). Of the nine non-native species present (Table 14), two species, Dog-Strangling Vine (*Cynanchum rossicum*), and Dames Rocket (*Hesperis matronalis*), are ranked as "…aggressive invasive exotic species that can alter and dominate sites and exclude native species. These organisms are a threat to natural areas, as they disperse widely through transport by animals and natural means (water, wind, etc.) … " (CLOCA, 2010-01MP). Three of the nine species, Field Bindweed (*Convolvulus arvensis*), White Bedstraw (*Galium mollugo*), and Moneywort (*Lysimachia nummularia*), rank in the second category and are described as "Species that are highly invasive but tend to only dominate certain niches or do not spread rapidly from major concentrations. They spread by vegetative means or by seeds that drop close to the parent. They may persist in dense populations for long periods. Control where necessary and limit their spread to other areas." (CLOCA, 2010-01MP). The remaining three non-native plants fall within categories three and four and are invasive but are not as aggressive as the above species. Garden Gooseberry (*Ribes rubrum*) does not fall into a category as it does not show invasive tendencies, however it is non-native.

Table 14: Non - Native Species list for Forested Plots - Pringle Creek Watershed

Latin Name	Common Name	Rank
Convolvulus arvensis	Field Bindweed	2
Cynanchum rossicum	Dog-Strangling Vine	1
Galium mollugo	White Bedstraw	2
Glechoma hederacea	Ground Ivy	4
Hesperis matronalis	Dames Rocket	1
Lysimachia nummularia	Moneywort	2
Ribes rubrum	Garden Gooseberry	-
Tussilago farfara	Sweet Coltsfoot	4
Urtica dioica ssp. dioica	Stinging-nettle	3

Table 15: CLOCA's Invasive Species Ranking Criteria (as adapted by Urban FOrested Associates, Inc., 2004)

Category Rank	Category Criteria
1	This category contains aggressive invasive exotic species that can alter or dominate sites and exclude native species. These organisms are a threat to natural areas, as they disperse widely, through transport by animals and/or natural means (water, wind, etc). These species are top priority, however control may be difficult.
2	Species that are highly invasive but tend to only dominate certain niches or do not spread rapidly from major concentrations. They spread by vegetative means or by seeds that drop close to the parent. They may persist in dense populations for long periods. Control where necessary and limit their spread to other areas.
3	Moderately invasive species, but can become locally dominant when the proper conditions exist. Control where necessary and limit their spread to other areas.
4	Species that do not pose a serious threat to natural areas unless they are competing directly with more desirable vegetation. These plants are sometimes substituted for native plants, but may not reproduce aggressively once established.
5	Some of these species have the potential to become invasive exotics in Ontario. They can reproduce aggressively on occasion but have not been shown to be a serious threat to natural areas in Ontario. Some are very similar to indigenous species and could simply have been overlooked.

BOWMANVILLE/SOPER CREEK WATERSHED

A majority of native species were found at all the forested sites within the Bowmanville/Soper Creek Watershed, with 25% non-native species overall. Total species richness ranged from 7 to 22, with an overall species richness of 60 plant species within all of the sites (

Table 16). A total of 15 non-native species were found (Table 17), two of which, Dog-Strangling Vine (*Cynanchum rossicum*) and Himalayan Balsam (*Impatiens gladulifera*), rank within the first category of CLOCA's Invasive Species List (CLOCA, 2010-01MP). Himalayan Balsam is an annual, found in riparian areas and wet woodlands; it is becoming more widespread within Durham Region. While Cow Vetch (*Vicia cracca*) is ranked within category 2, it is often found in more open meadows and does not pose a huge threat in a forested system. Eight of the remaining invasive plants rank within categories three and four, and while they still have the potential to invade and transform ecosystems they pose less of a threat than other invasive species. Both Garden Gooseberry (*Ribes rubrum*) and Common Dandelion (*Taraxacum* officinale) do not fall into a category as they show little invasive tendency, and do not pose a direct threat to a forest system.

Table 16: Ground Vegetation data for Forested Plots - Bowmanville/Soper Creek Watershed

Site Location	Site Name	Total Species Richness	Native Species Richness	Non-native species richness	% Non-native Species
Bowmanville Valley CA	BVF01	14	10	4	29%
Bowmanville Westside	BWMF01	15	14	1	7%
Bowmanville Westside	BWMF02	13	2	11	85%
Cane Property	CPF01	7	3	4	57%
Enniskillen CA	ECAF01	12	10	2	17%
Long Sault CA	LSCAF01	16	11	5	31%
Stephen's Gulch CA	SGF01	22	15	7	32%
Stephen's Gulch CA	SGF02	10	8	2	20%
Overall*		**60**	**45**	**15**	**25%**

*Overall species richness counts only unique occurrences; totals have been adjusted for this duplication.

Table 17: Non-Native Species list of Forested Plots - Bowmanville/Soper Creek Watershed

Latin Name	Common Name	Rank
Berberis vulgaris	Common Barberry	3
Cynanchum rossicum	Dog-Strangling Vine	1
Epipactis helleborine	Helleborine	4
Galium mollugo	White Bedstraw	2
Glechoma hederacea	Ground Ivy	4
Hemerocallis fulva	Day Lily	3
Hesperis matronalis	Dames Rocket	1
Hypericum perforatum	St. John's-wort	4
Impatiens glandulifera	Himalayan Balsam	1
Ribes rubrum	Garden Gooseberry	-
Solanum dulcamara	Bittersweet Nightshade	3
Sorbus aucuparia	European Mountain Ash	4
Taraxacum officinale	Common Dandelion	-
Urtica dioica ssp dioica	Stinging-nettle	4
Vicia cracca	Cow Vetch	2

2.2 Non-Forested Systems

PRINGLE CREEK WATERSHED

Non-forested systems, which include cultural meadows (CUM) and cultural thickets (CUT) account for 29% of the total natural cover of the Pringle Creek watershed, or 5% of the entire watershed. Only one non-forested plot was established in 2011 due to the ownership and availability of land to survey. This

site has six 1mx1m monitoring plots established and were observed twice during the field season, once in early June and once again in late August.

BOWMANVILLE/SOPER CREEK WATERSHED

Within the Bowmanville/Soper Creek Watershed, non-forested systems account for 24% of the entire natural cover, or 9% of the entire watershed. Five plots were established in 2009, and four were reassessed in 2011 for species richness and composition. One plot was removed due to invasive species management that occurred within Long Sault Conservation Area. To manage Autumn Olive and Russian Olive (*Elaeagnus umbellate and E. angustifolia*) the cultural meadow in which this plot was established was grubbed and sprayed with herbicide. Uncommon tall-grass prairie grasses were present in the area, and to assist in the re-establishment of this rare ecosystem, management was necessary. Ongoing management is expected to take place in Long Sault CA, and reseeding of tall-grass prairie flora is expected in the near future.

2.2.1 Ground Vegetation

PRINGLE CREEK WATERSHED

Table 18 shows the overall species composition of the site. A total of 9 species were observed, over half of which were non-native. Even though this site contained a high number of non-native species, not all of these species pose a threat to native diversity; many non-native species have become naturalized and live in harmony with the surrounding vegetation.

Table 19 shows all the non-native species present among the sites observed and their potential invasiveness, according to the categorized criteria.

Table 18: Ground Vegetation data for Non-Forested Sites - Pringle Creek Watershed

Site Name	Total Species Richness	Native Species Richness	Non-native species richness	% Non-native Species
WHBNF01	9	3	6	67%

Table 19: Non-Native Species List for Non-Forested Sites - Pringle Creek Watershed

Latin Name	Common Name	Rank
Cirsium arvense	Canada Thistle	1
Dactylis glomereata	Orchard Grass	3
Daucus carota	Queen Anne's Lace	-
Galium mollugo	White Bedstraw	2
Linaria vulgaris	Butter-and-Eggs	4
Vicia cracca	Cow Vetch	2

While the majority of plants are non-native at this site, only Canada Thistle (*Cirsium arvense*) is considered severely invasive, ranking in the first category. Both White Bedstraw (*Galium mollugo*) and Cow Vetch (*Vicia cracca*) can pose a threat by dominating open ecosystems. The remaining three species are common in open areas and are considered naturalized.

BOWMANVILLE/SOPER CREEK WATERSHED

Table 20 shows the species richness and composition for 2011, overall 41% of the plant species are considered non-native.

Table 20: Ground Vegetation data for Non-Forested Sites – Bowmanville/Soper Creek Watershed

Site Location	Site Name	Total Species Richness	Native Species Richness	Non-native species richness	% Non-native Species
Bowmanville Westside CA	BMWNF01	9	2	7	78%
Municipality of Clarington	CLRNF01	12	3	9	75%
Enniskillen CA	ECANF01	23	11	12	52%
Stephen's Gulch CA	SGNF01	10	3	7	70%
Overall*		**32**	**19**	**13**	**41%**

*Overall species richness counts only unique occurrences; totals have been adjusted for this duplication.

Table 21 shows all the native species present among the four sites observed and their potential invasiveness, according to the categorized criteria (CLOCA, 2010-01MP).

Table 21: Non-Native Species List for Non-Forested Sites - Bowmanville/Soper Creek Watershed

Latin Name	Common Name	Rank
Achillea millefolium ssp. millefolium	Yarrow	-
Chrysanthemum leucanthemum	Ox-Eye Daisy	-
Cirsium arvensis	Canada Thistle	1
Cynanchum rossicum	Dog-Strangling Vine	1
Dactylis glomereata	Orchard Grass	3
Daucus carota	Queen Anne's Lace	-
Galium mollugo	White Bedstraw	2
Hypericum perforatum	St. John's Wort	4
Linaria vulgaris	Butter-and-Eggs	4
Lithospermum officinale	European Gromwell	-
Medicago lupulina	Black-Medick	4
Phleum pratense	Timothy Grass	-
Potentilla recta	Rough-fruited Cinquefoil	-
Rosa multiflora	Multiflora Rose	2
Taraxacum officinale	Common Dandelion	-
Tragopogon pratensis	Goat's-beard	-
Trifolium hybridium	Alsike Clover	-
Vicia cracca	Cow Vetch	2

2.3 Wetlands

Wetlands play an integral part in the function and health of a watershed, as they act as natural filters, recharge groundwater, and provide habitat for many species. The wetlands being monitored as part of

this program are non-coastal wetlands, since all of the coastal wetlands within the CLOCA jurisdiction are monitored through the Durham Region Coastal Wetland Monitoring Program (DRCWMP). The wetlands being monitored comprise of the ELC community class treed swamp, which includes Coniferous Swamp (SWC), Deciduous Swamp (SWC) and Mixed Swamps (SWM). According to Environment Canada "How Much Habitat Is Enough" Guidelines (2004), a watershed should be comprised of greater than 10% wetland cover or greater than 6% wetland cover in subwatersheds.

PRINGLE CREEK WATERSHED

The Pringle Creek watershed wetland cover is 39%, 26% of which is forested wetland and monitored through the Terrestrial Watershed monitoring program. The wetlands include mixed swamp (SWM), being the most prominent with 20% of the natural cover, deciduous swamp (SWD) making up 3% of the natural cover, and coniferous swamp (SWC) making up the remaining 2% natural cover.

BOWMANVILLE/SOPER CREEK WATERSHED

Within the Bowmanville/Soper Creek watershed, wetlands make up 22% of the entire natural cover, 15% of which is forested wetland. The wetlands monitored within the Terrestrial Watershed Monitoring program are comprised of coniferous swamp (SWC), deciduous swamp (SWD) and mixed swamp (SWM), which in total account for 5% of the entire watershed cover. The distribution of these wetlands is 2%, 2% and 11% of the total natural cover, respectively.

2.3.1 Tree Health

Tree health was assessed using the same methodology as the Forested Monitoring Plots. Please refer to section 2.1.1 for more information on the process.

PRINGLE CREEK WATERSHED

Two wetland plots were established within the Pringle Creek watershed. Table 22 shows the percent mortality at each site, keeping in mind that the data presented in the table below represents the baseline data and the recommended threshold will not be applied to this year's data.

Table 22: Tree Health Summary for Wetland Sites - Pringle Creek Watershed

Site Name	Mortality of Trees (%)	Evidence of Emerald Ash Borer
WHBW01	1%	None
WHBW01	0%	None
Overall	**0.5%**	**None**

The mortality rate amongst the two wetlands was quite low, having an overall mortality of ½%.

Table 23 shows the species composition and percent of non-native species by site number; each site only had one species present, both of which were native. Table 24 shows the overall tree species according to importance value, White Cedar (*Thuja occidentalis*) dominated WHBW01 while White Ash (*Fraxinus americana*) dominated WHBW02.

Table 23: Wetland Plot Tree Species Composition - Pringle Creek Watershed

Site Name	Species Richness	Native	Non-Native	% Non-Native
WHBW01	1	1	0	0%
WHBW02	1	1	0	0%

Table 24: Wetland Plot Tree Species by Importance Values - Pringle Creek Watershed

Tree Species		Importance Value
Latin Name	Common Name	
Thuja occidentalis	White Cedar	193.43
Fraxinus americana	White Ash	106.57

While the mortality rate was low at both sites, many of the trees in WHBW02 showed signs of severe dieback within the crown. Since all the trees present within WHBW02 are Ash species and had evidence of insect damage, concern was raised that the cause might be due to the emerald ash borer (*Agrilus planipennis*) (EAB). EAB has recently been confirmed within Whitby and Oshawa. Photos were taken of the emergence holes and galleries (Figure 6) and sent to the Canadian Food Inspection Agency (CFIA) for confirmation. Due to the low resolution of photos it could not be confirmed 100%; however it was suspected that the galleries and emergence holes were due to the native red-headed ash borer (*Neoclytus acuminatus*). While this may be true, the representative at the CFIA suspected that EAB may also be present within this woodlot, due to the close proximity to the infested site (~4.5km). The emerald ash borer has serpentine galleries and 'D' shaped exit holes; whereas the red-headed ash borer has more vertical galleries that start in the phloem and proceed into the sapwood of the tree, and have circular exit holes (Lyons, *et al.*, 2007; Ohio State University, 2007). The red-headed ash borer tends to prefer already stressed or dying trees.

Throughout the CLOCA watershed there have been informal observations made over the past couple of years regarding the decline in Ash (*Fraxinus spp*) trees. There are a variety of insects, funguses and pathogens that infect ash trees, including Anthracnose, Ash Yellows and Ash plant bug that could be potential causes for this decline, also other environmental factors may play a role.

Figure 6: (left to right) Insect Galleries on Ash tree; Emergence holes; Larval gallery with frass

BOWMANVILLE/SOPER CREEK WATERSHED

Table 25 shows the rate of mortality in the five wetland sites within the Bowmanville/Soper Creek watershed for 2011, compared to the baseline data documented in 2009. Overall there has been a one percent increase in mortality, but within each of the sites there have been some slight increases and decreases in mortality. The slight reduction in mortality rates may be due to seasonal stresses which may delay leaf-out. Both ECAW01 and LSCAW01 saw an increase in mortality by 2% and 3% respectively. As mentioned in section 2.1.1, annual mortality rates of 1% to 3% are considered normal, and these sites reached that threshold within a two year time frame. Monitoring will occur again in five years.

Table 25: Tree Health Summary for Wetland Sites - Bowmanville/Soper Creek Watershed

Site Name	2009 Mortality (%)	2011 Mortality (%)
CLRW01	35%	35%
CLRW02	0%	0%
ECAW01	6%	8%
ECAW02	51%	50%
LSCAW01	16%	19%
Overall	**26%**	**27%**

Table 26 shows the species composition and the percent non-native species by site number. Two of the sites do not appear to have any non-native tree species, while the remaining three sites range from 17% to 100% non-native species. Table 27 shows the tree species found in all five sites according to importance value. Three non-native tree species are present within the wetland plots; Crack Willow (*Salix fragilis*); Manitoba Maple (*Acer negundo*); and Common Buckthorn (*Rhamnus cathartica*). Of these three species, Crack Willow and Manitoba Maple rank amongst the top four for importance values. Importance value is “an index made up of Relative Density, Relative Dominance and Relative Frequency that profiles the structural role of a species in a stand.” (Roberts-Pinchette, *et al.*, 1999). As a result, importance values are highly dependent on the quantity of tree species within the plots, as well as their size and

basal area. While there appears to be a relatively high number of Crack Willow and Manitoba Maple present, Common Buckthorn ranks further down the list. All trees observed and measured must be greater than 10cm dbh; Common Buckthorn does not often get larger than 10cm in diameter (Farrar, 2006). Tree health will be observed every five years as the plots are monitored.

Table 26: Wetland Plot Tree Species Composition - Bowmanville/Soper Creek Watershed

Site Name	Species Richness	Native	Non-Native	% Non-Native
CLRW01	3	2	1	33%
CLRW02	1	0	1	100%
ECAW01	6	5	1	17%
ECAW02	5	5	0	0%
LSCAW01	5	5	0	0%

Table 27: Wetland Plot Tree Species by Importance Values - Bowmanville/Soper Creek Watershed

Tree Species		Importance Value
Latin Name	Common Name	
Thuja occidentalis	White Cedar	193.43
*Salix fragilis**	Crack Willow	33.42
Betula allegheniensis	Yellow Birch	29.98
*Acer negundo**	Manitoba Maple	26.51
Tsuga canadensis	Eastern Hemlock	25.89
Fraxinus nigra	Black Ash	23.46
Picea glauca	White Spruce	9.58
*Rhamnus cathartica**	Common Buckthorn	7.86
Betula papyrifera	White Birch	6.45
Acer saccharinum	Silver Maple	6.18
Tilia Americana	American Basswood	5.89

indicates non-native species

2.3.2 Regeneration

Regeneration is assessed using the same methodology as the Forested Monitoring Plots; please refer to Section 2.1.2 for more information on the process.

PRINGLE CREEK WATERSHED

Only one of the two sites within the Pringle Creek watershed had regenerating saplings. Figure 7 shows the species count at each site. Two of the three species are non-native invasive, Manitoba Maple (*A. negundo*) and Common Buckthorn (*R. cathartica*).

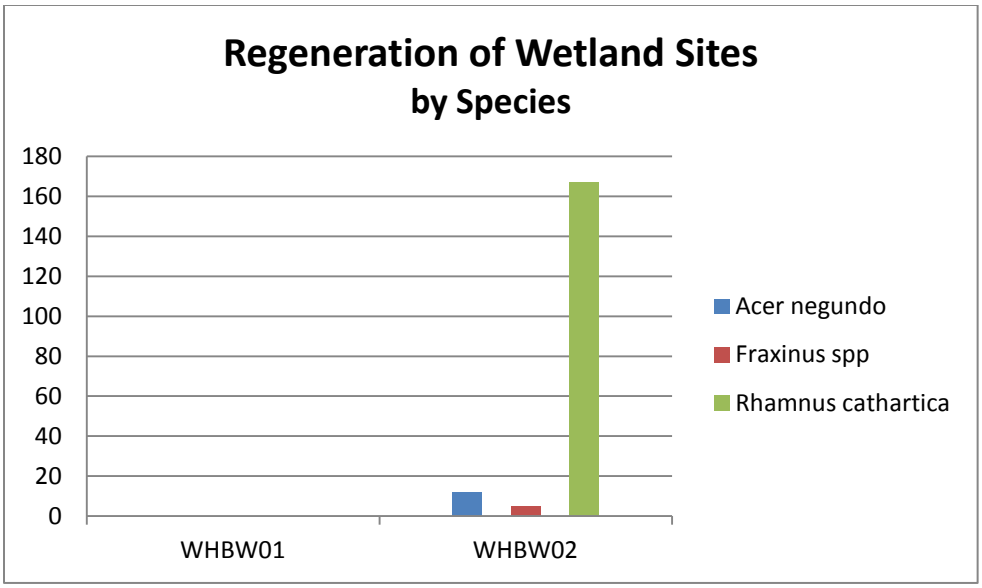


Figure 7: Regeneration of Wetland Sites by Species - Pringle Creek Watershed

As stated previously, the Pringle Creek watershed is highly urbanized, and this could be a contributing factor in the high density of non-native invasive saplings regenerating within the plots. While Common Buckthorn has close to 200 saplings within one plot, the majority of these saplings are within the first two height categories (Table 28); the vulnerability of saplings within these categories is greater. Common Buckthorn will succeed in limited light conditions with poor soils and suppresses understory vegetation with its domination of light, soil and nutrients. .

Table 28: Regeneration by height classification for Wetland Plots - Pringle Creek Watershed

Tree Species	Seedling Height Classes (cm)						Total by Species
	16-35	36-55	56-75	76-95	96-200	>200cm	
Acer negundo	1	5	6	0	0	0	**12**
Fraxinus spp	2	1	2	0	0	0	**5**
Rhamnus cathartica	72	12	29	11	9	34	**167**
Total by height class	**75**	**18**	**37**	**11**	**9**	**34**	**184**

BOWMANVILLE/SOPER CREEK WATERSHED

Figure 8 shows the species count for each regenerating tree species at the five wetland sites within the Bowmanville/Soper Creek watershed. All five sites show signs of regeneration, with a total of 11 different species overall; three of which are invasive and are on CLOCA's top terrestrial invasive species list; Common Buckthorn (*Rhamnus cathartica*), Norway Maple (*Acer platanoides*), and Manitoba Maple (*Acer negundo*).

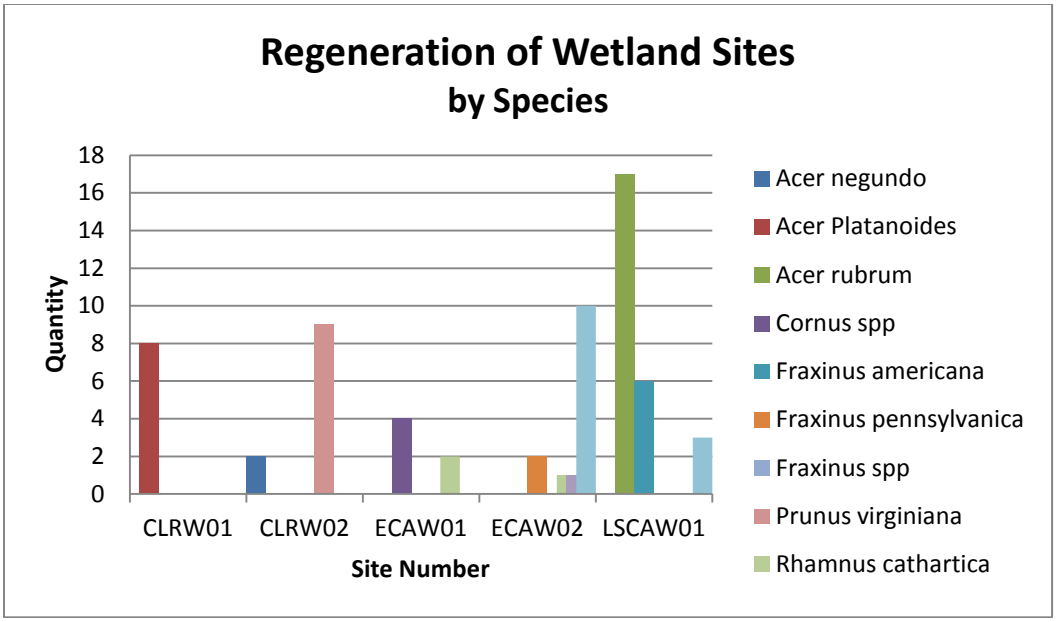


Figure 8: Regeneration of Wetland Sites by Species - Bowmanville/Soper Creek Watershed

Table 29 shows the height classification and count for all the recorded species present. As seen within the forested sites, saplings within the 16-35cm height classification dominate. Non-native species dominate the larger height classes. Survival rate of the larger saplings increases, however these saplings are still vulnerable to disease, browsing and other environmental factors.

Table 29: Regeneration by height classification for Wetland Plots - Bowmanville/Soper Creek Watershed

Tree Species	Seedling Height Classes (cm)						Total by Species
	16-35	36-55	56-75	76-95	96-200	>200cm	
Acer negundo	0	0	0	0	0	2	**2**
Acer platanoides	3	0	0	0	0	5	**8**
Acer rubrum	7	1	2	2	0	5	**17**
Cornus spp	4	0	0	0	0	0	**4**
Fraxinus Americana	3	2	0	0	0	1	**6**
Fraxinus pennsylvanica	0	0	0	1	0	1	**2**
Prunus virginiana	0	0	6	2	0	1	**9**
Rhamnus cathartica	3	0	0	0	0	0	**3**
Sambucus Canadensis	0	0	0	1	0	0	**1**
Thuja occidentalis	3	2	3	4	1	0	**13**
Total by height class	**23**	**5**	**11**	**10**	**1**	**15**	**65**

2.3.3 Ground Vegetation

Ground vegetation was assessed using the same methodology as the Forested Monitoring Plots, please refer to section 2.1.3 for more information on the process.

PRINGLE CREEK WATERSHED

Table 30 shows the species composition at the two wetland plots within the Pringle Creek watershed. Overall the sites had 80% native species; all non-native species present within the wetland plots are listed in

Table 31, showing their invasiveness ranking.

Table 30: Ground Vegetation data for Wetland Plots - Pringle Creek Watershed

Site Name	Total Species Richness	Native Species Richness	Non-native species richness	% Non-native Species
WHBW01	9	5	4	44%
WHBW02	14	11	3	21%
Overall*	**20**	**16**	**4**	**20%**

*Overall species richness counts only unique occurrences; totals have been adjusted for this duplication.

Table 31: Non-Native Species List for Wetland Sites

Latin Name	Common Name	Rank
Alliaria petiolata	Garlic Mustard	1
Cynanchum rossicum	Dog-Strangling Vine	1
Epipactis helleborine	Helleborine	-
Rhamnus cathartica	Common Buckthorn	1
Solanum dulcamara	Bittersweet Nightshade	3

BOWMANVILLE/SOPER CREEK WATERSHED

Table 32 shows the overall species composition at the 5 wetland plots within the Bowmanville/Soper Creek watershed. Overall the percent of native species is 78%, with a total of 68 unique species throughout the five sites.

Table 32: Ground Vegetation data for Wetland Plots - Bowmanville/Soper Creek Watershed

Site Name	Total Species Richness	Native Species Richness	Non-native species richness	% Non-native Species
CLRW01	30	20	10	33%
CLRW02	19	10	9	47%
ECAW01	14	10	4	29%
ECAW02	43	37	6	14%

LSCAW01	12	11	1	8%
Overall*	**68**	**53**	**15**	**22%**

*Overall species richness counts only unique occurrences; totals have been adjusted for this duplication.

Table 33 shows all fifteen non-native plant species found within the plots, and their invasiveness according to CLOCA's Invasive Species List (CLOCA, 2010-01MP). Five of the fifteen species rank in the first and second categories, however, the remaining species rank in the lower categories or are not listed at all, posing less of a threat to these unique wetland systems. The wetland plots with the highest amount of invasive species are located in more urbanized environments, and as a result are under greater pressures. Whereas, LSCAW01 is relatively isolated, with limited access to the public, and it only has one invasive species present. This reinforces the need for more public outreach and education regarding invasive species, and how humans play a large role in the spread and introduction of invasive species.

Table 33: Non-Native Species List for Wetland Sites - Bowmanville/Soper Creek Watershed

Latin Name	Common Name	Rank
Achillea millefolium ssp. millefolium	Yarrow	-
Alliaria petiolata	Garlic Mustard	1
Arctium minus	Common Burdock	-
Epilobium hirsutum	Great Hairy Willow-herb	-
Epipactis helleborine	Helleborine	-
Hesperis matronalis	Dame's Rocket	1
Impatiens glandulifera	Himalayan Balsam	1
Lysimachia nummularia	Moneywort	2
Ribes rubrum	Garden Gooseberry	-
Rumex obtusifolius	Bitter Dock	-
Solanum dulcamara	Bittersweet Nightshade	3
Taraxacum officinale	Common Dandelion	-
Tussilago farfara	Sweet Coltsfoot	4
Urtica dioica ssp. dioica	Stinging-Nettle	3
Vicia cracca	Cow Vetch	2

3.0 SPECIAL PROJECTS

3.1 Transplant Monitoring

A number of unique plant species were identified on a site proposed for development which included Fringed Gentia (*Gentianopsis crinita*), Bottle Gentia (*Gentiana andrewsii*), Large Yellow Lady's Slippers (*Cypripedium calceolus var. pubescens*), Gerardia (*Agalinis spp*) and other orchid species. While none of these species are considered to be at risk according to the provincial and federal Species at Risk Act (SARA), they are considered uncommon or rare within Durham Region and CLOCA's jurisdiction. CLOCA has permitted transplants of sensitive uncommon species as part of permit conditions in the past where plants could not be maintained in situ and have required the proponent to undertake monitoring to ensure a successful transplant. Typically, these transplants occur within the same geographical location, and until now, none of these transplants have been on CLOCA property. In this particular application, the rare species were noted during the original EIS, but during a subsequent site visit prior to the transplant much higher numbers of rare specimens were evident. As such, the pre-determined local transplant site was not large enough to support the entire population. Staff saw a unique opportunity for the plants to be transplanted to Heber Down Conservation Area where CLOCA staff can carry out post planting monitoring.

The purpose of this special project is to gauge the success of the transplant of four uncommon and rare species from a site set for development to a naturalized and protected area to better inform CLOCA Natural Heritage staff when confronted with rare or uncommon plants at development sites.

Due to the varying lifecycles of the plants, the Heber Down CA transplant site was visited several times within the 2011 field season. Each time, transects were walked approximately 2m apart from each other; counting unique individual occurrences of the transplanted plants. In mid July only Gentian species were present, comprising 35 plants in total. None of these plants were flowering, however Gentian species do not usually flower until late summer, early fall (Figure 9).

Figure 9: (left to right) Fruit of gentian's; sunburnt leaves of gentian; ladies tresses

The site was visited again in mid-September with a total of three genera's being observed. The plants observed included: 10 flowering gentians and 13 non-flowering gentians; 6 flowering gerardia and 6 non-flowering gerardia (Figure 10); and 3 ladies tresses. Ladies Tresses were not recorded as a transplanted species, but have been recorded within the Heber Down Conservation Area in the past which is a suitable location for this plant species.

Figure 10: Slender-leaved Gerardia (*Agalinis tenuifolia*)

Of all the transplanted species, no *Cypripedium*'s were observed at the transplant site. Large Yellow Lady's slipper is a perennial plant that flowers between May and June. It produces a rhizome and has a strong dependency on mycorrhiza in the early stages of development (Kull, 1999). It is not known exactly how many plants of the Large Yellow Lady's slipper were transplanted; monitoring will take place again in 2012 to assess the number and species of plants growing in the transplanted site. A consideration for future transplants of *Cypripedium* species may include an inoculation of mycorrhiza. The plants can then be monitored to assess if this treatment increases the likelihood of survival during a transplant.

3.2 Purple Loosestrife Biological Control Assessment

Over the past few years, there have been informal observations of purple loosestrife populations increasing within Cranberry marsh. However, it is common for population sizes to vary depending on short-term environmental factors. Because of these observations, staff were interested to see if galerucella beetles were still present in the marsh, and at what rates.

Purple loosestrife (*Lythrum salicaria*) is a highly invasive ornamental plant found in wetlands. It has the ability to choke out native vegetation, and suffocate suitable habitat for fish and wildlife rearing and feeding. During the 1990's, CLOCA staff noticed that purple loosestrife had become dominant within Cranberry Marsh and the Lynde Creek watershed. In 1999 CLOCA staff, in partnership with Ontario Beetles released a biological control, the *Galerucella spp* beetle, to help manage purple loosestrife populations. The galerucella beetle completes its entire lifecycle on the plant, eating the succulent leaves. As a result, the plant expends much of its energy on reproducing leaves instead of reaching the flowering and seed stage. The marsh was then drained in 2001, and saw a resurgence of purple loosestrife. During the monitoring activities of the Durham Region Coastal Wetland Monitoring Program, a large population of beetles was observed in 2003. That same year, the Ministry of Natural Resources Stewardship Rangers worked to remove flower heads; the following year, it was observed that the reproductive ability of the plants had been compromised.

In 2011, CLOCA staff went out and observed over 100 specimens of purple loosestrife, and documented if there was evidence of galerucella beetles, if there were beetles present on the plant, or if there was no evidence of beetle activity. Of the 111 plants surveyed, only two had no evidence of beetle activity; 38 plants had the insects present on them, and the remaining 73 had evidence of galerucella beetle herbivory (Figure 11).

Figure 11: Galerucella beetles on loosestrife leaf; Purple Loosestrife (*Lythrum salicaria*)

Surveys should be conducted again in 2012 to determine if any management of purple loosestrife should be conducted to help prevent a rise in population levels, such as the removal of flower heads.

3.3 Groundwater Levels at Heber Down CA

Heber Down Conservation Area contains the largest publicly owned Provincially Significant Wetland Complex along the former Lake Iroquois Shoreline. It is approximately 85.3ha, 96% swamp and 4% marsh. All but 2ha of this wetland complex fall within the Conservation Area (Planning Director's Report to the Planning and Development Committee, 2002). Over the past few years, CLOCA staff have made informal observations of water level changes occurring in the wetlands at Heber Down Conservation Area. Due to the nature of wetlands and their dependency on annual precipitation, changes in water levels are an expected occurrence. However, due to the increased development occurring in the Brooklin area and the anticipated future development of the area, monitoring began in the field season of 2009 to observe and document these changes.

Water levels were recorded on a monthly basis at four piezometers locations. In addition, vegetation inventories were conducted at the 4 transects, each containing 12 1mx1m plots.

Table 34: Ground Vegetation Data by Transect

Site Number	Total Richness	Native Species Richness	Non-native Species Richness	% Non Native Species
Transect 1	23	19	4	17%
Transect 2	16	14	2	13%
Transect 3	22	19	3	14%
Transect 4	23	20	3	13%
Overall	**45**	**42**	**3**	**7%**

Table 34 shows the species composition for each transect, breaking it up by native species, non-native species and percent non-native. Overall there were 46 different species identified which are distributed through all four monitoring plots. The amount of groundcover vegetation at each transect may have been limited since transects are located in mixed conifer swamps, dominated by Eastern White Cedar (*Thuja occidentalis*) Blue Beech (*Carpinus caroliniana*) and Black Ash (*Fraxinus nigra*).

In all of the transects combined there was a total of 3 non-native species found, however common buckthorn (*Rhamnus cathartica*) is not included in the table of the collected data, as it is considered a tree and only herbaceous plants are shown here. The herbaceous invasive species observed include Bittersweet Nightshade (*Solanum dulcamara*), Helleborine (*Epipactis helleborine*) and Dog-Strangling-Vine (*Cynanchum rossicum*). Dog-strangling-vine and Bittersweet Nightshade are on CLOCA's Invasive Species list for Terrestrial Plants and are ranked in categories 1 and 3 respectively.

Table 35: Wetness index by Transect

Site Number	Mean Wetness index	Maximum Wetness Value	Minimum Wetness Value	Mode Wetness Value
Transect 1	-2.05	5	-5	-5
Transect 2	0.38	5	-5	0
Transect 3	0.57	5	-5	5
Transect 4	-0.17		-5	-5

The wetness index categorizes plants based on the probability for them to be found in a wetland or upland area. Table 35 shows the average wetness for each transect, the maximum wetness value, minimum wetness value and the mode. The maximum wetness value represents the most upland plant within the transect, while the minimum value represents the most wetland plant within the transect. While the wetness index may classify a plant as an obligate wetland plant or obligate upland plant, it may not always be found in those specific areas. Non-native species are prefect examples of that, common buckthorn, helleborine and dog-strangling-vine receive a +3 (facultative upland), +5 and +5 (obligate upland) respectively, however, while they are more likely to inhabit dryer areas, due to their prolific nature to spread, they are still found quite readily in wetland areas.

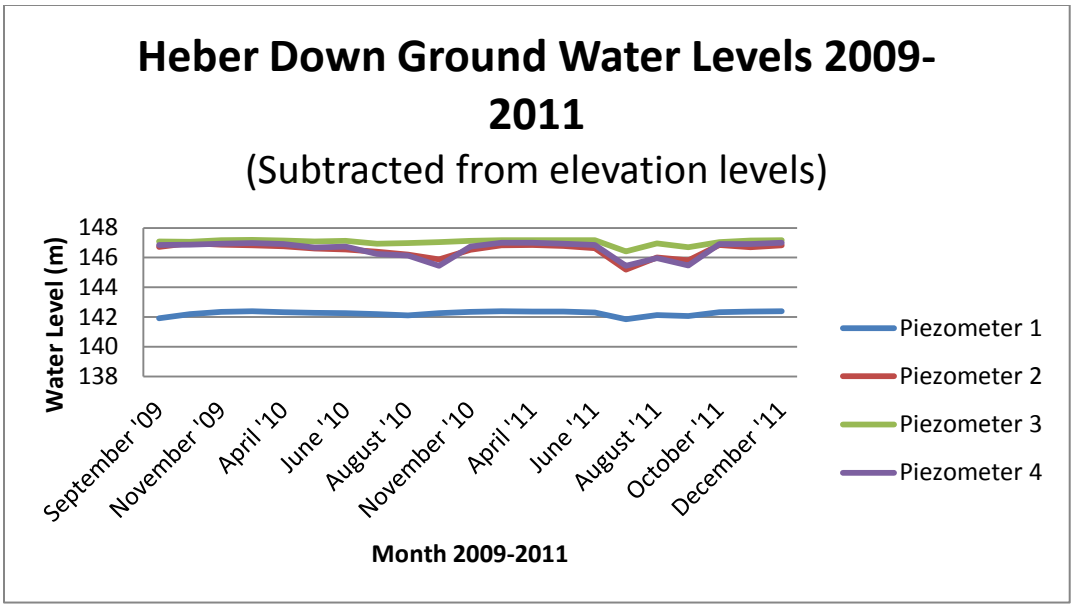


Figure 12: Piezometer groundwater levels

The piezometers measure surficial groundwater and have been installed to a maximum depth of 6ft. Without the use of drills and augers it was impossible to get the piezometers any deeper; and the roots of herbaceous vegetation reach a maximum depth of 2m (~6ft) (Canadell, *et al.*, 1996).

Figure 12 shows the water levels from 2009 to 2011. These monitoring sites are observed on an annual basis. When further data is collected the values will be compared to see if there is a change in species composition. Rain gauges were installed in the spring of 2010, and Figure 13 shows the varying precipitation levels on a monthly basis. As expected there are dips during the mid-summer months as a result of high temperatures and increased evapotranspiration. The summer of 2011 saw a particularly hot and dry period in July.

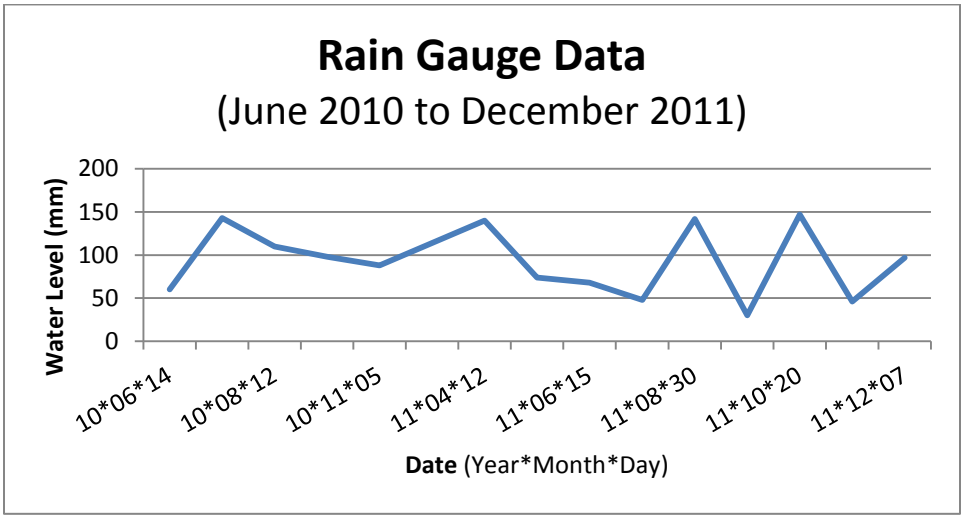


Figure 13: Rain Gauge Data

4.0 SUMMARY

The 2011 field season proved to be a productive and successful period, establishing plots within the Pringle Creek watershed and revisiting the existing 17 plots within the Bowmanville/Soper Creek. In addition to this, two new special projects were conducted. Two of the existing special projects will continue into the 2012 monitoring season. Purple Loosestrife and its biological control will continue to be monitored through the DRCWMP project, and will be assessed at a later date as to whether further surveying and management is necessary.

This data will be used in conjunction with future existing condition reports for CLOCA's watersheds, CA management plans, and Invasive Species Management planning. Monitoring will occur once every five years, similar to those established for CLOCA's other natural heritage monitoring programs.

Yellow Ladies Slippers
Cypripedium calceolus

Sharp-lobed Hepatica
Anemone acutiloba

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