

Sydenham River Conservation Action Plan



Prepared by

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Sydenham River Conservation Action Plan (CAP) 2014

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Background & Rationale

Carolinian Canada Coalition's Big Picture Vision

The Sydenham River Conservation Action Plan (CAP) area is situated in the heart of Ecoregion 7E, an area extending from Toronto to Grand Bend, south to Niagara Falls and the western Lake Erie islands. This ecoregion is colloquially known as Canada's "Carolinian life zone", or simply "Carolinian Canada" because many plants and animals found in the eastern United States as far south as the Carolinas reach their northern limit in this part of Ontario.

Green, healthy landscapes are essential to human quality of life and economic prosperity. Conservation efforts in the past have focused on "islands of green" on landscapes where human uses and activities prevail. In 1984 Carolinian Canada Coalition identified 38 critical natural areas across the ecoregion needing urgent action. But our scientific understanding has evolved and we now know that these "islands of green" cannot remain healthy in isolation. To remain viable they must be connected one to another in a "natural heritage system". Natural heritage systems are critical for maintaining the quality of our water and air, for species movement and genetic exchange, and for adapting to climate change. In 2000, Carolinian Canada's "Big Picture" analysis identified such a natural heritage system of core natural areas and connecting corridors.

The "Big Picture" continues to inform and complement the natural heritage planning being done by municipalities, conservation authorities, and provincial and federal departments. Carolinian Canada is working to update the Big Picture with new information, and find ways to monitor how well we are doing to achieve this vision.

Conservation Action Planning in Canada's Carolinian Life Zone

The Carolinian life zone occupies less than 0.25% of Canada's landmass, yet it provides habitat for over 40% of Canada's plant species and equally large proportions of vertebrate and invertebrate fauna. At the same time, one quarter of Canada's human population lives in the region, the nation's agricultural, industrial and economic heartland. As a result, extensive conversion to human land uses has occurred. In southern Ontario, 94% of upland forests were cleared over the past two centuries, while more than 70% of all pre-settlement wetlands have been converted, and up to 99% of prairies and savannahs have been lost.

On a heavily-modified working landscape such as this, habitat fragmentation has reduced most natural areas to sizes much smaller than is required to maintain basic ecological functions and diverse, resilient biological communities. Overall, natural cover across the Carolinian life zone now ranges from less than 7% in some areas to below 18% in others. These high levels of land conversion mean that many of the essential ecological processes needed for healthy soils, clean water and clean air have been severely compromised.

For these reasons, combined with the fact that many of the species found here are near the northern limits of their distribution, the ecoregion has the greatest number and concentration of Species At Risk (SAR) in Canada. At least 56 of them occur in the Sydenham River CAP Area. More than 500 additional plant and animal species found in the zone are recognized to be at some level of risk, and many of these are just as threatened as "official" SAR but have not yet gone through the legislative process required to designate them. If historical trends continue, more and more species will end up designated as SAR, resulting in greater costs to protect them and increased regulatory demands on rural landowners.

The Carolinian Woodlands Recovery Team (CWRT), made up of representatives from various levels of government, non-government organizations, the academic research community and the private sector, was established in 2004 to address the recovery needs of the many woodland plant species that are at risk in the ecoregion. The CWRT recognized that many SAR occupy similar habitats and face similar threats. The CWRT also noted that there is an array of organisations, agencies and groups with an interest in conserving and enhancing the ecological health of the landscape of southern Ontario, and that often these organisations are working independently and not in a particularly coordinated or collaborative fashion—a situation that potentially compromises the effective utilization of limited funding and resources.

While some species face threats requiring species-specific actions, taking a broad ecosystem-based approach for Ontario's Carolinian woodlands was considered to be the most efficient and proactive way to improve the chances of recovery of entire suites of species and their habitats. To address the need for large-scale “natural heritage system” planning, since 2000 the Carolinian Canada Coalition (CCC) has been promoting a “Big Picture” vision for the ecoregion, a map-based network of core natural areas and connecting corridors (http://www.carolinian.org/ConservationPrograms_BigPicture.htm). Between 2006 and 2008, a draft *National Recovery Strategy for Carolinian Woodland Ecosystems and Associated Species At Risk* (CWRS) was developed by the CWRT (Jalava and Mansur 2008, Jalava *et al.* 2009). Recovery goals were set at the ecosystem level in order to address the threats to the ecological processes that support biodiversity “hotspots”, SAR and their habitat, significant vegetation communities and natural areas. Restoring natural connectivity to such a network of core areas was deemed essential, as it would allow for genetic exchange between populations, adaptation and migration in response to climate change, and provide corridors for movement of wide-ranging species.

Strategies to address threats, recover habitats, and to monitor and evaluate recovery efforts were outlined in considerable detail. Ecosystem recovery would be directed along the following themes:

- refinement of the map-based template for an ecologically functioning network of core areas and corridors;
- better coordination of recovery efforts, with broad participation from agencies and stakeholders;
- improvements in databases, knowledge and understanding of Carolinian sites, SAR occurrences, and the biological needs of SAR;
- long term monitoring of sites, species and social trends;
- improvements in policy and legislation relating to conservation at all levels of government;
- net increases in overall woodland extent, average core area sizes, extent of forest interior, landscape connectivity, and extent of landscape protected through securement, easements, stewardship agreements and conservation plans;
- measurable reductions in threats to critical sites;
- improvement in population sizes, numbers of extant occurrences and habitat quality for SAR;
- significant increases in landowner participation in stewardship programs and incentives;
- municipalities applying natural heritage system design in official plans;
- enhanced public awareness and support for recovery of Carolinian ecosystems;
- community-based action plans developed for “biodiversity hotspots” to strategically implement ecosystem recovery objectives.

It was determined that The Nature Conservancy (U.S.) Conservation Action Plan (CAP) approach (<http://www.conservationgateway.org/topic/conservation-action-planning>) would best address these themes strategically and efficiently. The approach has been developed and refined over three decades throughout the world by a remarkable diversity of jurisdictions and organisations, including The Nature Conservancy of Canada (e.g., Southern Norfolk Sand Plain Natural Area Conservation Plan). CAPs are tailored to the specific characteristics and needs of ecologically-important landscapes. By applying this

approach to biodiversity “hotspots” in the Carolinian life zone, ultimately a network of linked conservation practitioners and action plans for each target landscape in the Carolinian life zone would be created. This network would:

- Address the urgent needs of priority SAR;
- Prevent increased numbers of species from being listed as SAR;
- Link SAR recovery strategies to watershed plans, official plans and a range of other key land use strategies and planning efforts;
- Heighten awareness, improve attitudes, and garner additional resources towards the recovery of species, communities and ecosystems at risk;
- Enhance community engagement in building a sustainable culture.

In 2007, a sophisticated analysis was undertaken in partnership between Carolinian Canada Coalition (CCC), the Nature Conservancy of Canada (NCC), Environment Canada (EC) and the Department of Fisheries and Oceans (DFO) to identify “biodiversity hotspots” in southern Ontario, based on the best available information on the occurrences and concentrations of rare species and natural communities. A map was developed that identified at least fifteen such areas. This map would serve as the template for targeting efforts on areas within the life zone where the greatest return on investment would be gained.

Two of the fifteen areas (Western Erie Islands and Southern Norfolk Sand Plain) had action plans already being developed or implemented by NCC, while another (Skunks Misery) had an action plan that was being implemented by the Thames Talbot Land Trust in collaboration with the NCC. Between 2008 and 2013, the CCC developed CAPs for nine additional priority areas (Essex Forests and Wetlands; Ausable River – Kettle Point – Pinery; Upper Thames River; Hamilton – Burlington; Short Hills; Niagara River Corridor; Elgin Greenway; Rondeau – Erie Coast; Lake St. Clair Coastal) with an array of local stakeholder groups, agencies and organisations, including conservation authorities, First Nations, agricultural organisations, provincial and federal government agencies, non-government organisations, naturalist clubs and municipalities.

The Chatham-Kent Shoreline Areas Community Sustainability Plan

The 2007 analysis demonstrated that four of the priority areas are in Chatham-Kent, including the Walpole Island – Lake St. Clair coast, the Rondeau - Erieau area, the lower Thames River, and the Chatham-Kent portion of the Sydenham River corridor. A large portion of these areas correspond very closely with areas that the Municipality of Chatham-Kent has identified in the “Chatham-Kent Shoreline Areas Community Sustainability Plan” (http://www.chatham-kent.ca/SiteCollectionDocuments/planning_development_services/Chatham-Kent%20Shoreline%20Areas%20%28Community%20Sustainability%20Plan%20-%20April%2011.%202011%29.pdf).

As part of an informal partnership between Chatham-Kent and the Carolinian Canada Coalition, and with the collaboration of a broad cross-section of stakeholders and sectors, CAPs for these areas of common interest represent an effort to develop and implement a realistic, action-oriented strategy that will build:

- healthier ecosystems and soils
- resilient, diverse biological communities
- cleaner water and air
- rewarding outdoor recreational experiences
- economic prosperity

- stronger communities
- improved quality of life for the communities.

At the same time, additional synergies emerged in discussions between the Municipality of Chatham-Kent and CCC, in which these parties concluded that a conservation action plan (CAP) would be an ideal complement to the Chatham-Kent Shoreline Areas Community Sustainability Plan (SACSP), in that the CAP would identify and prioritize the conservation activities to be implemented within the Shoreline Areas Community Sustainability Plan context. In other words, the Chatham-Kent Shoreline Areas Community Sustainability Plan would show *where* conservation work would best be done, and the CAP would identify and prioritize *what* would best be done and by *whom*, in order for conservation work to be most effective and efficient. The CAP also provides more refined mapping on potential priority areas for habitat stewardship, ecological restoration, etc. Although the Sydenham River CAP was originally to be part of the Lake St. Clair Coastal CAP and focused entirely on Chatham-Kent, the steering committee felt that the two areas should be treated as separate CAPs with the Sydenham CAP including the entire watershed.

In addition, the Chatham-Kent SACSP, the Lake St. Clair Coastal CAP and the Sydenham River CAP will complement the ecosystem-based recovery strategy for Walpole Island that has been developed by the Walpole Island (Bkejwanong) First Nation in collaboration with expert biologists and ecologists (Bowles 2005). The Sydenham River CAP is also intended to complement and address recommendations in the National Recovery Strategy for Species at Risk in the Sydenham River (Dextrase et al. 2003).

A steering committee was convened in June 2012, consisting of representatives from Municipality of Chatham-Kent, CCC, Chatham-Kent Wind Action Group, Lower Thames Valley Conservation Authority, National Wild Turkey Federation, Christian Farmers Federation - Chatham Kent, Stewardship Kent, Mitchell's Bay Association, St. Clair Region Conservation Authority / St. Clair Region Conservation Foundation, Sydenham Field Naturalists, Transition Town Chatham-Kent. The committee was introduced to the CAP methodology, discussed roles and levels of involvement of the organisations present, and other stakeholders that should be invited to contribute to the process. There was broad support for the initiative, and widespread agreement that the agricultural community, the major landowner and stewards of the area, needed to be actively engaged in the process. At this meeting the Sydenham River CAP and the Lake St. Clair Coastal CAP were separated and the Lake St. Clair Coastal CAP was developed in 2012-2013. On October 1, 2013 the steering committee for the Sydenham River CAP met and began the development of this CAP.

After the initial steering committee meeting additional partners became involved (see list of contributors on page iv) and contributed to the development of the CAP in the meetings and workshops that ensued over the next 4 months.

This report represents the results of the nearly two year planning process, which has drawn from the expertise and knowledge of a large and diverse group of local stakeholders. The long-term benefits of this approach include:

- Mapping tools are available to guide and prioritise site stewardship and ecological restoration activities in the Municipality of Chatham-Kent, Lambton and Middlesex Counties.
- Resources and funding can be targeted toward the most important projects, activities and sites as identified through a consensus-based multi-stakeholder approach;
- Multiple agencies, organisations and local groups can work collaboratively and efficiently to recover and steward healthy ecosystems, particularly in the highest priority areas;

- Information on Best Management Practices for species and habitats can be widely shared, and community knowledge and capacity will be enhanced.

The Sydenham River Conservation Action Plan essentially provides a workbook designed to help guide conservation activities and serve the community and stakeholder groups in the following ways:

- Stewardship, restoration and site securement by conservation authorities, land trusts, stewardship councils, and other agencies and groups, can be targeted on the areas where the greatest ecological benefits will be gained;
- Conservation and recovery activities are prioritized based on sound science combined with the best available local knowledge;
- Better coordinated, collaborative project proposals and funding applications, leading to greater likelihood of funding approval;
- Reduced duplication and competition for limited resources amongst the various agencies, groups and organisations;
- Clearly identified tasks and roles (developed on the basis of collaborative expertise) in conservation projects;
- Improved ability to measure progress and monitor results thanks to a mutually agreed-upon set of priorities and tasks;
- Greater transparency in conservation effort and greater buy-in from the community due to the collaborative nature of the approach.

This long-term, multi-faceted, targeted, coordinated approach will result in more vibrant, resilient ecosystems, healthier habitats and enhanced viability of flora and fauna across the Sydenham River watershed. Recovery of the ecosystems will not only serve the needs of SAR and other imperilled species, but will contribute to climate change adaptation and enhanced ecosystem services. Healthy ecosystems correlate directly to cleaner water and air, productive soils, sustainable agriculture, and enhanced tourism and recreational opportunities. Ultimately, this initiative aims to build more prosperous communities, healthier citizens, and improved quality of life in Sydenham River watershed and across the deep south of Ontario.

Vision

The Steering Committee developed the following vision for the Sydenham River CAP.

The Sydenham River Conservation Action Plan (CAP) aims to protect natural treasures, improve biodiversity through restoration of habitat to create healthy and sustainable ecosystems, enhance ecosystem services such as water quality for local communities, provide opportunities for economic viability, and engage citizens to work together toward a common, mutually-beneficial cause: a healthier environment for all.

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1. Conservation Context

i. Geographic Context

The Sydenham River Conservation Action Plan (CAP) area covers nearly the entire Sydenham River watershed, totalling 267,524 ha (2675 km²) of land in the heart of Ecoregion 7E (Figure 1 and 2). The CAP covers portions of the Municipality of Chatham-Kent, Lambton and Middlesex Counties. The CAP area is mostly within Ontario's Ecodistrict 7E-2 with a smaller portion in 7E-1. The CAP area boundaries were developed through GIS analyses of natural areas undertaken by the Nature Conservancy of Canada using methodology developed collaboratively by Ontario Nature and Carolinian Canada (see appendix A for methodology), with the input of the CAP team and other participating organisations listed above. A 10 km buffer that is mapped around the Sydenham River CAP area.

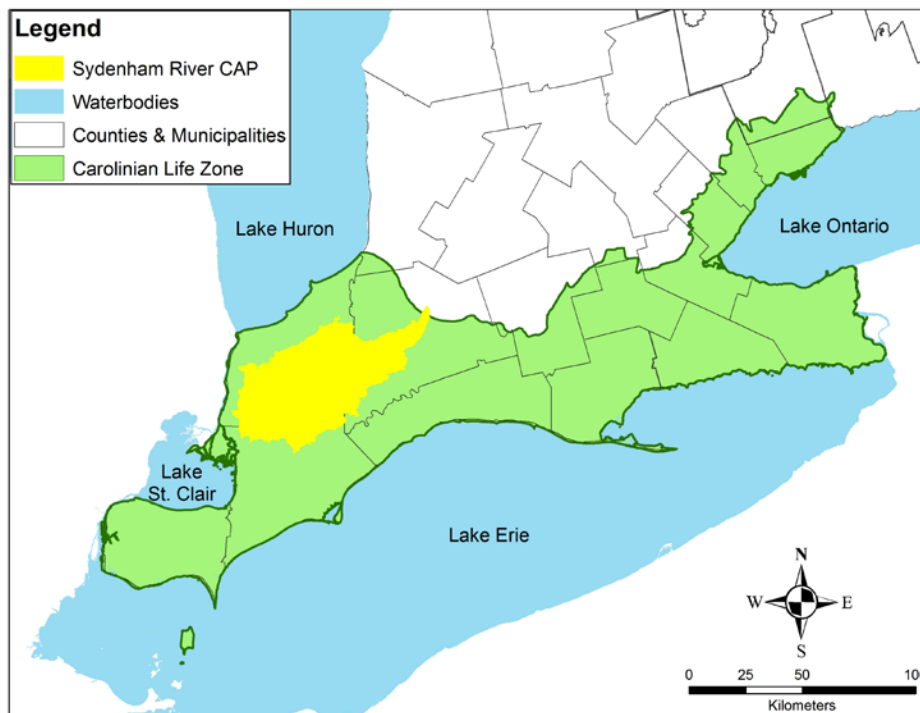


Figure 1. Location of Sydenham River Conservation Action Plan area.

ii. Historical, Cultural and Socioeconomic Context

Indigenous History – written by Rick Fehr, University of Western Ontario

The history of Indigenous land and water use throughout the Sydenham Watershed is extensive and diverse. While the archaeological record accounts for long and sustained Indigenous activities with semi-permanent villages, hunting camps, fishing and trapping activities, sugar maple orchards, agriculture, and

trade networks from various nations, the more recent historical record points to a large Anishinaabeg presence (specifically Ojibwe, Odawa, and Potawatomi).

Population estimates at the turn of the eighteenth century from the mouth of the Sydenham River to the Tupperville area indicate more than two-hundred Ojibwe and Odawas accounted for.¹ This number reflects a presence of extended families on Walpole Island, St. Anne's Island, Southeast Michigan, Saginaw, and Southern Ontario. This was a time when the British Crown promoted Indigenous settlement of the Chenal Ecarté tract by promising the area that is now Sombra Township to be a community set aside for Indigenous warriors allied to the Crown.² Historically, this area has long been favoured as a resource rich environment which features numerous aquatic and Carolinian ecosystems. The Anishinaabeg were particularly drawn to the vibrant fishing in Lake St. Clair, the St. Clair River, Chenal Ecarté (Snye River) which was used a staple trade item with communities and extended family throughout the region, including the Bear Creek community of Ojibwe near present-day Florence.³

Indigenous communities throughout the Sydenham watershed experienced tremendous difficulties maintaining traditional lifestyles as European settlers encroached onto their territory. One of the more profound disruptions to the loss of Indigenous livelihood was the loss of woodland. The clearing of wooded areas for farming not only removed game resources, it effectively put an end to a rich and vibrant Indigenous maple sugar industry. The sugar orchards⁴ generally existed along either shore of the major courses of the Sydenham River, and the water route offered quick product transportation. Other sites of sugar production (such as in Dover Township) occurred near footpaths or creeks). The disruption of the sugar industry is noted in Indian Affairs documents, as the Anishinaabeg relied on brass kettles as part of their treaty annuities with the Crown. There is a simultaneous trend of brass kettles being withheld, hunters having to go further afield to catch game, and increased European settlement along the Sydenham Watershed in the mid to late nineteenth century.⁵

Indigenous livelihood and presence on the Sydenham River has not ended. Although much of the wooded areas have been cleared, prairies removed and wetlands drained, the Indigenous communities continue to practice their Aboriginal Rights throughout the Sydenham Watershed. Traditional activities such as hunting, fishing, and trapping are still practiced by the on-Reserve and off-Reserve Indigenous population throughout the Sydenham Watershed.

Landscape Conversion

By the mid- to late 1800's, the natural vegetation of much of Southern Ontario had been cleared by European settlers (Langman 1971). The Sydenham River CAP is lies mostly in Ecodistrict 7E-2 and partly in 7E-1. Today, over 80% of Ecodistrict 7E-2 has been converted to agriculture (756,586 ha), with an additional 11,046 ha having been altered for residential, industrial and infrastructure uses (Henson and Brodribb 2005). About 16% of 7E-2 remains naturally-vegetated, most of this being forest (Henson and Brodribb 2005) in Norfolk and Elgin counties. Over 88% of Ecodistrict 7E-1 has been converted to agriculture (334,345 ha), with an additional 9,725 ha having been altered for residential, industrial and infrastructure uses (Henson and Brodribb 2005). Only about 8% of 7E-1 remains naturally-vegetated.

¹ Census of Chenail Ecarte Indians, 24 June 1798, British Military and Naval Records, R11,517-0-6-E, C 2,850, Vol 251, p 148, Library and Archives Canada.

² Colonel Alexander McKee to Sir John Johnson, 20 January 1797, Michigan Pioneer and Historical Society (MPH), 1892, Vol. 20, pg 497.

³ Neal Ferris. *Native-Lived Colonialism, Challenging History in the Great Lakes*, (Tucson: University of Arizona Press), 2009.

⁴ The term orchards is more accurate to reflect the diversity of fruit and nut bearing trees present in these wooded areas.

⁵ William Jones Letterbook, 1831 – 1839, F 454, Archives of Ontario.

Nearly half of that is marsh, with a mixture of forest and small patches of prairie and savannah (Henson and Brodribb 2005).

The Sydenham River watershed is predominantly rural. Historically the watershed was approximately 70% forest and 30% swamp but agriculture now accounts for 85% of the land use (Dextrase et al. 2003). Extensive drainage infrastructure, such as open and tile drains, has improved conditions for row cropping and now such artificial drainage affects approximately 60% of watershed (Dextrase et al. 2003). The amount of agriculture varies across the three counties/municipalities, with 90% of the area as farmland in Chatham-Kent, 80% in Lambton, and 75% in Middlesex reported in the 2011 Census (Statistics Canada 2012, OMAFRA 2012). The rich soils are ideal for growing a wide variety of crops. These are primarily, but not limited to, soybeans, greenhouse vegetables, floriculture nursery and sod, corn, field vegetables, fruit and wheat. The lake-moderated climate is among Canada's longest growing seasons, with relatively mild winters, and, in most years, adequate rainfall.

Outside of a few towns and villages the population density is low, reflecting the largely rural nature of the CAP area. The population in 2011 of the Municipality of Chatham-Kent was 103,671, for a density of 42.2 persons/km²; Lambton County was 126,199, for a density of 42 persons/km²; Middlesex County was 439,151, for a density of 132.4 persons/km². Communities within the Sydenham River CAP area include the towns of Wallaceburg, Strathroy, Petrolia, Dresden and Watford and a number of smaller communities with populations of approximately 1,000 or less (Table 1).

Table 1. Summary of Population Information in the Sydenham River CAP area. Only centres within the CAP area are included; all information is from the 2011 census (Statistics Canada 2012).

Name	Population	2006-2011 Population Change (%)	Population Density (persons/km ²)
Wallaceburg	10,163	-5	1,018.2
Dresden	2,446	-2.0	739.4
Strathroy	14,221	+5.0	929.4
Watford	1,592	-3.0	695.6
Petrolia	5,528	+5.9	435.8

The top four industries in terms of employment in each county/municipality of the CAP are (Statistics Canada 2012):

Chatham-Kent:

- Retail Trade (12%)
- Manufacturing (12%)
- Health Care and Social Assistance (12%)
- Agriculture, forestry, fishing and hunting (8%)

Lambton County:

- Health Care and Social Assistance (12%)
- Manufacturing (12%)
- Retail Trade (11%)
- Construction (8%)

Middlesex County:

- Health Care and Social Assistance (14%)

- Retail Trade (11%)
- Manufacturing (11%)
- Educational Services (9%)

iii. Ecological Context

Carolinian Canada

The Sydenham River CAP area is located in the southwestern portion of Ecoregion 7E, colloquially known as the Carolinian life zone of Canada, which falls south of a line running between Grand Bend and Toronto. This life zone encompasses the northernmost edge of the deciduous forest region of eastern North America, and though smaller than other Canadian ecological zones (0.25% of Canadian land area), it has greater numbers of species of flora and fauna than any other ecosystem in Canada (Norfolk Environmental Advisory Committee 2006). This zone is characterized by mainly deciduous-dominated forests including some conifer species [*e.g.*, Eastern Red-cedar (*Juniperus virginiana*), White Pine (*Pinus strobus*)], many southern trees at their northern range limits such as Tulip Tree (*Liriodendron tulipifera*), along with shrubs and herbaceous species not found in other parts of Canada (Lindsay 1984). Over 2,200 plant species, 70 native tree species, and more than half of all Canadian bird species can be found in Carolinian Canada (Solymár *et al.* 2008).

Ecodistrict 7E-1

At the southwest end of Ecoregion 7E is Ecodistrict (formerly, Ecological Site District) 7E-1 (Chatham), which is the southernmost ecodistrict in Ontario. It is largely composed of the Lake St. Clair clay plains with minor till moraines. The northern boundary borders the Bothwell sand plains and bevelled till plains. Lake Erie sandspits occur at Point Pelee and Rondeau. Ecodistrict 7E-1 is one of the most threatened ecodistricts in Ontario, with < 8% natural cover remaining, nearly half of which is marsh (mainly at Point Pelee and in the St. Clair Delta). The majority of the remaining natural cover is a mixture of forested ecological systems comprised predominantly of small remnant patches of sand plain deciduous forest complexes (4,071 ha/10,059 ac), till plain deciduous forest complexes (3,714 ha/9,177 ac) and clay plain deciduous forest complexes (2,140 ha/5,287 ac) (Henson and Brodribb 2005).

Despite the widespread conversion of natural cover to urban and agricultural land, 7E-1 remains biologically diverse. Within the remaining portions of natural cover, Ecodistrict 7E-1 still supports among the highest concentrations of globally rare species and communities in Ontario, and over 60 species listed as nationally Endangered, Threatened or Special Concern by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). In a recent assessment of global biodiversity values (rare species and communities, endemic and disjunct species), 7E-1 was found to rank fourth in Ontario, behind Manitoulin Island (6E-17) and the Northern and Southern Bruce Peninsula (6E-14 and 6E-4). Despite its high conservation value, Ecodistrict 7E-1 has very few protected areas. Only about 1% of the region is protected in regulated parks, with an additional 2% in conservation lands [*e.g.* Conservation Authority lands, Areas of Natural and Scientific Interest (ANSI)]. This is the lowest proportion of protected areas and conservation lands of any region in Ontario (Henson and Brodribb 2005).

Ecodistrict 7E-2

Also within Ecoregion 7E is Ecodistrict 7E-2 (St. Thomas), the largest ecodistrict in the ecoregion, extending from the Long Point – Norfolk County area west to Chatham and Grand Bend (reviewed in detail in Henson and Brodribb 2005). This ecodistrict consists predominantly of sand plains, with some kame moraines. Approximately 16% of the ecodistrict remains naturally-vegetated, most of this being forest. Sand plain deciduous forest complex comprises 43% of this remaining natural cover, followed by clay plain deciduous forest complexes and till plain forest complexes, each with 14% of the remaining natural cover. Another 12% of the remaining natural cover is wetland, with two-thirds composed of swamp complexes. There are also 2,430 ha of prairies and savannahs remaining in 7E-2, approximately 68% of the total area of all remnants known in southern Ontario. Over 80% of 7E-2 has been converted to agriculture (756,586 ha), with an additional 11,046 ha of residential, industrial and infrastructure development.

Despite the widespread conversion of natural cover, Ecodistrict 7E-2 remains biologically diverse, with among the highest numbers of globally rare species and communities in Ontario (Henson and Brodribb 2005). More than 60 COSEWIC Species At Risk (SAR) are found in the ecodistrict. Despite its high conservation value, conservation lands make up only approximately 4% of the total area of the Ecodistrict 7E-2 (39,875 ha), with most of this in Norfolk County. Provincially significant life science Areas of Natural and Scientific Interest (ANSIs), which often occur on private lands and receive only limited protection through provincial planning legislation, account for nearly half of this, with a total of 18,517 hectares (2% of the ecodistrict). Forty-three percent of all documented occurrences of species and vegetation community targets in 7E-2 are within identified conservation lands; more than half of these are within provincially significant life science ANSIs. Six of the 27 significant vegetation communities identified within 7E-2 are globally rare (dunes, savannahs and tallgrass prairie), 14 are provincially rare, and 12 are considered to be high-quality representative vegetation communities that are important to conservation.

Sydenham River CAP Area

The Sydenham River CAP area follows the Sydenham River watershed boundary, extending across northwest Chatham-Kent, southwest Lambton County and northeast Middlesex County (267,524 ha, Figure 2). Mapping includes an additional 10 km buffer to display landscape connectivity with natural features in adjacent watersheds. Forests are the dominant ecosystem in the Sydenham River CAP area, but wetland habitats of high conservation value also occur.

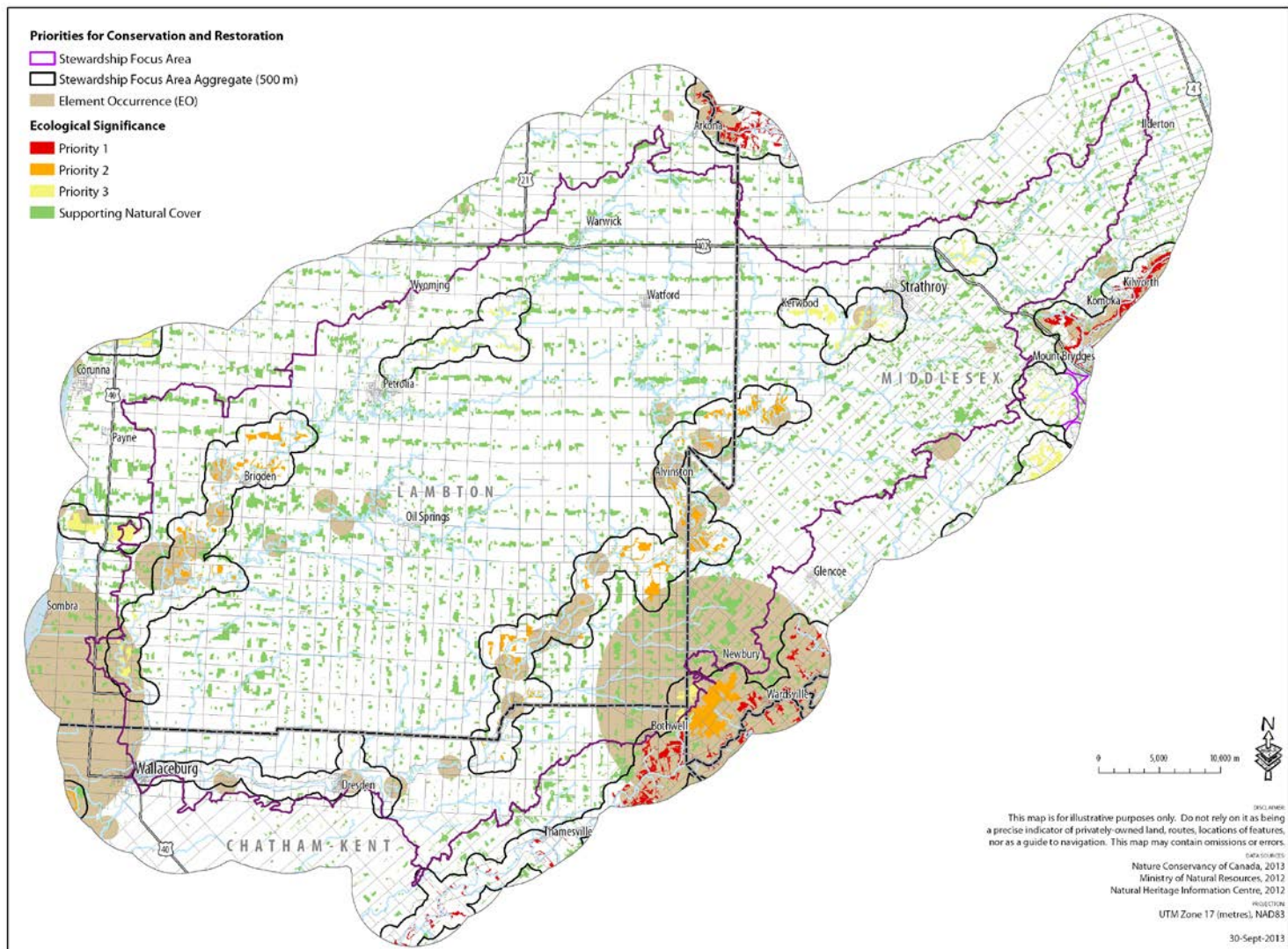


Figure 2. The Sydenham River CAP follows the watershed boundary across Chatham-Kent, Lambton and Middlesex. The map shows priorities for conservation and restoration (see legend and Appendix A for details). Element Occurrence = single population of a species tracked by the Natural Heritage Information Centre.

Physiography and Glacial History

The Sydenham River CAP overlaps with several physiographic regions of southern Ontario (Figure 3). The majority of the CAP is on the St. Clair Clay Plains in the north and west, with smaller portions in the Bothwell Sand Plains in the south, and small sections of the Ekfrid Clay Plain, Horseshoe Moraines, Cardoc Sand Plains and London Annex, and Stratford till Plain in the east (Chapman and Putnam 1984). The bedrock underlying the Sydenham River CAP area dates to the upper Devonian, consisting of softer sedimentary limestones, shales and sandstone. This softer material was greatly eroded by advance and recession of glaciers through the area in the last major glaciation. During the recession of the Wisconsin glacier, much of the Sydenham River CAP area was under glacial lakes.

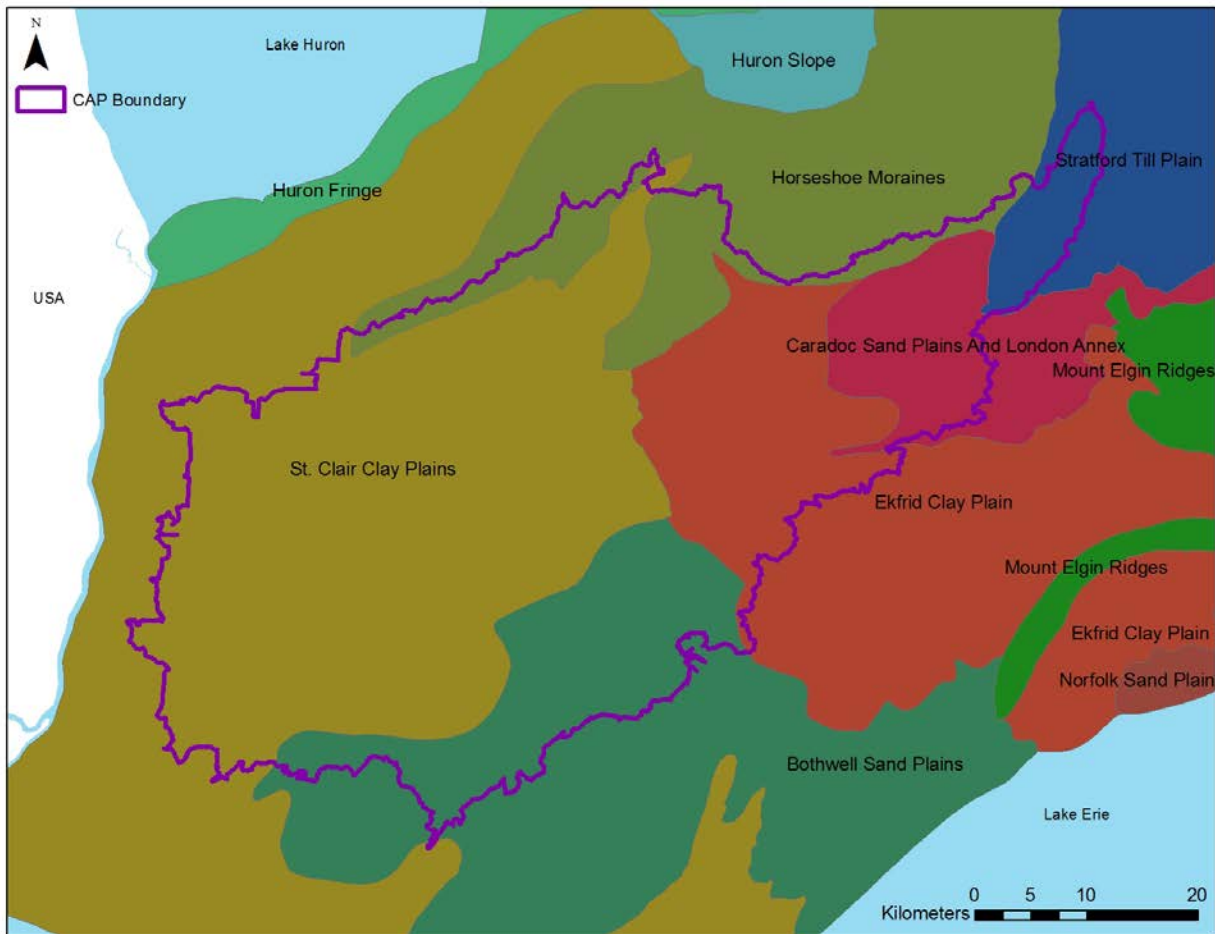


Figure 3. Physiographic regions of the Sydenham River CAP.

St. Clair Clay Plains

The north and west portions of the Sydenham River CAP are primarily located within the St. Clair Clay Plains physiographic region (Chapman and Putnam 1984). These extensive clay plains cover 363,200 ha (897,104 ac) in total, at an altitude of approximately 200 m above sea level with very little relief. There is a deep overburden covering the limestone and dolostone bedrock throughout the majority of the region. The region was once extensively covered by the glacial Lakes Whittlesey and Warren, which did not stratify the sediment and left the majority of the land covered in unconsolidated clay till, smoothed by

shallow deposits of lacustrine clay. Overall, the area is characterized by poorly drained soils, and in some undrained areas, peat and muck has accumulated.

Bothwell Sand Plain

The south edge of the CAP is on Bothwell Sand Plain. The area was the former delta of the Thames River as it joined the glacial Lake Warren (Chapman and Putnam 1984). The sand is spread thinly over clay resulting in water accumulation above the clay layer. Many depressions in the area are very moist creating swamp complexes. The Bothwell Sand Plain has generally high agricultural value (Class 3 agricultural lands), with a high water table.

Ekfrid Clay Plain

The Ekfrid Clay Plain is found in the east portion of the CAP. Streams draining into the Sydenham have cut some deep gullies that break up the nearly level Plain (Chapman and Putnam 1984). Knolls and low smooth ridges of sand and gravel can also be found throughout the area. Some areas of clay are superimposed by silty sediments leading to very good agricultural soils and most natural vegetation in this physiographic region has been cleared (Chapman and Putnam 1984).

Biodiversity

The Sydenham River CAP is situated in the southernmost part of Canada and is home to a remarkable diversity of southern flora and fauna, many of them at the northern limits of their ranges. Despite the fact that much of the area has undergone conversion to agricultural and urban land uses, at least 153 species of breeding birds (Bird Studies Canada et al. 2008), 34 mussels, and 80 fish (Dextrase et al. 2003) have been recorded in the watershed. The area provides habitat for at least 56 extant terrestrial and aquatic Species at Risk (SAR), with another 13 SAR having occurred historically, plus 94 rare species tracked by the Natural Heritage Information Centre (NHIC) (see Section vi).

Many southern plant species reach their northern limits in the Carolinian Zone, including trees such as Sassafras (*Sassafras albidum*), Blue Ash (*Fraxinus quadrangulata*) and Kentucky Coffee-tree (*Gymnocladus dioica*). Many southern herbaceous plants, sedges and grasses also reach their northern limits in this area. Characteristic southern fauna of the area include mammals such as Virginia Opossum (*Didelphis virginiana*) and reptiles such as Butler's Gartersnake (*Thamnophis butleri*).

Forests

Deciduous forests and swamps were the dominant ecosystem historically in the Sydenham River CAP area. Forest cover ranges between 6% and 14% across the various sub-watersheds of the CAP (St. Clair Region Conservation Authority, 2013). Nonetheless, these forests maintain more than 10 SAR such as the Butternut (*Juglans cinerea*, Endangered), Drooping Trillium (*Trillium flexipes*, Endangered, Figure 4) and Red-headed Woodpecker (*Melanerpes erythrocephalus*, Special Concern, Figure 4).

Rivers, Marshes and Wetlands

Wetlands and rivers are major features in the Sydenham River CAP. The Sydenham River supports aquatic SAR such as the Spiny Softshell Turtle (*Apalone spinifera*, Threatened), Kidneyshell (*Ptychobranthus fasciolaris*, Endangered, Figure 4) and Eastern Sand Darter (*Ammocrypta pellucida*, Threatened). Wetlands form a substantial part of the CAP, with nearly 2,723 hectares of the CAP being Provincially Significant Wetland (PSW). In addition to PSWs, the St. Clair Region Conservation Authority has identified an additional 342 ha of un-evaluated wetlands based on soil types, groundwater discharge mapping or proximity to evaluated wetlands (St. Clair Region Conservation Authority, 2013). Several large wetland complexes exist in the CAP area including Bickford Oak Woods Wetland Complex, Komoka/South Strathroy Creek Wetland, Sydenham River Wetland Complex, Melbourne



Figure 4. Example Species at Risk in the Sydenham River CAP. Top left: Kidneyshell mussel found in the Sydenham River © S. Staton; Bottom left: Drooping Trillium © P. A. Woodliffe; Right: Red-headed Woodpecker © P. A. Woodliffe.

Marsh, and Longwoods Woodlot Wetland Complex. Although the entire region covered by St. Clair Region Conservation Authority has less than 1% wetland cover, some of the highest wetland cover occurs in the upper reaches of the Sydenham River watershed (Sydenham Headwaters at 4.5%, Upper Sydenham River 2.6%) (St. Clair Region Conservation Authority, 2013). Most of Southern Ontario wetlands have been drained (Snell 1987), hence the remaining wetlands provide a refuge for many SAR. Reptiles such as snakes and turtles are particularly dependent on wetlands and many reptile SAR are found in the wetlands of the CAP [e.g. Blanding’s Turtle (*Emydoidea blandingii*, Threatened), Eastern Foxsnake (*Pantherophis gloydi*, Endangered)].

Prairies and Savannas

Prairies and savannas are rare ecosystems in Southern Ontario and few natural remnants remain (Bakowsky and Riley 1994). Historical mapping of prairies and savannas based on land surveyors’ notes from the late 1800s suggests some patches of these rare habitats occurred in the CAP area, particularly near Strathroy and in Chatham-Kent (McLean and Bakowsky 1998). Prairies and savannas typically occur as small patches and may not have been recorded in the original surveys, and some extant patches may not have been identified in the CAP area to date given how much of the landscape is privately-owned and largely inaccessible to ecologists. The lack of data on historic and extent prairie and savannah habitats in the CAP area are limiting our ability to assess the viability and threats to this conservation target. Restoration of these habitats may be warranted based on soils, surficial geology, terrain, climate

and proximity to existing or past grassland habitats. Several prairie plantings have already occurred in the CAP area and likely support Species at Risk already found in the CAP area. Species at Risk that prefer prairie and savannah habitats include Dense Blazing-star (*Liatris spicata*, Threatened), Butler’s Gartersnake (*Thamnophis butleri*, Endangered), Bobolink (*Dolichonyx oryzivorus*, Threatened) and Riddell’s Goldenrod (*Solidago riddellii*, Special Concern).

Natural Areas

Protected natural areas are essential for biodiversity conservation as they are often the only safe haven for many organisms that are sensitive to human influence. The Sydenham River CAP area contains many natural areas of various sizes and designations that support the remaining natural cover (Table 2, Appendix B). Only a very small proportion of the CAP area, however, has any strictly regulated protection criteria as set out by the International Union for Conservation of Nature (IUCN). The largest protected area is the Bickford Oak Woods Conservation Reserve, although there are other tracts of land with lower protection levels present, often associated with swamps or stream valleys that are unsuitable for agricultural purposes. In southwestern Ontario many natural areas are stewarded by conscientious landowners dedicated to biodiversity protection. Natural areas without strict protection, however, can be vulnerable to land use changes and impacts from human uses. For a complete list of the Natural Heritage sites in the Sydenham River CAP area, please see Appendix B.

Table 2. Natural Heritage Designations for the CAP area. Some sites can be included in more than one category (e.g. Plum Creek Upland Forest is both an ANSI and a Carolinian Canada Site). Additional natural areas exist which do not have any protection and are not included in this table. See Appendix B for full listing of natural areas.

Designation	IUCN Protected Area Management Category¹	Area in hectares	Percentage of CAP area	Reference
Wilderness Area	Ib	314	0.12	OMNR
National Wildlife Area	IV	111	0.04	Environment Canada
Conservation Authority Area	V	1912	0.71	Conservation Authority
Provincial Life Science Area of Natural and Scientific Interest	VI	580.25	0.22	NHIC 2014
Regional Life Science Area of Natural and Scientific Interest	N/A	4058.15	1.52	NHIC 2014
Provincially Significant Wetland	VI	2722.92	1.02	NHIC 2014
Carolinian Canada Site	N/A	568	0.21	CCC

¹ IUCN Categories (Dudley, 2008): Ia. Strict nature reserve*; Ib. Wilderness area*; II. National/provincial park*; III. Natural monument or feature; IV. Habitat/species management area, V. Protected landscape or seascape, VI. Protected area with sustainable use of natural resources. * Strictly regulated protected areas. Some areas may have more than one IUCN category because of internal zoning.

iv. Natural Cover / Ecosystem Types

Twenty vegetation communities have been identified within ecodistrict 7E-1 (Henson and Brodribb 2005). Of these, 4 are forest types, 3 are wetlands (swamps or marshes), 1 is prairie, 4 are savannahs, 3 are grasslands, 2 are woodlands, 2 are shrublands and 1 is sand beach. Deciduous forest is the dominant ecosystem with pockets of other types of communities dispersed throughout where conditions are appropriate.

v. Dominant Environmental Processes

The deciduous forests that historically formed the dominant matrix community throughout southern Ontario were relatively stable and supported wide-ranging species (Davis 1996; Anderson and Bernstein 2003). Nested within these large forests were large and small patch habitat types (Anderson and Bernstein 2003) that often resulted in response to unique or specific terrain. Within the Carolinian life zone large patch communities include marshes, savannahs and prairies.

Minimum Dynamic Area

Minimum dynamic area (MDA) is often used to determine the minimum area needed to maintain natural ecological processes and to ensure that examples of all successional stages will exist within a given habitat type under all disturbance regimes (e.g. wind, fire, insects) (Pickett and Thompson 1978). Most forests in southern Ontario experienced average disturbances of less than 2 hectares (4 acres), and early successional stages were limited to gaps created in the canopy by windstorms, downbursts and ice-storms (Riley and Mohr 1994; Larson *et al.* 1999). It has been estimated that protected landscapes must be 50 to 100 times larger than average disturbance patches in order to maintain a relative equilibrium of habitats (Shugart and West 1981). In such landscapes, the proportions of different successional stages (e.g. young forest, old growth forest) would be relatively constant over time, even though the sites occupied by different stand types would change. On this basis, minimum recommended area for core forests in southern Ontario would be between 100 and 200 hectares (~250 and 500 acres). Given projections for larger, more frequent storms due to climate change, a conservative strategy would recommend cores of at least 200 hectares (~500 acres) in size.

Fire

Primary disturbance regimes in the prairies and savannahs of southern Ontario were largely driven by drought and fire cycles. Most of these tallgrass systems occurred on sand plains that experienced fires every 5-15 years. Fire is a significant process in the functioning and maintenance of Ontario's remaining prairies (areas which historically supported grasses and herbs with few trees), grasslands (anthropogenic communities of grasses which occur as a result of abandoned cultural use such as farming) and savannahs [grasslands with 25-35% cover of woody species (Lee *et al.* 1998)]. Fire encourages species that respond to newly burned and open conditions and that benefit from the lack of competition from woody species, which cannot populate burned areas as quickly and efficiently. Natural fire regimes in southern Ontario have been suppressed or altered since European settlement, and as a result, many valuable natural areas have been, and continue to be, lost to succession. Succession is defined as the eventual encroachment of woody species, especially trees, into areas which will cause the cover to eventually become a woodland or forest. In this setting, woody species dominate and prairie or grassland species often die out due to shading or competition from these plants.

Savannahs exist as a delicate balance between scattered woody species and grassland species, and grow specifically in areas wet enough to support trees but dry enough to be subject to fire. They rely on frequent fire events to prevent forested oak woodland cover from becoming dominant.

Grasslands and prairies are similar to savannahs but have less cover of fire-tolerant oak species and greater expanses of open land carpeted in herbaceous, fire-tolerant grasses. Fire is usually an essential component in maintaining grasslands, prairies and savannahs. Burning tallgrass prairies has been shown to stimulate growth of prairie plants and the mycorrhizae that aid plants in nutrient acquisition (Bentivenga and Hetrick 1991).

Hydrology

The Sydenham River is a large river originating west of London and flowing 165 kilometres through the agricultural heartland of southwestern Ontario to Lake St. Clair, which drains into Lake Erie (Figure 5). The river has two main branches. The North Sydenham begins near the village of Arkona, and winds through a narrow and shallow valley to the Town of Wallaceburg (Jacques Whitford Environment Limited, 2001). The East Sydenham River, which is longer, arises from the Lucan moraine near Ilderton and meets the North Sydenham River at Wallaceburg. The main stem of the river empties into Chenal Ecarté just south of Wallaceburg.

Due to low relief across the watershed (0.06%) drainage is poor and much of the area has historically experienced drainage problems and flooding (Jacques Whitford Environment Limited, 2001). Not surprisingly, nearly 30% of the area was historically covered in swamps. Construction of tile drainage and open drains since 1859 have resulted in more than 60% of the area now being tile drained (Jacques Whitford Environment Limited, 2001). In addition several dams have been installed along the river's main stem and its tributaries (Jacques Whitford Environment Limited, 2001). Although these dams are typically not used for flow regulation (but mainly for recreation and aesthetics) they do back up water during extreme rainfall events.

Changes in land cover, drainage and damming of streams greatly affect the ecological integrity of river ecosystems (Allan 2004). In much of Southern Ontario, including the Sydenham River CAP, large amounts of forest cover have been removed (Larson *et al.* 1999) and a large proportion of wetlands have been drained (Snell 1987). In addition, streams and rivers in the area are dammed, channelized and dyked to control water flow, modifying the natural flooding cycles and floodplain ecosystems.



Figure 5. East Sydenham River near Dresden. © E. Carroll

vi. Significant Species

Despite the fact that much of the area has undergone conversion to agricultural and urban land uses, it provides habitat for at least 56 extant terrestrial and aquatic Species at Risk (SAR), with another 13 SAR having occurred historically.

Unless otherwise indicated, data in Tables 1.3-1.4 are from NHIC (February 2014) but the individual records are generally not current to 2014. Additional records from CAP team members have been included in parentheses. Only designated Species At Risk (SAR) (Endangered, Threatened or Special Concern) or candidate species are included in table 3. Many additional globally and provincially rare species (Table 4) occur in these areas, and some of them may be considered as focal conservation targets during the CAP process. Records have in some cases not been included for locally extirpated species (indicated with X) occurring at sites considered so modified that they are not recoverable, although records of many historic (indicated with H) and extirpated taxa are presented since these could conceivably recolonise (or be reintroduced) as habitats are restored.

Table 3. Significant Species found in the Sydenham River CAP Area. Data from NHIC (2014) plus additional observations of species by CAP team members in parentheses.

Element	G-rank ¹	S-rank ¹	COSEWIC ²	OMNR ²	EO Rank ³	Last Observed Date (DD/MM/YYYY)	Associated Conservation Target(s) (see Table 5 for key to codes)
Acadian Flycatcher	G5	S2S3B	END	END	H*	07/07/1985 (OBBA 2001-2005)	UF
American Badger	G5	S2	END	END	E	No Data	PS; TF; AG
American Chestnut	G4	S2	END	END	D	2001-2002	UF; AG
Barn Owl	G5	S1	END	END	H	09/1963	PS; TF; AG
Barn Swallow	G5	S4B	THR	THR		OBBA 2001-2005	AG
Blackstripe Topminnow	G5	S2	SC	SC	E	1997	RS; FM
Black Tern	G4	S3B	NAR	SC		OBBA 2001-2005	WE
Blanding's Turtle	G4	S3	THR	THR	E	08/06/1994	WE; RS; RP
Blue Ash	G5	S3	SC	SC	A	1992	RS; WE
Bobolink	G5	S4B	THR	THR		OBBA 2001-2005	PS; AG
Butler's Gartersnake	G4	S2	END	END	E	08/04/2009	PS; TF; RP
Butternut	G4	S3?	END	END	E	2001	UF edges; TF?
Cerulean Warbler	G4	S3B	END	THR	H*	1985 (OBBA 2001-2005)	UF
Chimney Swift	G5	S4B,S4N	THR	THR		OBBA 2001-2005	AG; UF

Element	G-rank¹	S-rank¹	COSEWIC²	OMNR²	EO Rank³	Last Observed Date (DD/MM/YYYY)	Associated Conservation Target(s) (see Table 5 for key to codes)
Climbing Prairie Rose	G5	S3	SC	SC	D	13/07/1993	PS; TF
Common Five-lined Skink (Carolinian population)	G5T2	S2	END	END	H	15/04/1963	PS; UF; RP
Common Nighthawk	G5	S4B	THR	SC		OBBA 2001-2005	UF; TF; WE
Crooked-stem Aster	G4G5	S2	SC	THR		(date unknown)	RS; UF
Dense Blazing Star	G5	S2	THR	THR	D	04/09/2008	PS; WE
Drooping Trillium	G5	S1	END	END	A	13/05/2007 (2013)	UF; WE; RS
Eastern Flowering Dogwood	G5	S2?	END	END		15/05/2008	PS; UF; TF
Eastern Foxsnake (Carolinian population)	G3TNR	S2	END	END		(2013)	WE; RP; PS; RS
Eastern Hog-nosed Snake	G5	S3	THR	THR		30/05/1988	UF; TF; WE; RP; PS
Eastern Meadowlark	G5	S4B	THR	THR		OBBA 2001-2005	PS; AG
Eastern Pondmussel	G4	S1	END	END		31/07/1991	RS; FM
Eastern Ribbonsnake	G5	S3	SC	SC	H	1938	WE; RP
Eastern Sand Darter	G3G4	S2	THR	END	E	13/08/2002	RS; FM
Eastern Whip-poor-will	G5	S4B	THR	THR		OBBA 2001-2005	UF; TF
Eastern Wood-Pewee	G5	S5B	SC	N/A		OBBA 2001-2005	UF
False Hop Sedge	G4	S1	END	END	B	20/07/2005	WE
Fawnsfoot	G5	S2	END	END		(2013)	RS; FM

Element	G-rank¹	S-rank¹	COSEWIC²	OMNR²	EO Rank³	Last Observed Date (DD/MM/YYYY)	Associated Conservation Target(s) (see Table 5 for key to codes)
Golden-winged Warbler	G4	S4B	THR	SC		OBBA 2001-2005	UF; TF
Gray Ratsnake (Carolinian population)	G5T1	S1	END	END		04/09/1983	UF; TF; RP; PS
Green Dragon	G5	S3	SC	SC	D	20/07/2002	UF; WE; RS
Hooded Warbler	G5	S3B	THR	NAT	E	25/06/1998	UF
Kentucky Coffee-tree	G5	S2	THR	THR	A	25/07/1999	RS; WE; TF (hedgerows, edge)
Kidneyshell	G4G5	S1	END	END	E	07/08/2001 (2012)	RS; FM
Loggerhead Shrike	G5	S2B	END	END	E	13/07/1990	TF; AG?
Mapleleaf Mussel	G5	S2	THR	THR		(2012)	RS; FM
Massasauga	G3G4	S3	THR	THR	X	24/07/1895	All targets
Milksnake	G5	S3	SC	SC		(2013)	TF; AG; RP; PS
Mudpuppy (Salamander)							
Mussel	G3	S1	END	END	B	06/10/1999 (2012)	RS; FM
Northern Bobwhite	G5	S1	END	END	H	25/05/1983	Mix of PS, TF, AG, UF
Northern Map Turtle	G5	S3	SC	SC	H	25/07/1987	RS; WE; RP
Northern Riffleshell	G2T2	S1	END	END	E	21/08/1997 (2012)	RS; FM
<i>Paper pondshell</i>	G5	S2	<i>Candidate</i>	N/A		<i>(date unknown)</i>	RS; FM
Prothonotary Warbler	G5	S1B	END	END	X	1970	WE
Purple Twayblade	G5	S2	THR	END	CD	1997	PS; UF
Pugnose Minnow	G5	S2	THR	THR		(date unknown)	RS; FM

Element	G-rank¹	S-rank¹	COSEWIC²	OMNR²	EO Rank³	Last Observed Date (DD/MM/YYYY)	Associated Conservation Target(s) (see Table 5 for key to codes)
Rainbow Mussel	G5Q	S2S3	END	THR		(2012)	RS; FM
Rayed Bean	G2	S1	END	END	E	21/08/1997 (2012)	RS; FM
Red-headed Woodpecker	G5	S4B	THR	SC	E	08/06/2000	PS; TF; UF; RS; WE; AG
Riddell's Goldenrod	G5	S3	SC	SC		(date unknown)	PS
Round Hickorynut	G4	S1	END	END	E	18/07/2001 (2012)	RS; FM
Round Pigtoe	G4G5	S1	END	END	E	30/07/2002 (2012)	RS; FM
Shumard Oak	G5	S3	SC	SC	E	2001	WE; TF
Small White Lady's-slipper	G4	S1	END	END	X	1924	PS; WE; TF
Snapping Turtle	G5	S3	SC	SC		(2013)	WE; RP
Snuffbox	G3	S1	END	END	C	10/05/1999 (2013)	RS; FM
Spiny Softshell	G5	S3	THR	THR	A	23/06/2004	RS; RP
Spoon-leaved Moss	G5	S1	END	END	H	15/04/1973	WE
Spotted Gar	G5	S1	THR	THR	H	04/07/1975	RS; FM
Spotted Sucker	G5	S2	SC	SC	E	05/08/1997	RS; FM
Threehorn wartyback	G5	S1	THR	N/A		(date unknown)	RS; FM
<i>Wabash Pigtoe</i>	G5	S2S3	<i>Candidate</i>	N/A		(date unknown)	RS; FM
Wavy-rayed Lampmussel	G5	S1	END	THR	X	30/07/2002	RS; FM
Willowleaf Aster	G5	S2	THR	THR	H	08/10/1960	PS; TF; RS?
Wood Thrush	G5	S4B	THR	N/A		OBBA 2001-2005	UF

Element	G-rank¹	S-rank¹	COSEWIC²	OMNR²	EO Rank³	Last Observed Date (DD/MM/YYYY)	Associated Conservation Target(s) (see Table 5 for key to codes)
Woodland Vole	G5	S3?	SC	SC	H	1940	UF
Wood-poppy	G5	S1	END	END		(date unknown)	WE; UF
Yellow-breasted Chat	G5	S2B	SC	END	H	1986	PS; TF; RS

¹ Global and Subnational Ranks: Ranks indicate the conservation status of a species and are designated by a number from 1 (critically imperiled) to 5 (secure), preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global, and S = Subnational, in this case referring to Ontario).

² National and Provincial Status: Status of species listed nationally (COSEWIC) or provincially (OMNR): END = Endangered, THR = Threatened, SC = Special Concern.

³ EO = Element Occurrence, a single population of a species tracked by the Natural Heritage Information Centre. EO Rank indicates the viability of the population: A - Excellent predicted viability, B - Good predicted viability, C - Fair predicted viability, D - Probably not viable, E - Verified extant, F - Failed to find, H - Historical, X – Extirpated.

Table 4. Additional Globally and Provincially Significant Taxa of the Sydenham River CAP. Codes as for Table 3.

Common Name	Scientific Name	Taxonomic Group	G-rank¹	S-rank¹
American Brook Lamprey	<i>Lampetra appendix</i>	Fish	G4	S3
American Gromwell	<i>Lithospermum latifolium</i>	Vascular Plant	G4	S3
American Lotus	<i>Nelumbo lutea</i>	Vascular Plant	G4	S2
Arrow Clubtail	<i>Stylurus spiniceps</i>	Insect	G5	S2
Azure Bluet	<i>Enallagma aspersum</i>	Insect	G5	S3

Common Name	Scientific Name	Taxonomic Group	G-rank ¹	S-rank ¹
Black Gum	<i>Nyssa sylvatica</i>	Vascular Plant	G5	S3
Blue-ringed Dancer	<i>Argia sedula</i>	Insect	G5	S2
Blue-tipped Dancer	<i>Argia tibialis</i>	Insect	G5	S3
Blunt-lobed Grapefern	<i>Botrychium oneidense</i>	Vascular Plant	G4	S3?
Brainerd's Hawthorn	<i>Crataegus brainerdii</i>	Vascular Plant	G5	S2
Brindled Madtom	<i>Noturus miurus</i>	Fish	G5	S2
Burning Bush	<i>Euonymus atropurpureus</i>	Vascular Plant	G5	S3
Carey's Sedge	<i>Carex careyana</i>	Vascular Plant	G4G5	S2
Carolina Vetch	<i>Vicia caroliniana</i>	Vascular Plant	G5	S2
Caughuawaga Hawthorn	<i>Crataegus suborbiculata</i>	Vascular Plant	G3?	S1
Chinese Hemlock Parsley	<i>Conioselinum chinense</i>	Vascular Plant	G5	S2
Crowned Beggarticks	<i>Bidens trichosperma</i>	Vascular Plant	G5	S2
Culver's Root	<i>Veronicastrum virginicum</i>	Vascular Plant	G4	S2
Davis' Sedge	<i>Carex davisii</i>	Vascular Plant	G4	S2
Double-striped Bluet	<i>Enallagma basidens</i>	Insect	G5	S3
Dusky Dancer	<i>Argia translata</i>	Insect	G5	S2
Eastern Green-violet	<i>Hybanthus concolor</i>	Vascular Plant	G5	S2
Fall Crab Grass	<i>Digitaria cognata</i>	Vascular Plant	G5	S1
False Tomentose Balsam Groundsel	<i>Packera paupercula</i> var. <i>pseudotomentosa</i>	Vascular Plant	G5TNR	S2S3
Flag-tailed Spinyleg	<i>Dromogomphus spoliatus</i>	Insect	G4G5	S1
Forster's Tern	<i>Sterna forsteri</i>	Bird	G5	S2B
Geniculate Three-awned Grass	<i>Aristida longespica</i> var. <i>geniculata</i>	Vascular Plant	G5T5?	S2

Common Name	Scientific Name	Taxonomic Group	G-rank ¹	S-rank ¹
Ghost Shiner	<i>Notropis buchanani</i>	Fish	G5	S2
Golden Redhorse	<i>Moxostoma erythrurum</i>	Fish	G5	S4
Great Lakes Sand Reed	<i>Calamovilfa longifolia var. magna</i>	Vascular Plant	G5T3T5	S3
Greater Redhorse	<i>Moxostoma valenciennesi</i>	Fish	G4	S3
Green-faced Clubtail	<i>Gomphus viridifrons</i>	Insect	G3G4	S1
Hackberry Emperor	<i>Asterocampa celtis</i>	Insect	G5	S2
Hairy Bedstraw	<i>Galium pilosum</i>	Vascular Plant	G5	S3
Hairy Pinweed	<i>Lechea mucronata</i>	Vascular Plant	G5	S3
Hairy-fruited Sedge	<i>Carex trichocarpa</i>	Vascular Plant	G4	S3
Harbinger-of-spring	<i>Erigenia bulbosa</i>	Vascular Plant	G5	S3?
Heart-leaved Alexanders	<i>Zizia aptera</i>	Vascular Plant	G5	S1
Large Yellow Pond-lily	<i>Nuphar advena</i>	Vascular Plant	G5T5	S3
Lizard's Tail	<i>Saururus cernuus</i>	Vascular Plant	G5	S3
Long-styled Canadian Sanicle	<i>Sanicula canadensis var. grandis</i>	Vascular Plant	G5T3T5	S2
Lowland Brittle Fern	<i>Cystopteris protrusa</i>	Vascular Plant	G5	S2
Many-fruit Primrose-willow	<i>Ludwigia polycarpa</i>	Vascular Plant	G4	S2S3
Margarett's Hawthorn	<i>Crataegus margaretta</i>	Vascular Plant	G5?	S1
Missouri Ironweed	<i>Vernonia missurica</i>	Vascular Plant	G4G5	S3?
Muskingum Sedge	<i>Carex muskingumensis</i>	Vascular Plant	G4	S3
Northern Fogfruit	<i>Phyla lanceolata</i>	Vascular Plant	G5	S2
Northern Hawthorn	<i>Crataegus dissona</i>	Vascular Plant	G4G5	S3
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Mammal	G4	S3?
Ovate Beak Grass	<i>Diarrhena obovata</i>	Vascular Plant	G4G5	S1

Common Name	Scientific Name	Taxonomic Group	G-rank ¹	S-rank ¹
Palmate-leaved Violet	<i>Viola palmata</i>	Vascular Plant	G5	S2S3
Pawpaw	<i>Asimina triloba</i>	Vascular Plant	G5	S3
Pignut Hickory	<i>Carya glabra</i>	Vascular Plant	G5	S3
Prairie Milkweed	<i>Asclepias sullivantii</i>	Vascular Plant	G5	S3
Prairie Straw Sedge	<i>Carex suberecta</i>	Vascular Plant	G4	S2
Pronghorn Clubtail	<i>Gomphus graslinellus</i>	Insect	G5	S3
Prostrate Tick-trefoil	<i>Desmodium rotundifolium</i>	Vascular Plant	G5	S2
Pumpkin Ash	<i>Fraxinus profunda</i>	Vascular Plant	G4	S2?
Purple Giant Hyssop	<i>Agastache scrophulariifolia</i>	Vascular Plant	G4	S1
Puttyroot	<i>Aplectrum hyemale</i>	Vascular Plant	G5	S2
Ravenfoot Sedge	<i>Carex crus-corvi</i>	Vascular Plant	G5	S1
Rigid Sedge	<i>Carex tetanica</i>	Vascular Plant	G4G5	S3
Round-fruited Panic Grass	<i>Dichanthelium sphaerocarpon</i>	Vascular Plant	G5	S3
Round-fruited St. John's-wort	<i>Hypericum sphaerocarpon</i>	Vascular Plant	G5	S1
Round-leaved Hawthorn	<i>Crataegus lumaria</i>	Vascular Plant	G3G4	S3?
Royal River Cruiser	<i>Macromia taeniolata</i>	Insect	G5	S1
Scarlet Beebalm	<i>Monarda didyma</i>	Vascular Plant	G5	S3
Sharp-fruited Rush	<i>Juncus acuminatus</i>	Vascular Plant	G5	S3
Shellbark Hickory	<i>Carya laciniosa</i>	Vascular Plant	G5	S3
Shrubby St. John's-wort	<i>Hypericum prolificum</i>	Vascular Plant	G5	S2
Slender Mountain-mint	<i>Pycnanthemum tenuifolium</i>	Vascular Plant	G5	S3
Slender Paspalum	<i>Paspalum setaceum</i>	Vascular Plant	G5	S2
Slim-flowered Muhly	<i>Muhlenbergia tenuiflora</i>	Vascular Plant	G5	S2

Common Name	Scientific Name	Taxonomic Group	G-rank ¹	S-rank ¹
Slim-spiked Three-awned Grass	<i>Aristida longespica</i> var. <i>longespica</i>	Vascular Plant	G5T5?	S2
Small-footed Bat	<i>Myotis leibii</i>	Mammal	G3	S2S3
Smoky Rubyspot	<i>Hetaerina titia</i>	Insect	G5	S2
Southern Slender Ladies'-tresses	<i>Spiranthes lacera</i> var. <i>gracilis</i>	Vascular Plant	G5T4T5	S1
Spreading Chervil	<i>Chaerophyllum procumbens</i>	Vascular Plant	G5	S2
Stiff Gentian	<i>Gentianella quinquefolia</i>	Vascular Plant	G5	S2
Stiff Goldenrod	<i>Solidago rigida</i> ssp. <i>rigida</i>	Vascular Plant	G5T5	S3
Striped Cream Violet	<i>Viola striata</i>	Vascular Plant	G5	S3
Sundial Lupine	<i>Lupinus perennis</i>	Vascular Plant	G5	S3
Tawny Emperor	<i>Asterocampa clyton</i>	Insect	G5	S2S3
Texas Stiff Yellow Flax	<i>Linum medium</i> var. <i>texanum</i>	Vascular Plant	G5T5	S1
Virginia Bugleweed	<i>Lycopus virginicus</i>	Vascular Plant	G5	S3
Virginia Lungwort	<i>Mertensia virginica</i>	Vascular Plant	G5	S3
Weak Blue Grass	<i>Poa saltuensis</i> ssp. <i>languida</i>	Vascular Plant	G5T3T4Q	S3
White-haired Panic Grass	<i>Dichanthelium ovale</i> ssp. <i>praecocius</i>	Vascular Plant	G5T5?	S3
Wild Senna	<i>Senna hebecarpa</i>	Vascular Plant	G5	S1
Winged Loosestrife	<i>Lythrum alatum</i>	Vascular Plant	G5	S3
Wingstem	<i>Verbesina alternifolia</i>	Vascular Plant	G5	S3
Yellow False-indigo	<i>Baptisia tinctoria</i>	Vascular Plant	G5	S2
Yellow Ladies'-tresses	<i>Spiranthes ochroleuca</i>	Vascular Plant	G4	S2
Yellow-fruited Sedge	<i>Carex annectens</i>	Vascular Plant	G5	S2

2. Biodiversity Targets and Associated Threats

i. Conservation Targets

Conservation Targets are meant to represent the overall biodiversity of the CAP area. Although they may not capture all elements of genes, species and ecological systems, they help to focus conservation efforts (Conservation Measures Partnership, 2013). Targets can be either ecosystems, such as upland forest, or species or species assemblages, such as Reptiles and Amphibians. For the Sydenham River CAP, Conservation Targets were selected by the Sydenham River CAP Science and Ecology Team, and all Species at Risk that occur within that ecosystem or species assemblage were included as nested targets (Table 5). The ‘health’ of these targets was then determined based on Key Ecological Attributes, such as the presence of certain indicator species (Table 6). The size, condition and landscape context of the targets were assessed, which gives an overall rank for the viability of the target. Overall rank was calculated using Miradi v. 4.0 (Foundations of Success 2013).

Table 5. Conservation Targets for the Sydenham River CAP. Species indicated in italics are rare species tracked by NHIC, all others are federal and/or provincial Species at Risk.

Conservation Targets	Code	Nested Targets
Upland Forests	UF	Acadian Flycatcher, American Chestnut, Butternut, Cerulean Warbler, Chimney Swift, Common Nighthawk, Crooked-stem Aster, Drooping Trillium, Eastern Flowering Dogwood, Eastern Hog-nosed Snake, Eastern Whip-poor-will, Eastern Wood-Pewee, Golden-winged Warbler, Gray Ratsnake, Green Dragon, Hooded Warbler, Purple Twayblade, Red-headed Woodpecker, Wood-poppy, Wood Thrush
Wetlands (Deciduous & Coniferous Swamps, Inland Marshes)	WE	Swamps: Blue Ash, Drooping Trillium, False Hop Sedge, Green Dragon, Kentucky Coffee-tree, Red-headed Woodpecker, Shumard Oak, Spoon-leaved Moss, Wood-poppy; Marshes: Blanding’s Turtle, Dense Blazing-star, Common Nighthawk, Eastern Foxsnake, Eastern Hog-nosed Snake, Eastern Ribbonsnake, False Hop Sedge, Northern Map Turtle, Snapping Turtle

Conservation Targets	Code	Nested Targets
Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields	TF	American Badger, Barn Owl, Butler's Gartersnake, Butternut, Climbing Prairie Rose, Common Nighthawk, Eastern Flowering Dogwood, Eastern Hog-nosed Snake, Eastern Whip-poor-will, Golden-winged Warbler, Gray Ratsnake, Kentucky Coffee-tree, Loggerhead Shrike, Milksnake, Northern Bobwhite, Red-headed Woodpecker, Shumard Oak
Streams/Drains & Riparian Habitat	RS	Blackstripe Topminnow, Blanding's Turtle, Blue Ash, Crooked-stem Aster, Eastern Pondmussel, Eastern Sand Darter, Fawnsfoot, Green Dragon, Kentucky Coffee-tree, Kidneyshell, Mapleleaf Mussel, Mudpuppy (Salamander) Mussel, Northern Map Turtle, Northern Riffleshell, <i>Paper Pondshell</i> , Pugnose Minnow, Rainbow, Rayed Bean, Round Hickorynut, Round Pigtoe, Snuffbox, Spiny Softshell, Spotted Sucker, Threehorn Wartyback, <i>Wabash Pigtoe</i> , Yellow-breasted Chat
Prairies & Savannahs	PS	American Badger, Barn Owl, Bobolink, Butler's Gartersnake, Climbing Prairie Rose, Common Five-lined Skink, Dense Blazing Star, Eastern Flowering Dogwood, Eastern Foxsnake, Eastern Hog-nosed Snake, Eastern Meadowlark, Gray Ratsnake, Milksnake, Northern Bobwhite, Purple Twayblade, Red-headed Woodpecker, Riddell's Goldenrod
Reptiles	RP	Blanding's Turtle, Butler's Gartersnake, Eastern Foxsnake, Eastern Hog-nosed Snake, Eastern Ribbonsnake, Gray Ratsnake, Milksnake, Northern Map Turtle, Snapping Turtle, Spiny Softshell
Fish & Mussels	FM	Blackstripe Topminnow, Eastern Pondmussel, Eastern Sand Darter, Fawnsfoot, Kidneyshell, Mapleleaf Mussel, Mudpuppy (Salamander) Mussel, Northern Riffleshell, <i>Paper Pondshell</i> , Pugnose Minnow, Rainbow, Rayed Bean, Round Hickorynut, Round Pigtoe, Snuffbox, Spotted Sucker, Threehorn Wartyback, <i>Wabash Pigtoe</i>
Sustainable Agricultural Practices	AG	American Badger, American Chestnut, Barn Owl, Barn Swallow, Bobolink, Chimney Swift, Eastern Meadowlark, Loggerhead Shrike, Milksnake, Northern Bobwhite, Red-headed Woodpecker

Table 6. Conservation Target Viability in the Sydenham River CAP. Assessment ranking and colour codes are described below the table. Wetland sub-targets are: DS = deciduous swamp, CS = coniferous swamp, IM = inland marsh.

Conservation Target	Key Ecological Attributes (Indicators)	Size	Condition	Landscape Context	Overall
Upland Forests	<ul style="list-style-type: none"> • Extent of forest cover and interior habitat (overall extent; interior habitat extent) • Quality of forest communities (FQI; age class; structure; presence of reproducing populations of characteristic forest interior bird species [ovenbird, wood thrush]; presence of invasive species; presence of disease/pests) • Landscape context (proximity to nearest patch) 	Poor	Poor	Poor	Poor
Wetlands (Deciduous & Coniferous Swamps, Inland Marshes)	<ul style="list-style-type: none"> • Extent of forest cover and interior habitat (overall extent; interior habitat extent), size of patch • Quality of forest communities (Presence of: salamander diversity [egg masses], presence / persistence of ephemeral pools; presence of invasive species; presence of disease/pests) • Structural and vegetation composition (species diversity [native vs. non-native, invasive]) • Groundwater recharge (salamander diversity; extent/presence of tile drains around patches) • Presence of deeper organic soils • Landscape context (proximity to nearest patch) • Water quality (presence of indicator species such as amphibians, birds, plants?) • Extent of naturally-vegetated buffers (% of wetland having 30m buffer as measured by GIS) • Landscape context (surrounding land uses within x distance of wetlands) • Intact hydrology (extent/presence of tile drains around wetlands) 	DS: Fair	DS: Fair	DS: Poor	Poor
		CS: Poor	CS: Poor	CS: Poor	
		IM: Poor	IM: Poor	IM: Poor	

Conservation Target	Key Ecological Attributes (Indicators)	Size	Condition	Landscape Context	Overall
Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields	<ul style="list-style-type: none"> • Extent of habitat (width [10 m, 30 ft]; height of trees) • Quality of habitat (species diversity; tree roots not being damaged; agricultural activities being limited to canopy dripline; presence of indicator species such as pollinators, certain plants, herps) • Landscape context (linkages/proximity to other hedge rows, thickets or other habitats) 	Poor	Poor	Poor	Poor
Streams/drains and Riparian Habitat	<ul style="list-style-type: none"> • Water quality (benthic organism composition; temperature; species diversity [native vs. non-native invasive]) • Quality of vegetation (structural and vegetation composition, species diversity [native vs. non-native invasive]) • Extent of naturally-vegetated buffers (% of watercourse having 30m buffer as measured by GIS) • Landscape context (surrounding land uses as measured by % of watershed) • Intact hydrology (extent natural watercourse vs. altered watercourse; presence of dams/dykes; proportion of closed drains) 	Unknown	Fair	Fair	Fair
Prairies & Savannahs	<ul style="list-style-type: none"> • Species diversity – presence of key indicator species • Disturbance/Fire – need fire to maintain the species • Minimum size 	Unknown	Unknown	Unknown	Unknown
Reptiles	<ul style="list-style-type: none"> • Population size • Habitat connectivity (proximity to habitats required to complete life cycle; number of reported road kill) • Quality of habitat (absence of invasive species such as Phragmites, Eurasian milfoil) 	Poor	Poor/Fair	Poor	Poor
Fish & Mussels	<ul style="list-style-type: none"> • Population size • Quality of habitat (water quality) 	Poor/Fair	Poor/Fair	Poor/Fair	Fair
Sustainable Agriculture	<ul style="list-style-type: none"> • Healthy soils (presence of organic matter, bacteria, earthworms, fungi; minimal compaction) • Agriculture does not depend on synthetic inputs • Healthy water (not nutrient rich; free of toxins; buffered hydrology) 	NA	NA	NA	NA

Very Good	Optimal Health: The biodiversity target is functioning at an ecologically desirable status, and requires little management.
Good	Minimum Health: The biodiversity target is functioning within its range of acceptable variation; it may require some management.
Fair	Likely Degradation: The biodiversity target lies outside of its range of acceptable variation and requires management. If unchecked, the biodiversity target will be vulnerable to serious degradation.
Poor	Imminent Loss: Allowing the biodiversity target to remain in this condition for an extended period will make restoration or preventing extirpation practically impossible.
Unknown	Research Need: The biodiversity target is known to occur, but information on this viability criterion is currently is unknown.
NA	Not Applicable: This criterion is not significant for assessing the health of this biodiversity target.

ii. Threats

Once the conservation targets were selected for the CAP area, the Science and Ecology Team identified the direct threats to these targets. Direct threats can include both human activities that immediately degrade a conservation target (e.g. unsustainable fishing, construction of roads, introduction of exotic invasive species), or natural phenomena altered by human activity (e.g. increase in extreme storm events due to global climate change) (Conservation Measures Partnership, 2013). Threats are based on the IUCN classification of direct threats (Salafsky et al. 2008). The threats rank is based on the scope, severity, and irreversibility, and the results are ranked as the following:

Very High	The threat is likely to <i>destroy or eliminate</i> the biodiversity target.
High	The threat is likely to <i>seriously degrade</i> the biodiversity target.
Medium	The threat is likely to <i>moderately degrade</i> the biodiversity target.
Low	The threat is likely to <i>only slightly impair</i> the biodiversity target.

Species-specific threats to Sydenham River CAP Species at Risk are available in Appendix C and D. Table 7 summarizes most relevant threats.

Table 7. Summary of Threats in the Sydenham River CAP.

Threats \ Targets	Prairies & Savannas	Sustainable Agriculture	Fish and Mussels	Upland Forests	Stream/drain and riparian	Reptiles	Wetlands	Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields	Summary Threat Rating
Non-Timber Crops (agriculture)	Unknown		High	Very High	High	Very High	Very High	High	Very High

Threats \ Targets	Prairies & Savannahs	Sustainable Agriculture	Fish and Mussels	Upland Forests	Stream/drain and riparian	Reptiles	Wetlands	Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields	Summary Threat Rating
Agricultural & Forestry Effluents	Unknown		High		High				High
Roads	Unknown		High		High	Medium			High
Tile Drainage & Drains					High		Very High		High
Invasive Non-native/Alien Species	Unknown		High	Medium	High		Medium	Medium	High
Problematic Native Species						High			Medium
Reptile Persecution						Medium			Low
Excess Energy - Hydrological changes					Medium				Low
Household Sewage & Urban Waste Water					Low				Low

Threats \ Targets	Prairies & Savannahs	Sustainable Agriculture	Fish and Mussels	Upland Forests	Stream/drain and riparian	Reptiles	Wetlands	Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields	Summary Threat Rating
Renewable Energy - Wind								Medium	Low
Motorized vehicles damaging natural spaces	Unknown			Low	Low		Medium		Low
Poor Logging & Wood Harvesting Practices				Low					Low
Oil and gas pipelines				Medium					Low
Summary Target Ratings:	Unknown		High	High	High	High	Very High	Medium	Very High

3. Conservation Objectives and Strategies

i. Conservation Objectives

The objectives for the CAP aim to abate specific threats and improve viability of the conservation targets (table 8). The objectives can be broadly split into two categories: 1) outreach and education, and 2) restoration and creation of habitat. In many cases restoration projects can be used as demonstration sites for education and outreach so these two broad categories of activities are often linked within each objective. For additional details of strategic actions and action steps for accomplish the objectives see table 9.

Table 8. Conservation objectives for the Sydenham River CAP.

	Objectives	Threats Addressed	Targets Addressed
1	Establish ongoing outreach program to communicate the reasons for the Conservation Action Plan, its goals and objectives to community by 2014.	All	All
2	Establish outreach program to communicate “good news stories” about Species at Risk and habitat diversity by 2014	All	All
3	Protect, maintain and enhance natural heritage features in the CAP area through positive incentives, stewardship, securement, restoration, habitat creation and policy support by 2019	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Logging & Wood Harvesting, Roads, Tile Drainage & Drains	All

	Objectives	Threats Addressed	Targets Addressed
4	Promote value of native-multi-species windbreaks to target audiences and plant 20 hectares (50 acres) of windbreaks by 2019	Non-Timber Crops (agriculture), Roads	Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields; Sustainable Agriculture; Streams/ Drains and Riparian Habitat; Fish & Mussels; <i>Habitat Connectivity</i>
5	Prevent and control the spread of new populations of high priority terrestrial and aquatic invasive species at critical sites in the Sydenham River CAP area.	Invasive Species	Upland Forests; Wetlands; Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields; Streams/ Drains and Riparian Habitat; Fish & Mussels
6	Buffers of vegetation (including native plants where possible) of >1 m width on each side established along 50 km of open watercourses by 2019, and 3m width on each side included in all new engineers reports.	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels
7	Include habitat and water quality enhancements to all new drain projects (i.e., those being done under Section 4 of the Drainage Act) and drain Improvement projects (i.e., those being done under Section 78 of the Drainage Act), and in at least two drain Maintenance and Repair projects (those being done under Section 76 of the Drainage Act) annually.	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels
8	Maintain and enhance water quality monitoring programs on an ongoing basis.	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels
9	Support objectives and actions identified by the Sydenham River Recovery Program through development of partnerships by 2016	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels; Reptiles

	Objectives	Threats Addressed	Targets Addressed
10	Promote road sides as habitat in two municipalities by 2019	Invasive Non-native/Alien Species, Roads	Streams/ Drains and Riparian Habitat; Fish & Mussels; Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields; Sustainable Agriculture; <i>Habitat connectivity</i>
11	Reduce road mortality of reptiles at three key sites by 2019	Roads	Reptiles
12	Establish and implement program to comprehensively identify prairie remnants, existing prairies and potential prairie restoration sites within the CAP area by 2019	Non-Timber Crops (agriculture), Invasive Non-native/Alien Species	Prairies & Savannahs

ii. Strategic Actions and Action Steps

The CAP team developed strategic actions and action steps to achieve the objectives set out in table 8. Details of each strategic action, links to threats and targets, as well as organizations involved in completion of each task are listed in table 9. Several strategic actions are best achieved through collaboration across the ecoregion with other CAP teams. In particular the CAP team agreed that the following should be addressed at an ecoregional scale: positive incentives for landowners to protect biodiversity and create habitat (e.g. tax relief), lobbying for approval of safe herbicides to use over water for Phragmites control, updating of the Noxious Weed Act to remove ecologically important species from the list and add ecologically detrimental invasives to the list, approaching Landscape Ontario regarding sale of invasive plants at plant nurseries and garden centres.

Many of the strategic actions involve outreach and education to the general public and targeted audiences. The following themes should be incorporated into publications (printed or online), site tours and outreach events for the general public: CAP themes, goals and updates; good news stories about Species at Risk; current and historical best stewardship practices materials (e.g. sustainable forestry practices, stewardship for Species at Risk, benefits of windbreaks, benefits of riparian buffers, roadsides as habitat, using native plants); materials about invasive species (e.g. prevention, early detection, control

measures, how to report occurrences); information about reptiles and their threats; materials encouraging reporting of reptile road kill occurrences to SCRCA.

Acronyms used for Potential Leads and Collaborators:

CCC	Carolinian Canada Coalition
CSLT	Canada South Land Trust
DFO	Fisheries and Oceans Canada
EC	Environment Canada
LWI	Lambton Wildlife Inc.
MSC	Middlesex Stewardship Council
MTO	Ministry of Transportation
OFAH	Ontario Federation of Anglers & Hunters
OIPC	Ontario Invasive Plant Council
OMAF	Ontario Ministry of Agriculture and Food
OMNR	Ontario Ministry of Natural Resources

ONS	Ontario Native Scape
OSCIA	Ontario Soil and Crop Improvement Association
RTL	Return the Landscape
SK	Stewardship Kent
SCRCA	St. Clair Region Conservation Authority
SCRCF	St. Clair Region Conservation Foundation
SFN	Sydenham Field Naturalists
TgO	Tallgrass Ontario
UWO	University of Western Ontario.

Table 9. Strategic actions and action steps for the Sydenham River CAP.

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
Objective 1	Establish ongoing outreach program to communicate the reasons for the Conservation Action Plan, its goals and objectives to community by 2014.	2014 and beyond	All	All	CCC (SCRCA, SFN, LWI, Nature London, RLSN, Woodlot Owners Associations)	OMNR SARSF, HSP, EcoAction, OTF
1.1 Strategic Action	Inform area residents and stakeholders of the CAP, its goals and objectives	2014 and beyond	as above	as above	as above	as above
1.1.1 Action Step	Work with steering committee to identify and collaborate with existing relevant outreach programs (e.g. CCC, SCRCA, Field Naturalists, Woodlot Owners Associations)	2014 and beyond	as above	as above	as above	as above
1.1.2 Action Step	Prepare and/or make available best stewardship practice materials for landowners via website and publications	2014 and beyond	as above	as above	as above	as above
1.1.3 Action Step	Research key websites visited by rural landowners and request links to relevant stewardship websites be added by 2016	2014-2016	as above	as above	as above	as above
1.1.4 Action Step	Prepare annual CAP report/newsletter and make available to the community through websites, mail-outs (e.g. with tax bills) and advertising (e.g. free newspapers) starting in 2015	2015 and beyond	as above	as above	as above	as above
1.1.5 Action Step	Include content on Sydenham CAP in SCRCA's Outdoor Education program starting in 2014.	2014 and beyond	as above	as above	as above	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
1.1.6 Action Step	Present to target audiences (e.g. municipalities, drainage conference, Good Roads, ploughing matches, agricultural colleges), conferences, chapter meetings	2014 and beyond	as above	as above	as above	as above
1.1.7 Action Step	Seek funding to support additional education and outreach programs annually.	2014 and beyond	as above	as above	as above	as above
Objective 2	Establish outreach program to communicate “good news stories” about Species at Risk and habitat diversity by 2014	2014 and beyond	All	All	CCC (SCRCA, SFN, LWI, Nature London, RLSN, OMNR)	OMNR, SARSF, HSP, EcoAction, TD FEF
2.1 Strategic Action	Inform area residents and stakeholders of Species at Risk and habitat diversity in the CAP area	2014 and beyond	as above	as above	as above	as above
2.1.1 Action Step	Work with steering committee to identify and collaborate with existing relevant outreach programs (e.g. SCRCA, Field Naturalists, Woodlot Owners Association)	2014 and beyond	as above	as above	as above	as above
2.1.2 Action Step	Research current and historical best stewardship practices through discussions/interviews with landowners	2014-2019	as above	as above	CCC, UWO (SCRCA, SFN, LWI, Nature London, RLSN)	as above plus targeted research grants
2.1.3 Action Step	Make available current and historical best stewardship practice materials to landowners via website and publications	2016 and beyond	as above	as above	CCC (SCRCA, SFN, LWI, Nature London, RLSN, OMNR)	OMNR, SARSF, HSP, EcoAction, TD FEF

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
2.1.4 Action Step	Prepare annual newsletter on Species at Risk and habitat diversity and make available to the community through websites and mail-outs	2014 and beyond	as above	as above	CCC, SCRCA (SFN, LWI, Nature London, RLSN, OMNR)	as above
2.1.5 Action Step	Prepare signage at two demonstration sites or public areas to engage local citizens by 2019 (e.g. Peers Wetland)	2014-2019	as above	as above	CCC (SCRCA, SFN, LWI, Nature London, RLSN, OMNR)	as above
2.1.6 Action Step	Promote/ maintain Sydenham River aquatic Species at Risk webpage (www.sydenhamriver.on.ca)	2014 and beyond	as above	as above	SCRCA	as above plus DFO
2.1.7 Action Step	Continue to include Species at Risk and habitat diversity content in SCRCA's Outdoor Education program.	2014 and beyond	as above	as above	as above	OMNR SARSF, HSP, EcoAction, TD FEF
Objective 3	Protect, maintain and enhance natural heritage features in the CAP area through positive incentives, stewardship, securement, restoration, habitat creation and policy support by 2019	2014 and beyond	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Logging & Wood Harvesting, Roads, Tile Drainage & Drains	All	SCRCA, CCC, MSC, RLSN, Municipalities, OSCIA, LWI, SFN, CSLT, ONS	SARSF, HSP, Trees Ontario, Corporate (Wind turbine companies, Shell), Crowd Sourcing, OLTAP, EcoAction, OTF

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
3.1 Strategic Action	Research and promote positive incentive approaches for farmers to conserve biodiversity on their land	2014-2019	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents	All	OSCIA, SCRCA, CCC, MSC, RLSN, municipalities, agricultural organizations, OMAF, ONS	Corporate (Wind turbine companies, Shell), Crowd Sourcing, Drainage Investment Group
3.1.1 Action Step	Research types of programs available to farmers in other regions (e.g. Alternative Land Use Service-type initiative, Ecosystem Goods and Services cost-benefit analyses, Environmental Farm Plan cost sharing, leasing farmland for native habitat, tax relief, carbon credits, municipal policies, MFTIP, non-financial intrinsic incentives) by 2016. Refer to Environmental Farm Plan, Nutrient Management Act, SCRCA BMP program “Sydenham River Habitat Stewardship Program or Healthy Sydenham Headwaters Initiative”	2014-2016	as above	as above	as above	as above
3.1.2 Action Step	Disseminate results of research to target audiences (e.g. conference, workshops, presentations, meetings)	2016-2017	as above	as above	as above	as above
3.1.3 Action Step	Work with partners to identify and secure funding sources for incentive programs	Ongoing	as above	as above	as above	as above
3.2 Strategic Action	Protect 20 hectares (50 acres) of high ecological value land through securement by 2019.	2014-2019	Non-Timber Crops (agriculture)	All	CCC, LWI, SFN, CSLT, SCRCA, SCRCF, NCC	OLTAP

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
3.2.1 Action Step	Identify priority areas for securement through existing CAP mapping, SCRCA priority areas for enhancement of fish and mussel populations, priority areas for increasing forest interior, etc. by 2015	2014-2015	as above	as above	LWI, SFN, CSLT, NCC (SCRCA)	as above
3.2.2 Action Step	Develop network of partners to communicate opportunities for securement as they arise by 2015	2014-2015	as above	as above	CCC, LWI, SFN, CSLT, SCRCA, SCRCF, NCC	as above
3.2.3 Action Step	Secure properties through purchase, donation or conservation easements for a total of 20 hectares (50 acres) by 2019	2014-2019	as above	as above	as above	as above
3.3 Strategic Action	Create 100 hectares (250 acres) of new habitat (wetlands, tallgrass prairies, native tree planting) at priority sites by 2019.	2014-2019	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Roads, Tile Drainage & Drains	All	SCRCA, RLSN, MSC, RTL, CCC, ONS	SARSF, HSP, Trees Ontario
3.3.1 Action Step	Identify priority areas for restoration through existing CAP mapping, SCRCA priority areas for enhancement of fish and mussel populations, priority areas for increasing forest interior, etc. by 2015	2014-2015	as above	as above	as above	as above
3.3.2 Action Step	Approach landowners regarding restoration in key areas by 2015 through letters, postcards and/or site visits	2014-2015	as above	as above	as above	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
3.3.3 Action Step	Recruit three rural landowners into CCC's Landowner Leaders Program by 2016.	2014-2016	as above	as above	CCC (SCRCA)	as above
3.3.4 Action Step	Complete habitat creation (wetlands, tallgrass prairies, tree planting) of 100 hectares (250 acres) by 2019	2014-2019	as above	as above	SCRCA, CCC	as above
3.3.5 Action Step	Investigate potential for habitat restoration on two utility corridor sites (e.g. 32km pipeline site in Lambton county) by 2019	2014-2019	as above	as above	CCC, RLSN	as above
3.4 Strategic Action	Investigate incentives and provide support to increase use of sustainable forestry practices by 25% (measured by proportion of logging applications that use sustainable forestry) by 2019	2014-2019	Logging & Wood Harvesting	Upland Forest; Wetlands	Municipalities, Woodlot Owners Associations, Field Naturalists, CCC, SCRCA	
3.4.1 Action step	Consult with tree bylaw officers and municipalities with sustainable forestry bylaws (e.g. Huron) by 2015	2014-2015	as above	as above	as above	
3.4.2 Action step	Review existing tree cutting bylaws and make suggestions to increase use of sustainable forestry practices (e.g. ban diameter limit logging, incentives/rebates to cover cost of Registered Professional Foresters) by 2016	2014-2016	as above	as above	as above	
3.4.3 Action step	Undertake outreach and education to woodlot owners about best practices and sustainable forestry practices on an ongoing basis	Ongoing	as above	as above	as above	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
3.5 Strategic Action	Encourage good policy regarding protection of natural heritage features	2014-2019	Non-Timber Crops (agriculture), Logging & Wood Harvesting, Roads, Tile Drainage & Drains	All	CCC, SCRCA, OMNR	
3.5.1 Action Step	Encourage Natural Heritage Systems Plans be included in Official Plans at next revisions	2014 and beyond	as above	as above	as above	
3.5.2 Action Step	Prioritize evaluation or ground-truthing of areas that have been desktop identified by SCRCA as potentially wetlands by 2017	2014-2017	as above	Wetlands	SCRCA, OMNR	
3.5.3 Action Step	Ground-truth 60 ha of potential wetlands identified by SCRCA desk-top review by 2019	2014-2019	as above	Wetlands	SCRCA	
3.5.4 Action Step	Evaluate 25 potential wetlands identified by SCRCA desk-top review using Ontario Wetland Evaluation System by 2019	2014-2019	as above	Wetlands	OMNR (SCRCA)	
3.5.5 Action Step	Incorporate evaluated or identified wetland information into CA Regulations to support feature protection by 2019	2014-2019	as above	Wetlands	SCRCA	
3.5.6 Action Step	Encourage incorporation of evaluated or CA regulated wetlands into the Official Plan by 2019	2014-2019	as above	Wetlands	SCRCA, OMNR, CCC	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
Objective 4	Promote value of native-multi-species windbreaks to target audiences and plant 20 hectares (50 acres) of windbreaks by 2019	2014-2019	Non-Timber Crops (agriculture), Roads	Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields; Sustainable Agriculture; Streams/ Drains and Riparian Habitat; Fish & Mussels; <i>Habitat Connectivity</i>	SCRCA, CCC, OSCIA, Field Naturalists, MTO, municipalities, ONS, RLSN	
4.1 Strategic Action	Develop programs to raise awareness of the advantages and importance of windbreaks.	2014-2019	as above	as above	as above	
4.1.1 Action Step	Assemble existing BMPs and educational materials about windbreaks and identify relevant partners for distributing materials by 2015	2014-2015	as above	as above	as above	
4.1.2 Action Step	Distribute BMPs and educational materials through publications, online and at outreach events	Ongoing	as above	as above	as above	
4.1.3 Action Step	Develop and promote two demonstration sites for reducing snow drifting along roads using windbreaks (potential: Plympton township, Mandaumin Rd, 402; existing: Confederation Rd by Wyoming, Hwy 40, near Strathroy) by 2019	2014-2019	as above	as above	as above	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
4.1.4 Action Step	Promote 50-100 m wide native-, multi-species, shrub dominated windbreaks as wildlife corridors where possible	Ongoing	as above	as above	as above	
4.2 Strategic Action	Plant or enhance 20 hectares (50 acres) of windbreaks (using site appropriate combination of tallgrass prairie, shrub and trees) by 2019	2014-2019	as above	as above	as above	
Objective 5	Prevent and control the spread of new populations of high priority terrestrial and aquatic invasive species at critical sites in the Sydenham River CAP area.	2014-2019	Invasive Species	Upland Forests; Wetlands; Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields; Streams/ Drains and Riparian Habitat; Fish & Mussels	OIPC, OFAH, Field Naturalists, MSC, RLSN, SK, ONS, SCRCA	SARSF, HSP, EcoAction, Ontario Trillium Foundation
5.1 Strategic Action	Collaborate with relevant partners to provide education and outreach to target audiences about invasive species in the CAP area	2014-2019	as above	as above	as above	as above
5.1.1 Action Step	Contact all partners working on invasive species at the local and regional level (e.g. Ontario Invasive Plant Council, CAs, land trusts) to coordinate available programs and materials by 2015	2014-2015	as above	as above	OIPC, OFAH, Field Naturalists, MSC, RLSN, SK	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
5.1.2 Action Step	Distribute materials about invasive species focusing on early detection and prevention at five relevant outreach events by 2019	2014-2019	as above	as above	OIPC, OFAH, Field Naturalists, MSC, RLSN, SCRCA, SK	as above
5.1.3 Action Step	Post signs at all boat launches and five bait and tackle shops about aquatic invasives (e.g. cleaning equipment, early detection) by 2019	2014-2019	as above	as above	OIPC, OFAH, SCRCA, Field Naturalists, MSC, RLSN, SK	as above
5.1.4 Action Step	Encourage reporting of invasive species by citizens through online materials, printed information and outreach at relevant events annually	2014-2019	as above	as above	Field Naturalists, MSC, RLSN, SK, SCRCA, OIPC, OFAH,	as above
5.1.5 Action Step	Approach Landscape Ontario by 2016 to discuss the sale of invasive plants at plant nurseries and garden centres	2014-2016	as above	as above	OIPC, OFAH, Field Naturalists, MSC, RLSN, SK	as above
5.1.6 Action Step	Educate garden plant purchasers and local garden centres about effects of invasive plants (e.g. aquatic plants, moneywort, periwinkle), “naturalizing” woodlots with crocuses and daffodils, and offer native alternatives at relevant events targeting horticultural societies, master gardeners, etc. (coordinate with OIPC “Grow me instead” program)	2014-2019	as above	as above	as above	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
5.1.7 Action Step	Encourage local control programs by citizens on private and public lands (e.g. garlic mustard pulling)	2014-2019	as above	as above	as above	as above
5.1.8 Action Step	Develop educational workshops for agricultural and horticultural programs at colleges and schools regarding invasive species by 2019	2014-2019	as above	as above	as above	as above
5.2 Strategic Action	Support updating of Noxious Weed Act to remove ecologically important species from the list and add ecologically detrimental invasives to the list	2014-2019	as above	as above	OIPC, OFAH, Field Naturalists, MSC, RLSN, SK (SCRCA)	as above
5.2.1 Action Step	Make priority list of invasives that should be added to noxious weed list (e.g. Phragmites) and species that should be removed (e.g. milkweeds) through a coordinated effort for all CAPs in the ecoregion by 2015	2014-2015	as above	as above	as above	as above
5.2.2 Action Step	Identify and contact relevant partners to support and collaborate on project by 2015	2014-2015	as above	as above	OIPC, OFAH, Field Naturalists, MSC, RLSN, SK	as above
5.2.3 Action Step	Approach Ontario government with suggested modifications to Noxious Weed Act by 2016	2014-2016	as above	as above	as above	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
5.3 Strategic Action	Work with municipalities to develop Phragmites control programs along drains by 2019	2014-2019	Invasive Species, Agricultural & Forestry Effluents, Tile Drainage & Drains	Streams/ Drains and Riparian Habitat; Fish & Mussels	Municipalities, SCRCA, CCC, Drainage Superintendents, ONS, RLSN	
5.3.1 Action Step	Identify existing municipal programs for Phragmites control that could serve as a model or demonstration for other municipalities by 2015	2014-2015	as above	as above	as above	
5.3.1 Action Step	Work with all willing municipalities in CAP area to develop control programs for Phragmites along drains	2014-2019	as above	as above	as above	
5.3.1 Action Step	Develop two visible demonstration sites of Phragmites control along municipal drains in each county by 2019	2014-2019	as above	as above	as above	
5.4 Strategic Action	Keep up to date on best management practices for control of invasive species	Ongoing	as above	as above	CCC, SCRCA, OIPC, OFAH, Field Naturalists, MSC, RLSN, SK, ONS	
5.5 Strategic Action	Lobby federal government to permit use of safe herbicides to use over water for Phragmites control annually until achieved	Ongoing	as above	as above	CCC, OIPC, OFAH, Field Naturalists, MSC, RLSN, SK, ONS	
5.5.1 Action Step	Identify relevant partners and coordinate activities to achieve strategic action	Ongoing	as above	as above	as above	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
Objective 6	Buffers of vegetation (including native plants where possible) of >1 m width on each side established along 50 km of open watercourses by 2019, and 3m width on each side included in all new engineers reports.	2014-2019	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels	RLSN, SCRCA, OSCIA, CCC, Drainage Superintendents, Municipalities, MSC, RTL, ONS	Trees Ontario, OTF, corporate grants
6.1 Strategic Action	Develop soil-specific seed mixes for use along watercourses (trying to include more native species) by 2017	2014-2017	as above	as above	as above	as above
6.1.1 Action Step	Develop lists of species that would be appropriate for various soil types (trying to include more native species) by 2015	2014-2015	as above	as above	RLSN, RTL (SCRCA)	as above
6.1.2 Action Step	Make seed mix packets specific for soil types and promote their use among drainage superintendents by 2017	2015-2017	as above	as above	RTL, RLSN, ONS	as above
6.2 Strategic Action	Profile progressive practices and disseminate to high priority target audiences by 2019	2014-2019	as above	as above	RLSN, SCRCA, OSCIA, CCC, Drainage Superintendents, municipalities	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
6.2.1 Action Step	Assemble existing educational materials on BMPs by 2015 and make available online, through publications and at outreach events	2014-2015	as above	as above	as above	as above
6.2.2 Action Step	Develop one visible demonstration site at a municipal drain that showcases BMPs by 2017	2014-2017	as above	as above	as above	as above
6.2.3 Action Step	Hold two webinars (or series of webinars) or workshops to inform community on issue (could include tour of demonstration site, tie in to local OSCIA annual meetings, Drainage Superintendents, etc.) by 2019	2014-2019	as above	as above	as above	as above
6.2.4 Action Step	Seek funding to implement above action steps on an ongoing basis	Ongoing	as above	as above	as above	
6.3 Strategic Action	Investigate possibilities for using hay as buffer along private and municipal drains by 2016	2014-2016	as above	as above	OSCIA, agricultural organizations	
6.3.1 Action Step	Approach hay farmers/operators to see what areas they operate in and identify landowners en route that could use hay buffers by 2015	2014-2015	as above	as above	as above	
6.3.2 Action Step	Send information material about hay buffers to key landowners identified above by 2016	2015-2016	as above	as above	as above	
6.4 Strategic Action	All new drainage engineers reports include at least 1m buffer for small intermittent watercourses, and at least 3m buffer for permanent watercourses.	2014 and beyond	as above	as above	SCRCA, Drainage Superintendents, municipalities	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
Objective 7	Include habitat and water quality enhancements to all new drain projects (i.e., those being done under Section 4 of the Drainage Act) and drain Improvement projects (i.e., those being done under Section 78 of the Drainage Act), and in at least two drain Maintenance and Repair projects (those being done under Section 76 of the Drainage Act) annually.	2014 and beyond	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels	SCRCA, Drainage Superintendents, RLSN, DFO, Drainage Investment Group	Drainage Investment Group, OMAF
7.1 Strategic Action	Assemble existing educational materials on habitat and water quality enhancements such as sediment/catchment basins, 2-stage ditches, wetlands, refuge pools, riparian buffers, native plants by 2015 and make available online, through publications and at outreach events	2014-2015	as above	as above	as above plus CCC	
7.2 Strategic Action	Promote benefits of fish habitat enhancements to engineers, drain superintendents and landowners during drain work application process (e.g. present at Drainage Superintendent Association of Ontario (DSAO) Convention held annually, provide BMP “newsletter” annually to drainage superintendents)	2014 and beyond	as above	as above	as above	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
7.3 Strategic Action	Discourage enclosure of headwater streams to attenuate flooding, improve water quality, and maintain fish habitat.	2014 and beyond	as above	as above	SCRCA	
7.3.1 Action Step	Develop policy that discourages enclosures (focusing on headwater systems) by 2019	2014-2019	as above	as above	as above	
7.3.2 Action Step	Participate in workshops on Managing Small (Headwater) Drainage Features in Rural Landscapes in 2014	2014	as above	as above	as above	
Objective 8	Maintain and enhance water quality monitoring programs on an ongoing basis.	Ongoing	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels	SCRCA	Great Lakes Guardian Fund, World Wildlife Foundation
8.1 Strategic Action	Monitor benthic communities and surface and ground water quality (including monthly and event based surface water chemistry monitoring)	Ongoing	as above	as above	as above	as above
8.1.1 Action Step	Prioritize locations for installation of ISCO water sampling equipment (for event-based rural storm water monitoring in the Sydenham River CAP)	2014	as above	as above	as above	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
8.1.2 Action Step	Installation of ISCO water sampling equipment in key locations (e.g., Trout Creek, Sydenham Headwaters or Bear Creek at Brigden Road) by 2015	2014-2015				
8.1.3 Action Step	Conduct monthly Provincial Water Quality Monitoring Program (PWQMN), annual SCRCA benthic monitoring program and watershed reporting (e.g., watershed report cards every five years)	Ongoing	as above	as above	as above	as above
8.1.4 Action Step	Evaluate influence of wastewater treatment plants and stormwater management facilities	Ongoing	as above	as above	MOE	as above
8.1.5 Action Step	Review stormwater management facilities and apply a progressive standard for quantity and quality control in new developments and investigate retro-fitting of existing development where possible.	Ongoing	as above	as above	MOE	as above
Objective 9	Support objectives and actions identified by the Sydenham River Recovery Program through development of partnerships by 2016	2014 and beyond	Non-Timber Crops (agriculture), Agricultural & Forestry Effluents, Tile Drainage & Drains, Invasive Species, Excess Energy - Hydrological changes	Streams/ Drains and Riparian Habitat; Fish & Mussels; Reptiles	CCC, DFO, SRRT, SCRCA	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
9.1 Strategic Action	Develop relationship with Sydenham River Recovery Team (SRRT) to share information, develop/support grant applications, partner in events and share resources by 2016	2014-2016	as above	as above	as above	
9.1.1 Action Step	Identify key contacts and share contact information between SRRT and CCC and identify key members of both teams to review SRRT and CAP and identify common objectives by 2015	2014-2015	as above	as above	CCC (SRRT, SCRCA)	
9.1.2 Action Step	Each team to provide regular updates through a meeting, webinar or written document starting in 2016	2016 and beyond	as above	as above	as above	
Objective 10	Promote roadsides as habitat in two municipalities by 2019	2014-2019	Invasive Non-native/Alien Species, Roads	Streams/ Drains and Riparian Habitat; Fish & Mussels; Thickets, Hedgerows, Fencerows, Shelterbelts, Abandoned Fields; Sustainable Agriculture; <i>Habitat connectivity</i>	Municipalities, LWI, SFN, CCC, RLSN, ONS, Nature London, (SCRCA)	
10.1 Strategic Action	Approach municipalities, counties, MTO in CAP area to develop best practices for roadside habitat by 2017	2014-2017	as above	as above	as above	

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
10.1.1 Action Step	Identify municipalities that could serve as a model for CAP area municipalities (e.g. West Elgin) by 2015	2014-2015	as above	as above	as above	
10.1.2 Action Step	Investigate effects of road-side mowing on pollinators (e.g. early vs. late mowing once pollinator peak is over) by 2019	2014-2019	as above	as above	LWI, SFN, Nature London, CCC	
10.1.3 Action Step	Identify and approach relevant local partners interested in supporting proposal to municipalities by 2015	2014-2015	as above	as above	Municipalities, LWI, SFN, CCC, RLSN, ONS, Nature London, (SCRCA)	
10.1.4 Action Step	Prepare relevant materials and approach CAP area municipalities to adopt best practices for roadside habitat by 2017	2015-2017	as above	as above	as above	
10.2 Strategic Action	Engage in public education and outreach about road sides as habitat	2014 and beyond	as above	as above	as above	
10.2.1 Action Step	Promote native plants along roads by developing one visible road side demonstration site in the CAP area by 2017 (e.g. Bentpath Line)	2014-2019	as above	as above	as above	
10.2.2 Action Step	Engage in public education and outreach at two relevant events to discourage private landowners from encroachment on road sides and encourage the use of native plants by 2019	2014-2019	as above	as above	as above	
Objective 11	Reduce road mortality of reptiles at three key sites by 2019	2014-2019	Roads	Reptiles	SCRCA, CCC, SFN, LWI, ONS, RLSN, Nature London	SARF, HSP, EcoAction

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
11.1 Strategic Action	Identify key road mortality sites by 2016 (SCRCA has some sites identified)	2014-2016	as above	as above	as above	as above
11.1.1 Action Step	Assemble existing data on road mortality from all available sources (e.g. SCRCA, OREG, ORAA) by 2015	2014-2015	as above	as above	as above	as above
11.1.2 Action Step	Encourage more citizen science reporting of road kill to SCRCA through information available online, publications, outreach at events	2014-2019	as above	as above	as above	as above
11.1.3 Action Step	Encourage local naturalist clubs to include reptile roadkill reports and locations as part of their regular reporting	Ongoing	as above	as above	as above	as above
11.2 Strategic Action	Explore opportunities for ecopassages at existing culverts and bridges (e.g. riparian habitat frequented by Eastern Foxsnakes) and key sites identified in 11.1	2014-2019	as above	as above	CCC, SFN, LWI (SCRCA)	as above
11.2.1 Action Step	Assemble information on appropriate ecopassages for target species and habitats by 2017	2014-2017	as above	as above	as above	as above
11.2.2 Action Step	Present at at least one workshop with relevant municipalities and municipal planners about ecopassages by 2018	2017-2018	as above	as above	as above	as above
11.3 Strategic Action	Educate general public regarding threats faced by reptiles (e.g. scale and impact of road mortality on at risk populations, how to prevent road mortality, building hibernacula and artificial nesting sites away from roads, assisting movement of turtles across the road, snake persecution)	2014 and beyond	as above	as above	SCRCA, CCC, SFN, LWI Nature London	as above
11.3.1 Action Step	Provide educational materials online, through publications and at outreach events each year	2014 and beyond	as above	as above	as above	as above

#	Objective & Strategic Actions	Timeline	Threats Addressed	Targets Addressed / Recovery Strategy links	Potential Leads (Collaborators)	Costs / Funding Sources
11.3.2 Action Step	Include reptile related materials in events and workshops aimed at youth each year	2014 and beyond	as above	as above	as above	as above
11.3.3 Action Step	Post appropriate signage at key road mortality sites to raise awareness of road mortality issues for reptiles	2014 and beyond	as above	as above	as above	as above
Objective 12	Establish and implement program to comprehensively identify prairie remnants, existing prairies and potential prairie restoration sites within the CAP area by 2019	2014-2019	Non-Timber Crops (agriculture), Invasive Non-native/Alien Species	Prairies & Savannahs	CCC, TgO, OMNR, EC, ONS	
12.1 Strategic Action	Work with relevant partners (SCRCA, TgO, RLSN, EC, OMNR) to compile existing mapping and data regarding prairies (and land ownership) in the CAP area by 2016	2014-2016	as above	as above	as above	
12.2 Strategic Action	Based on data from 12.1, identify all prairie remnants, existing prairies and potential prairie restoration sites within the CAP area by 2019	2016-2019	as above	as above	as above	
12.2.1 Action Step	Perform on-site investigation of public sites identified in 12.1 by 2017	2016-2017	as above	as above	as above	
12.2.2 Action Step	Contact landowners who have prairie remnants, existing prairies and potential prairie restoration sites regarding site investigation, stewardship and restoration by 2017	2016-2017	as above	as above	as above	
12.2.3 Action Step	Perform on-site investigation of private sites identified in 12.1, where landowner permission has been obtained, by 2019	2017-2019	as above	as above	as above	

iii. Evaluation and Monitoring

An important component of the CAP process is monitoring. Are the CAP's strategic actions and action steps being implemented as planned? Are the strategic actions achieving the objectives they were designed to achieve? And are they resulting in the improved viability of the conservation targets and enhanced overall ecosystem health? Are target audiences receiving the appropriate information and educational materials? Is the community actively engaged and supportive of the CAP objectives and strategies? Are public policy changes occurring that support the vision and long-term goals of the CAP?

Having answers to questions such as these during the ongoing implementation of the CAP will allow for 'adaptive management' in what is meant to be a flexible, long-term program for positive change on the landscape. Objectives, quantitative targets, timelines, strategic actions and other aspects of the CAP may need adjustment based on unforeseen factors that either impede or prevent progress on a specific objective or target, or at least make it unrealistic to achieve that target within a given timeframe. The CAP is therefore a 'living document' that will be reviewed at least annually, and periodically revised as necessary, based on evaluation of monitoring results.

As long as adequate funding is available, Carolinian Canada Coalition (CC) is committed to monitoring the actual implementation of the CAP (i.e., are the strategic actions being undertaken as planned?). The Sydenham River CAP will be included in CC's annual CAP monitoring report, which is normally submitted to the key funders of the CAP program as well as to all local CAP implementation partners. CC is also exploring ways in which landscape-level monitoring can be undertaken on a regular basis in order to document changes and trends in land cover and land use in CAP areas as well as across the entire Carolinian life zone in Canada. Such high-level monitoring using remotely-sensed data will help determine if goals such as extent of forest cover, forest interior, prairie, wetland and natural connectivity are being achieved by the CAP. For finer-scale monitoring, such as would be required at individual sites and to determine how target species populations are faring, the support of CAP partner agencies and groups will be essential.

Table 6 includes a column that lists "key ecological attributes" or KEAs for each major conservation target. KEA are critical components of a target's life history, habitat, physical processes, or community interaction that, if degraded or lost would seriously jeopardize the target's integrity. Tracking change in the KEAs will thus be an excellent measure of the success of the CAP's strategic actions. In many cases, relatively straightforward, efficient, low-cost measures were identified by the CAP science team for each conservation target, and are included in the KEA column in Table 6. Wherever appropriate and feasible, CAP implementation partners should consider monitoring KEA in their project work plans. CC will strive to assist partners in developing methods to undertake such monitoring.

A comprehensive array of excellent conservation planning resource materials, including guidance on CAP monitoring methods, are also available on-line at The Nature Conservancy (U.S.) web site (www.conserveonline.org).

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Appendix A

Sydenham River CAP Mapping Methodology

Scope

The project area is the entire watershed of the Sydenham River. A 10km buffer was used in order to avoid exclusion of natural features falling just outside of the boundary. Any individual land use polygon with a centroid falling within the CAP area or its 10km buffer was included in the mapping analysis. Using this approach, entire polygons were either included or excluded; none were divided.

Data Layers

The data layer SOLRIS v1.2 was the primary component used to create the CAP Mapping. The Southern Ontario Land Resource Information System, or SOLRIS, was developed by the Ontario Ministry on Natural Resources (see document entitled Southern Ontario Land Resource Information System (SOLRIS) - Phase 2 - Data Specifications, Version 1.2, April, 2008) for details about this data layer.

Goal of Map

The goal of the Priorities for Conservation and Restoration map is to provide a tool to guide restoration, stewardship and land securement in Sydenham River watershed.

Identification of Core Habitats

Areas of natural cover shown on the maps have been placed into one of the following categories: Priority 1 Core, Priority 2 Core, Priority 3 Core, or Supporting Natural Cover. The category indicates that area's ecological importance within the Sydenham River watershed. Areas categorized as Priority 1 Core are greater than 1500 hectares in size and represent the largest and most intact areas of natural cover in the watershed. Areas categorized as Priority 2 Core are between 501 and 1500 hectares in size. Areas categorized as Priority 3 Core are between 200 and 500 hectares and, although smaller than Priority 1 and 2 Cores, nonetheless are an important part of the system, especially when they are located in areas without much overall natural cover. Areas categorized as Supporting Natural Cover are important as stepping stones between core areas.

The categorization of areas of natural cover was based on the overall size of each area. The assessment ignored all fragmenting features with a width of 25 metres or less (e.g., minor roads, trails, power lines). In other words, two or more areas of natural cover separated by a road 25 metres or less in width were considered to be one area. Also, adjacent areas of natural cover (e.g., an area of forest adjacent to an area of marsh) were treated as one area. The criteria are shown in Table A1.

Table A1: Criteria for Identification of Core Habitats

Category	Size (ha)	Fragmenting features
Priority 1	Core >1500	<25m
Priority 2	Core 501 - 1500	<25m

Priority 3	Core 200 - 500	<25m
Supporting Nature Cover	< 200	<25m

Identification of Natural Heritage Features

The map indicates the locations of evaluated wetlands (PSW and non-PSW), Areas of Natural and Scientific Interest (Life Science and Earth Science ANSIs) and freshwater streams.

Footnotes and References

1. We used the definition of a wetland complex from the Ontario Wetland Evaluation System Manual (May 1994 revised).
2. Evaluation by The Nature Conservancy of stopover sites for migratory birds in the western Lake Erie basin ranked undeveloped cover within 1.6km of the Lake Erie shoreline as high or very high for landbirds and raptors (Ewert, *et al.* 2006).
3. We used the size and water protection criteria from the Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 – second edition (March 2010).

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Appendix B:

Natural Heritage Designations – Sydenham River CAP

Area Name	Area Type
A.W. Campbell CA	Conservation Authority Lands
Alexandra Park	Conservation Authority Lands
Bear Creek Floodplain Life ANSI	Provincial Life Science ANSI
Bear Creek Source Woodlot	Unofficial wetland
Bear Creek South of Wyoming	Regional Life Science ANSI
Bear Creek Woodlot #4	PS Wetland
Bear Creek Woods	Unofficial wetland
Bickford Oak Woods Conservation Reserve	Conservation Reserve
Bickford Oak Woods Wetland Complex	PS Wetland
Black Creek	Regional Life Science ANSI
Bobcat Swamp Wetland Complex	PS Wetland
Bray's Swamp	Unofficial wetland
Bridgeview CA	Conservation Authority Lands
Brigden Crown Game Reserve	Unofficial wetland
Brown Creek Woods	PS Wetland
Brown Creek Woods	Regional Life Science ANSI
Burton Drain Woodlot	PS Wetland
Camden CA	Conservation Authority Lands
Centennial Park	Conservation Authority Lands
Centennial Park	Conservation Authority Lands
Chicken Island	Unofficial wetland
Chontos MF	Conservation Authority Lands
Clark Wright CA	Conservation Authority Lands
Clay Creek Woodland	Regional Life Science ANSI
Cochrane Property	Conservation Authority Lands
Coldstream CA	Conservation Authority Lands
Coldstream CA	Conservation Authority Lands
Crothers CA	Conservation Authority Lands
Cuddy woods	Conservation Authority Lands
Deyo's Woodlot	PS Wetland
Dresden Floodplain Acquisition	Conservation Authority Lands
Duncrief Wetland	PS Wetland

Area Name	Area Type
Duthill Woodlot	Regional Life Science ANSI
Duthill Woodlot #2	PS Wetland
Eastern Lake St. Clair IBA	Important Bird Area (very small portion in CAP)
Euphemia #3 (Cairo Wetland)	PS Wetland
Evoy Woodlot	Conservation Authority Lands
Fox Creek Woods	Unofficial wetland
Gawne Property	Conservation Authority Lands
Gold Creek Wetland	Unofficial wetland
Grant's Woodlot	Unofficial wetland
Grape Fern Woods	PS Wetland
Hardy Creek Swamp	Unofficial wetland
Hardy Creek Wetland	Unofficial wetland
Harford Wetland	Unofficial wetland
Harrison Property	Conservation Authority Lands
Hospital Property	Conservation Authority Lands
Hyde Park Wetland	Unofficial wetland
Jim Thompson Wetland	PS Wetland
Kerwood Swamp ME3	PS Wetland
Komoka/South Strathroy Creek Wetland	PS Wetland
Longwoods Woodlot Wetland Complex	PS Wetland
Lorne C. Henderson CA	Conservation Authority Lands
Lorne C. Henderson Conservation Area	Unofficial wetland
Marsh Walk	Conservation Authority Lands
Marthaville HMA	Conservation Authority Lands
McAlpine Managed Forest	Conservation Authority Lands
McCready Woods	PS Wetland
McKeough Floodway	Conservation Authority Lands
McKeough Floodway	Conservation Authority Lands
McKeough Upstream Lands	Conservation Authority Lands
McPhail Managed Forest	Conservation Authority Lands
McPhail Tract	Unofficial wetland
Melbourne Marsh	PS Wetland
Melwood Conservation Area	Unofficial wetland
Napier Swamp SC-16	Unofficial wetland
Oakdale Woods	Regional Life Science ANSI
Oaks Arboretum	Conservation Authority Lands

Area Name	Area Type
Peers Wetland	Conservation Authority Lands
Petrolia Conservation Area	Unofficial wetland
Plum Creek Life ANSI	Provincial Life Science ANSI
Plum Creek Upland Woods	Carolinian Canada Site
Plum Creek Woods	Unofficial wetland
Reid Property	Conservation Authority Lands
SCRCA Admin Office	Conservation Authority Lands
Shetland CA	Conservation Authority Lands
Shetland Kentucky Coffee-tree Woods	Carolinian Canada Site
Sinclair CA	Conservation Authority Lands
Sinker Drain Wetland	Unofficial wetland
South Ilderton Heronry Complex	PS Wetland
Sports Field	Conservation Authority Lands
St.Clair (Bear Creek) National Wildlife Area	National Wildlife Area
Strathroy CA	Conservation Authority Lands
Sydenham River Corridor	Carolinian Canada Site
Sydenham River Wetland Complex	PS Wetland
Telfer Woodlot	Unofficial wetland
Tony Stranak CA	Conservation Authority Lands
W. Darcy McKeough CA	Conservation Authority Lands
Walnut Heronry Woods	PS Wetland
Walnut Woods	Regional Life Science ANSI
Warwick CA	Conservation Authority Lands
Warwick Conservation Area	PS Wetland
West Warwick Woods	Unofficial wetland

*ANSI = Area of Natural and Scientific Interest, PS = Provincially Significant

Appendix C

Species-specific Threats to Sydenham River CAP species at risk

O=Ontario-wide threats, OC=Ontario-wide threats also documented in this CAP.

ELEMENT	Associated Conservation Target(s) (see Table 5 for key to codes)	Habitat Fragmentation	Habitat Loss	Degradation of Habitat	Incompatible Forest Management	Changes to natural succession	Disease	Changes to Hydrology	Disturbance (Recreation, Construction or Maintenance)	Accidental Mortality	Discriminate Killing, Collection, Harvesting	Pollution	Road Mortality	Excessive Predation, Parasitism or Herbivory	Competition with Introduced Species	Hybridization with Introduced Species	Comments
Acadian Flycatcher	UF	OC	OC	OC	OC		O?	O	OC					OC			Limited by availability of suitable habitat; Incompatible Forestry: diameter-limit harvesting, canopy opening; Brown-headed Cowbird nest parasitism; Predators?
American Badger	PS; TF; AG	OC	OC				O			OC?	OC?		OC	OC?			Limited by low population density and large home ranges, low reproductive capacity, presence of deep sandy soils suitable for dens; reduced prey availability; predation by coyotes and domestic dogs; incidental trapping; canine distemper and tularemia
American Chestnut	UF; AG		OC	OC	O		OC		O			O				O	Main threat is Chestnut blight (<i>C. parasitica</i>) ; Limited by self-incompatible breeding system and low seed dispersal
Barn Owl	PS; TF; AG	O	O										O				Limited by availability of suitable habitat (grasslands) and nesting sites (wooden farm buildings torn down and replaced by more modern “bird proof” barns); loss of habitat for prey (rodents such as voles); road mortality
Barn Swallow	AG		O	O					O								Limited by availability of suitable nesting sites (wooden farm buildings torn down and replaced by more modern “bird proof” barns) and foraging habitat in open agricultural areas; loss of food (pesticide spraying reduces the insect population)

ELEMENT	Associated Conservation Target(s) (see Table 5 for key to codes)	Habitat Fragmentation	Habitat Loss	Degradation of Habitat	Incompatible Forest Management	Changes to natural succession	Disease	Changes to Hydrology	Disturbance (Recreation, Construction or Maintenance)	Accidental Mortality	Pollution	Road Mortality	Excessive Predation, Parasitism or Herbivory	Competition with Introduced Species	Hybridization with Introduced Species	Comments
Blackstripe Topminnow	RS; FM		O C	O C				O C			O C			O		Loss and degradation of habitat (riparian vegetation removal, shoreline modification, activities that change hydrology); pollution (oil seepage from oil wells, sedimentation, nutrient loading, agricultural pesticides); exotic species
Black Tern	WE		O	O				O C	O	O						Main threats include wetland drainage and alteration, water pollution, human disturbance at nesting colonies (particularly boat traffic which can swamp floating nests)
Blanding's Turtle	WE; RS; RP	O C	O C	O C			O? C?				O C	O C	O C			Limited by naturally low recruitment, low dispersal, long generation time; road mortality (female-biased); availability of nesting habitat; unusually high levels of predation (esp. nests); fragmentation and isolation of populations (roads/urbanization)?; sarcophagid fly infestation of nests?
Blue Ash	RS; WE		O		O C			O?					O			Indiscriminate forestry; livestock grazing prevents seedling establishment; low reproduction at some sites (cause not identified); exotic species
Bobolink	PS; AG		O	O					O	O						Limited by availability of suitable habitat; disturbance of nests during hay mowing; possible threats along migration route
Butler's Gartersnake	PS; TF; RP	O	O									O				Loss of tallgrass prairie and other grassland habitat; habitat fragmentation; road mortality

ELEMENT	Associated Conservation Target(s) (see Table 5 for key to codes)	Habitat Fragmentation	Habitat Loss	Degradation of Habitat	Incompatible Forest Management	Changes to natural succession	Disease	Changes to Hydrology	Disturbance (Recreation, Construction or Maintenance)	Accidental Mortality	Pollution	Road Mortality	Excessive Predation, Parasitism or Herbivory	Competition with Introduced Species	Hybridization with Introduced Species	Comments
Butternut	UF edges; TF?	O	O C		O C		O C						O C		O	Main threat is butternut canker ; Limited by short life-span, short dispersal distance, low genetic diversity, specific conditions for regeneration; incompatible forest management: intentional harvesting (in anticipation of disease), indiscriminate removal of trees that have canker (prevents natural development of resistance), indiscriminate silvicultural practices; diseases and pests; excessive seed predation; hybridization with exotic Juglans species
Cerulean Warbler	UF	O C	O C		O C						O		O C?			Limited by high breeding site fidelity and threats in wintering grounds; acid rain; stream pollution, Forestry practices: remove most mature trees and open canopy (diameter-limit /diameter-cut, maintaining young, even-aged stands through short rotations); brown-headed cowbird brood-parasitism; light pollution, Forest pests? (emerald ash borer? Tent caterpillar? Gypsy moth?) disease? (oak wilt)
Chimney Swift	AG; UF		O	O			O?		O	O	O	O	O	O		Loss or degradation of nesting and roosting sites (changes to chimneys, loss of large-diameter hollow trees); reduced abundance and quality of prey; bioaccumulation of pesticides; disturbance during breeding period (nest removal, chimney sweeping); competition with European Starlings for nest sites; accidental mortality (asphyxiation or burns in chimney); road mortality; predation; West Nile Virus (tested positive in US)
Climbing Prairie Rose	PS; TF		O	O		O			O					O		Main threats include urban development, incompatible site management, succession, competition with non-native shrubs.
Common Five-Lined Skink	PS; UF; RP	O C	O C	O C		O C?			O C			O C	O C?			Limited by availability of sandy substrates used for overwintering; vegetation succession (suppression of fire/other disturbances?); subsidized predators

ELEMENT	Associated Conservation Target(s) (see Table 5 for key to codes)	Habitat Fragmentation	Habitat Loss	Degradation of Habitat	Incompatible Forest Management	Changes to natural succession	Disease	Changes to Hydrology	Disturbance (Recreation, Construction or Maintenance)	Accidental Mortality	Pollution	Road Mortality	Excessive Predation, Parasitism or Herbivory	Competition with Introduced Species	Hybridization with Introduced Species	Comments
Common Nighthawk	UF; TF; WE		O	O								O	O			Habitat loss and degradation; loss of food (pesticide spraying reduces the insect population); road mortality; excessive predation in urban areas; climate change
Crooked-stem Aster	RS; UF		O C	O C	O C			O C	O C					O C		Limited by semi-obligate out-breeding system (requires genetically different individuals to produce seed); Forestry: clear-cutting, heavy selective timber harvesting, damage; erosion due to tile drainage or other agricultural activities; garlic mustard; trampling by off-road vehicles
Dense Blazing-star	PS; WE		O C			O C		O C	O		O C		O C?	O C	O C?	Limited by climate and lack of disturbance (e.g. fire); over-grazing; hybridization and genetic erosion (cultivated varieties available at garden centres); herbicide application; mowing
Drooping Trillium	UF; WE	O C	O C	O C				O	O C?	O? C?			O? C?	O C		Limited by low dispersal ability, low seed production, climate; excessive opening of canopy; dumping; decreased soil moisture; exotic earthworms; herbivory/browsing/grazing?; garlic mustard; honeysuckles
Eastern Flowering Dogwood	PS; UF; TF	O C	O C	O C	O C	O C	O C						O C			Main threat is dogwood anthracnose fungus ; fire suppression and forest succession (closed canopy results in reduced EFD vigour and encourages fungal growth); reduced probability of seed dispersal; restricted gene flow (possibly reducing ability to develop natural resistance to anthracnose); insects and pests

ELEMENT	Associated Conservation Target(s) (see Table 5 for key to codes)	Habitat Fragmentation	Habitat Loss	Degradation of Habitat	Incompatible Forest Management	Changes to natural succession	Disease	Changes to Hydrology	Disturbance (Recreation, Construction or Maintenance)	Accidental Mortality	Discriminate Killing, Collection, Harvesting	Pollution	Road Mortality	Excessive Predation, Parasitism or Herbivory	Competition with Introduced Species	Hybridization with Introduced Species	Comments
Eastern Foxsnake	WE; RP; PS	O C	O C	O C					O C	O	O C	O C	O C	O C			Limited by fidelity to hibernacula, communal use of hibernacula, number of suitable hibernacula available; alteration of distribution of wetland/forest/field mosaics; roads and other barriers; disturbance of hibernacula or nests; accidental mortality from human activities; loss of suitable microhabitats (shedding sites) and replacement with less suitable anthropogenic features; limited availability of natural oviposition sites (reliance on compost piles leads to mortality)
Eastern Hog-nosed Snake	UF; TF; WE; RP; PS	O C	O C	O C							O C	O C	O C	C?			Limited by prey specialization, climate, low population densities; roads; pesticides (reduced fitness and reproductive success, prey abundance)
Eastern Meadowlark	PS; AG	O	O	O										O			Habitat loss, degradation and fragmentation; reforestation; loss of food (pesticide spraying reduces the insect population); excessive predation
Eastern Whip-poor-will	UF; TF	O	O	O									O	O			Habitat loss and degradation; road mortality; loss of food (pesticide spraying reduces the insect population); excessive predation
Eastern Pondmussel	RS; FM			O				O				O		O?	O		Main threats include invasive dreissenid mussels, decline in water quality, climate change, changes in hydrology. Possibly limited by excessive predation by muskrats, lack of host fish (unknown).
Eastern Ribbonsnake	WE; RP		O C	O C				O C		OC?	O C		O C	O C			Limited by habitat (ponds/wetlands bordered by dense vegetation) and prey specialization (amphibians); declines in prey abundance; boat mortality?; subsidized predators

ELEMENT	Associated Conservation Target(s) (see Table 5 for key to codes)	Habitat Fragmentation	Habitat Loss	Degradation of Habitat	Incompatible Forest Management	Changes to natural succession	Disease	Changes to Hydrology	Disturbance (Recreation, Construction or Maintenance)	Accidental Mortality	Discriminate Killing, Collection, Harvesting	Pollution	Road Mortality	Excessive Predation, Parasitism or Herbivory	Competition with Introduced Species	Hybridization with Introduced Species	Comments
Eastern Sand Darter	RS; FM			O				O		O		O			O		Limited by strong preference for sandy substrates (not silt or cobble); increased siltation; impoundments; stream channel and flow modifications; excessive nutrient enrichment and turbidity; round goby; incidental harvest in commercial bait fisheries; aquatic insecticides (reduce prey abundance)
Eastern Wood-Pewee (no reports available)	UF			O													Habitat loss or degradation on its wintering grounds in South America; loss of food (pesticide spraying reduces the insect population)
False Hop Sedge	WE		O C	O C	O C			O C				O C					Limited by availability of sunlight and climate; drains; dams; agricultural runoff
Fawnsfoot	RS; FM			O				O				O			O		Main threats include invasive dreissenid mussels, decline in water quality, climate change, changes in hydrology.
Golden-winged Warbler	UF; TF		O											O	O*		Loss of habitat; hybridization with *native Blue-winged Warblers; nest parasitism by Brown-headed Cowbirds
Gray Ratsnake	UF; TF; RP; PS	O C	O C	O C						O C	O C		O C	C?			Limited by fidelity to hibernacula, communal use of hibernacula, number of suitable hibernacula available, life history features; loss and change in configuration of habitat mosaic; road density; accidental mortality (due to agricultural and construction machinery, lawnmowers, off-road vehicles, boats); disturbance or destruction of hibernacula (aggregate extraction, road construction, high density residential development); collection for pet trade
Green Dragon	UF; WE; RS		O					C			O				C		Limited by climate; collection; changes in hydrological regime; garlic mustard

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Kentucky Coffee-tree	RS; WE; TF (hedgerows, edge)	O	O	O	O			O		O				O		O	Limited by climate, lack of suitable habitat, low genetic diversity (only 2 sites in Canada produce seed, most sites are single-sex clones); livestock grazing; Double Crested Cormorant colonies; introgression of non-native cultivars; dams and water flow regulation (may affect seed dispersal); roadside maintenance activities
Kidneyshell	RS; FM		O C	O C				O C				O C			O C		Main threats include non-native dreissenid mussels, siltation, water quality (nutrients and contaminants), water quantity, decline of host fish?, urbanization?, impoundments?, predation?. Limited by complex reproductive cycle and limited dispersal.
Loggerhead Shrike	TF; AG?		O	O								O	O				Habitat loss; pollution (accumulation of toxins from the prey they eat); loss of food (pesticide spraying reduces the insect population); road mortality
Mapleleaf Mussel	RS; FM		O	O								O			O		Habitat loss and degradation; pollution; non-native dreissenid mussels; threats to host fish
Massasauga	All targets (extirpated)	O	O								O		O				Low population numbers; isolation
Milksnake	TF; AG; RP; PS		O	O							O		O	O			Persecution
Mudpuppy (Salamander) Mussel	RS; FM		O	O								O			O		Habitat loss and degradation; pollution; non-native dreissenid mussels

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Northern Bobwhite	Mix of PS, TF, AG, UF	O	O	O							O			O		O	Alteration of relative proportions and/or distribution of grassland/forest/field mosaics; roads and other barriers; severe winters with heavy snow cover (buries food); predation by cats; hunting; interbreeding with imported/domestic NOBO
Northern Map Turtle	RS; WE; RP		O C					O C	O C	O C	O C	O C					Development, shoreline hardening; dams, control of water levels (submerge nest sites, alter habitat); Heavy metals and other toxins
Northern Riffleshell	RS; FM		O	O								O		O			Habitat loss and degradation; pollution; non-native dreissenid mussels; possibly decline in fish hosts
Prothonotary Warbler	WE	O C	O C		O C			O C				O C?		O C			Pesticides, agricultural runoff, water pollution (mainly in wintering areas); drainage of swamp forests; Brown-headed cowbird nest parasitism; competition for nest sites with wrens and other species
Purple Twayblade	PS; UF		O C			O					O C	O C?					Will grow in partial shade but not full shade; habitat loss due to vegetative succession; pesticides
Pugnose Minnow	RS; FM		O	O								O					Habitat loss and degradation; pollution
Rainbow Mussel	RS; FM		O	O								O		O			Habitat loss and degradation; pollution; non-native dreissenid mussels
Rayed Bean	RS; FM		O	O								O		O			Habitat loss and degradation; pollution; non-native dreissenid mussels; possibly decline in fish hosts

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Red-headed Woodpecker	PS; TF; UF; RS; WE; AG		O C		O C							O C	O C				Limited by availability of preferred habitat (mature, open oak and beech forests); loss of nesting and roosting sites (dead trees); Beech-bark disease (reduces food supply); Pesticides and industrial chemicals; lack of suitable habitat?
Riddell's Goldenrod	1. PS; 2. RS; 3. TF (Wet prairie-like sites and roadside ditches)		O						O	O							Roadside and ditch maintenance; small, isolated populations (susceptible to habitat disturbance)
Round Hickorynut	RS; FM		O C	O C				O C				O C			O C		Main threats include non-native dreissenid mussels, siltation, water quality (nutrients and contaminants), water quantity, decline of host fish?, urbanization?, impoundments?, predation?. Limited by complex reproductive cycle and limited dispersal.
Round Pigtoe	RS; FM		O	O C								O			O C		Main threats include siltation, nutrient loads, contaminants, increased water temperatures, exotic species especially dreissenid mussels. Limited by low dispersal ability.
Shumard Oak	WE; TF		O C		O? C?	O C						O C					Limited by requirement of full sunlight for seedling establishment; clearing of hedgerows/ fencerows to accommodate larger agricultural equipment; herbicides; mowing; canopy closure
Small White Lady's-slipper	PS; WE; TF		O C			O C					O C				O C		Limited by lack of optimal habitat; collecting; invasive species (leafy spurge, St. John's wort); low genetic diversity, isolation of populations; fire suppression and discontinuance of grazing
Snapping Turtle	WE; RP												O	O			Limited by long generation time; road mortality; persecution; excessive predation of eggs (especially in urban and agricultural areas)

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Snuffbox	RS; FM	O		O				O			O		O			Main threats include degradation of habitat (impoundments, siltation, channel modification, pollution), invasive dreissenid mussels, excessive predation.
Spiny Softshell	RS; RP	O C	O C	O C			O C	O C?	O C	O C	O C		O C			Limited by prey specialization (crayfish and molluscs); main threat is habitat degradation (alteration of nest sites by/for human recreation, shoreline hardening, disturbance from construction projects; disturbance during nesting; fragmentation by dams; decline in crayfish and mollusc (mussel?) populations; subsidized predators; sarcophagid fly infestation of nests; environment contamination; high numbers of infertile eggs at some Ontario sites; accidental mortality (angling and hunting activities, collisions with watercraft); egg poaching
Spoon-leaved Moss	WE	C	O C	C		O					O? C?			O? C?		Limited by low diaspore production, low dispersal, habitat specificity, may benefit from a milder climate due to climate change; pesticides? road salt? air pollution? garlic mustard?
Spotted Gar	RS; FM	O		O C						O	O C			O?	O?	Main threats include habitat modification, aquatic vegetation removal, sediment loadings, nutrient loadings, exotic species degrading habitat, climate change, barriers to movement, incidental harvest, competition and hybridization with exotic species?. Limited by cool water temperatures, availability of habitat, habitat fragmentation.
Spotted Sucker	RS; FM	O	O	O						O	O			O		Main threats include habitat loss and degradation (turbidity, siltation), nutrient loading, exotic species, altered coastal processes, barriers to movement, toxic compounds, climate change, incidental harvest. Limited by cool temperatures?

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Threehorn wartyback	RS; FM			O						O		O			O		Habitat degradation; pollution (sediment loading, nutrient loading and contaminants and toxic substances); invasive exotic species (dreissenid mussels, Round Goby); recreational activities (ATVs)
Wavy-rayed Lampmussel	RS; FM			O								O		O?	O		Main threats include invasive dreissenid mussels, decline in water quality; small populations possibly limited by excessive predation by muskrats, threats to host fish
Willowleaf Aster	PS; TF; RS?	O C	O C			O		O	O						O		Requires cross-pollination (semi-obligate outbreeding); loss of genetic diversity; reduced seed production; changes in species community and increased competition; fire suppression; mowing; herbicides; dredging; invasive species (Black Locust, Common Buckthorn, Phragmites, White Sweet Clover)
Wood Thrush (no reports available)	UF	O	O			O						O					Habitat loss and fragmentation on both its breeding grounds its Central American wintering grounds; forest succession; acid rain (negatively affects reproduction)
Woodland Vole	UF	O	O										O?	O			Limited by climate and short life span; low population densities; road mortality? (fossorial, may not be a significant threat)
Wood-poppy	WE; UF	O	O	O											O		Habitat loss, degradation and fragmentation; invasive exotic species (Garlic Mustard, Japanese Knotweed).
Yellow-breasted Chat	PS; TF; RS		O C			O C								O C			Limited by lack of available suitable habitat; Brown-headed Cowbird nest parasitism (low)