Chapter 5: Ecology & Biology

Biological diversity – or biodiversity – is the term given to the diversity, or variety of plants and animals and other living things in a particular area or region. It is the variety within and between all species of plants, animals and micro-organisms and the ecosystems within which they live and interact.

Ecological biodiversity is the diversity of ecosystems, natural communities, and habitats. In essence, ecological biodiversity is the variety of ways that species interact with each other and their environment, including humans. It is biodiversity on a larger scale. All natural areas are made up of a community of plants, animals, and other living things in a particular physical and chemical environment. In practice, conservation of biodiversity requires sustaining the diversity of species in each ecosystem as we plan human activities that affect the use of the land and natural resources.

Maintaining a wide diversity of species in each ecosystem is necessary to preserve the web of life that sustains all living things. Each species of vegetation and each creature have a place on the earth and play a vital role in the circle of life. Biodiversity boosts ecosystem productivity where each species, no matter how small have an important role to play. Plant, animal, and insect species interact and depend upon one another for what each offers, such as food, shelter, oxygen, and soil enrichment. Greater species diversity ensures natural sustainability and increased stability in the food web for all life forms. Therefore, healthy ecosystems and biodiversity influence and sustain natural ecosystems and the natural resources those ecosystems support, such as water. This chapter outlines the important biological components and ecology of the watershed. Protection of all organisms within an ecosystem, such as fish, birds, reptiles, mammals and plants should be considered in order to retain ecological biodiversity. By outlining the distribution of key indicators of ecological health in a given region, we can identify necessary improvements to mitigate impact from human activity.

Ecological Regions within the Watershed

The 1.5 million acres of the Niagara River/Lake Erie Watershed contains a variety of ecological conditions in regards to land cover, topography, hydrology, and geology. The headwaters contain distinct topographic relief and are dominated by large patches of forested cover, while the northern part of the watershed is flat and consists mostly of low-lying wetland habitat. More specific differences throughout the watershed are reflected through the classification of ecological regions (ecoregions). Defined by US EPA, ecoregions delineate areas containing similar ecological characteristics that provide a spatial framework recognizing the different potentials and capacities that are associated with the various environmental features within each region. Within the watershed, seven physiographic ecological regions exist (See Figure 5.1) and are listed here according to size from largest to smallest acreage:

- Cattaraugus Hills (461,639 acres or 30.4% of the watershed)
- Ontario Lowlands (387,091 acres or 25.5% of the watershed)
- Erie/Ontario Lake Plain (341,879 acres or 21.1% of the watershed)
- Glaciated Low Allegheny Plateau (175,818 acres or 11.6% of the watershed)
- Low Lime Drift Plain (141,597 acres or 9.3% of the watershed)
- Glaciated Allegheny Hills (10,060 acres or 0.7% of the watershed)
- Unglaciated High Allegheny Plateau (737 acres or < 0.1% of the watershed)

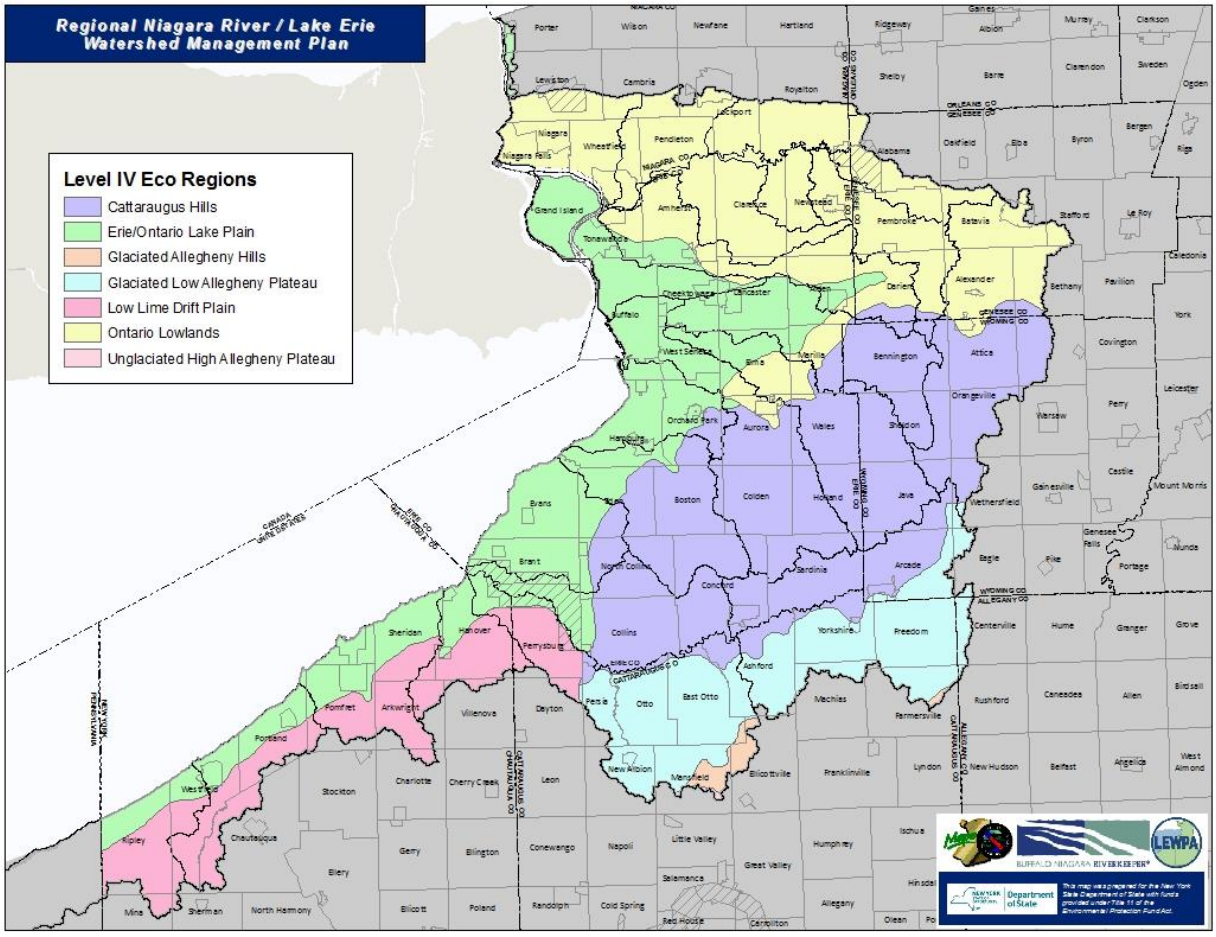


Figure 5.1: Ecoregions of the Niagara River/Lake Erie Watershed

Cattaraugus Hills

This ecoregion contains the upland headwater area of Eighteenmile Creek, Buffalo River, Buffalo Creek, Cayuga Creek, and Upper Tonawanda Creek sub-watersheds. The topography is characterized as dissected plateau, rolling hills, and plateau toe-slopes. Streams within this ecoregion are generally low gradient with substrates consisting of gravel or silt, and in some cases are spring-fed and

therefore able to support populations of native trout. Land cover within the Cattaraugus Hills contains significant areas of both deciduous and evergreen forest, emergent herbaceous wetlands, and fens. Rural residential, urban and, farmed lands also exist throughout this ecoregion.

Ontario Lowlands

The delineation of the Ontario Lowlands ecoregion stems from the extent of glacial Lake Iroquois. This zone covers the northern portion of the watershed, including Lower Tonawanda Creek, Middle Tonawanda Creek, Ellicott Creek and Murder Creek sub-watersheds. This area was once dominated by forests, however much of it has been cleared due to the agricultural capability of the land. Much of the land is low-lying, containing large wetland complexes, glacial lake plains, grasslands, and kettle topography. Streams within this zone are characterized as low-gradient, and transition into a channel closer to the confluence with the Niagara River. The built landscape contains residential, urban centers, and farmed land for both livestock and crop cultivation.

Erie/Ontario Lake Plain

The middle portion of the watershed is characterized by the Erie/Ontario Lake Plan ecoregion. The physiography of this ecoregion consists of flat lake plain bounded inland by Pleistocene beach ridges. Streams empty into the Niagara River and Lake Erie, and host a variety of Great Lakes migratory fish species. Historically the area had natural vegetation types including beech-maple forest along with chestnut and oak, however the land is now dominated by residential and urban land uses.

Glaciated Low Allegheny Plateau

This ecoregion has shallow and stony soils, which drain well in moderately sloped areas, and are used for farmland. However, much of the ecoregion has a very dense layer of subsurface soil called fragipan, which is difficult for roots to penetrate through and drains very poorly. This leads to a patchwork of land use throughout the ecoregion, which consists of low rolling hills alternated by steep forested shale slopes. The forests are a mix of northern hardwood-conifers, Appalachian oaks, and hemlocks.

Low Lime Drift Plain

This ecoregion is just inland of the Erie/Ontario Lake Plain, so it is more protected from lake-effect weather conditions. A glacial moraine prevents Chautauqua Lake from draining into Lake Erie. The Low Lime Drift Plain has beech-maple forests with hemlocks. The soils do not drain properly, which makes the land better for dairy and livestock farming instead of crop cultivation.

Glaciated Allegheny Hills

This ecoregion is adjacent to the unglaciated High Allegheny plateau, but is more rounded with more lake features, due to its glaciated geologic history. The soils are stony, acidic, and nutrient depleted. As such, this ecoregion is highly forested and not well-suited for farming. Bedrock is Devonian

sandstone and shale. There are many steep cliffs and waterfalls where the bedrock was not as susceptible to erosion, which causes a rugged look to the landscape. Forests are northern hardwoods and Appalachian oak.

Unglaciated High Allegheny Plateau

This ecoregion has lower quality soil for agriculture than its glaciated low plateau counterpart. The plateau is more dissected by streams, leading to a very steep topography interrupted by valleys and waterfalls. This area receives more precipitation than the unglaciated adjacent ecoregion as well. Historically, the area was forested by beech-hemlock, although currently there is more of a mix of hardwoods, maples, and basswoods scattered throughout the ecoregion. The waterways originate from Pleistocene glacial melt.

Watershed Biology

Fish

Various fish sampling efforts have taken place in select locations throughout the watershed; however most data exists for the Niagara River and the Niagara River/Lake Erie waterfront communities. Much of the data collection within the watershed has been conducted by NYSDEC, D. Carlson, and studies conducted in relation to the New York Power Authority's relicensing process.

Figure 5.2: Native Brook Trout

Typical fish species within the watershed include: smallmouth bass, walleye, white bass, yellow perch, white sucker, muskellunge, northern pike, carp, various shiners and minnows, brown bullhead, bluegill, and rainbow smelt.[1] Generally, migratory fishes travel upstream along the tributaries off of the Niagara River, however many are impeded by both man-made and naturally caused barriers. Figure 5.3 depicts the known fish barriers within the tributaries of the Niagara River Greenway Communities[2] from the Niagara River Greenway Habitat Strategy Phase 1. Barriers within the river itself are also present, and include water level fluctuations and changes in water velocities

[1] From Niagara River Greenway Plan and Final EIS.

[2] Niagara River Greenway Communities were designated as such as part of the New York Power Authority's relicensing process and include the City of Buffalo; Town of Tonawanda; Village of Kenmore; City of Tonawanda; City of North Tonawanda; Town of Wheatfield; Town of Grand Island; Town of Niagara, City of Niagara Falls, Town of Lewiston; Village of Lewiston, Town of Porter; and Village of Youngstown.

caused by man-made influences. In the upper portions of the watershed smaller populations of non-migratory fishes are present, including self-sustaining populations of native and naturalized trout. These trout streams are documented within the water quality classifications section found in Chapter 4 and in Figure 5.4.

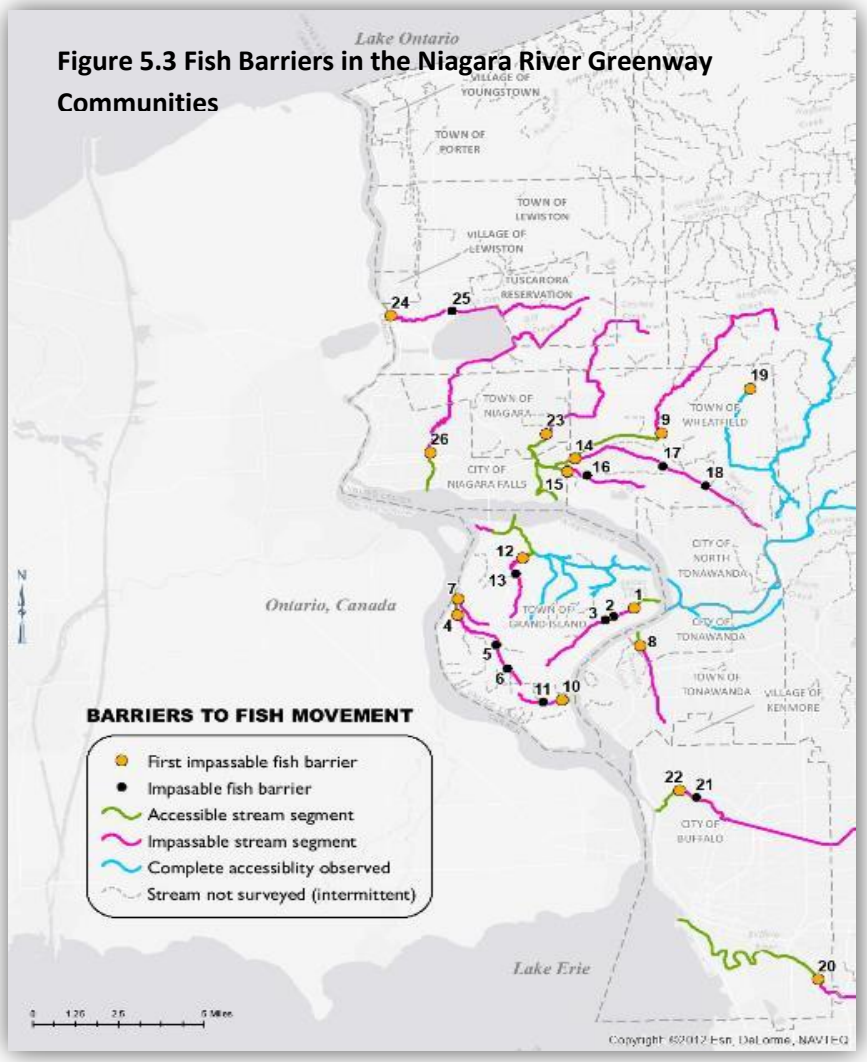


Figure 5.3 Fish Barriers in the Niagara River Greenway Communities

The master list of fish species is provided in Chart 5.1 and was compiled as part of the evaluation for Ramsar designation[3] of the Niagara River Corridor. The Niagara River Watershed Phase 1 list detailed 102 fish species that have been documented within the Niagara River Watershed. However, the following list has been updated to reflect other fishes found in the additional seven sub-watersheds. There are now 123 fish species listed. Within the Niagara River corridor, species community composition differs above and below the falls. The upper Niagara River has been recorded to support 89 species of fish, 36 of which have been introduced since 1960. The lower Niagara River has had 38 species documented, two of which were not observed until after the late 1800s.[4]

[3] https://www.ramsar.org/about-the-ramsar-convention

[4] Carlson, D.M. 2001. Species accounts for the rare fishes of New York. NYS Department of Environmental Conservation, Albany, NY.

Chart 5.1: Fish Species in the Niagara River/Lake Erie Watershed

FISH											
Species	Status						Records		Spawning Records		Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	E	
Lake Sturgeon *(Acipenser fulvescens)*	Least concern	Appendix II	-	Threatened	-	Threatened	X	X			
Gizzard Shad *(Dorosoma cepedianum)*	Least concern	-	-	-	-	-	X	X		X	X[1]
Rainbow Smelt *(Osmerus mordax)*	Least concern	-	-	-	-	-	X	X	X		X[1]
Central Mudminnow *(Umbra limi)*	Least concern	-	-	-	-	-	X	X			
American Eel *(Anguilla rostrata)*	-	-	-	-	-	Endangered	X	X			
Lake Whitefish *(Coregonus clupeaformis)*	-	-	-	-	-	-	X				
Lake Herring *(Coregonus artedi)*	Least concern	-	-	-	-	-	X	X			
American Brook Lamprey *(Lampetra appendix)*	Least concern	-	-	SGCN*	-	-	X	X			
Longnose Gar *(Lepisosteus osseus)*	Least concern	-	-	-	-	-	X	X	X	X	
Bowfin *(Amia calva)*	Least concern	-	-	-	-	-	X	X	X	X	
Grass Pickerel *(Esox americanus vermiculatus)*	-	-	-	-	Special concern	Special concern	X	X			
Mooneye *(Hiodon tergisus)*	Least concern	-	-	Threatened	-	-	X				
Longnose Sucker *(Catostomus catostomus)*	-	-	-	SGCN	-	-	X				
White Sucker *(Catostomus commersonii)*	-	-	-	-	-	-	X	X	X	X	
Northern Hognose Sucker *(Hypentelium nigricans)*	Least concern	-	-	-	-	-		X		X	
Golden Redhorse *(Moxostoma erythrurum)*	Least concern	-	-	-	-	-	X	X			
Shorthead Redhorse *(Moxostoma macrolepidotum)*	Least concern	-	-	-	-	-	X	X			
Greater Redhorse *(Moxostoma valenciennesi)*	-	-	-	-	-	-	X	X			
Black Redhorse *(Moxostoma duquesnei)*	Least concern	-	-	Special concern	-	Threatened	X	X			
Silver Redhorse *(Moxostoma anisurum)*	Least concern	-	-	-	-	-	X				
Redhorse sp. *(Moxostoma sp.)*	-	-	-	-	-	-	X				
Quillback Carpsucker *(Carpiodes cyprinus)*	Least concern	-	-	-	-	-	X	X		X	
Lake Chubsucker *(Erimyzon sucetta)*	Least concern	-	-	Threatened	Endangered	Threatened	X	X			
Black Bullhead *(Ameiurus melas)*	Least concern	-	-	SGCN	-	-	X	X			
Yellow Bullhead *(Ameiurus natalis)*	Least concern	-	-	-	-	-	X	X			
Brown Bullhead *(Ameiurus nebulosus)*	Least concern	-	-	-	-	-	X	X	X	X	
Channel Catfish *(Ictalurus punctatus)*	Least concern	-	-	-	-	-	X	X			
Stonecat *(Noturus flavus)*	Least concern	-	-	-	-	-	X	X			
Tadpole Madtom *(Noturus gyrinus)*	Least concern	-	-	-	-	-	X	X			
Brindled Madtom *(Noturus miurus)*	Least concern	-	-	-	-	-	X	X			
Burbot *(Lota lota)*	Least concern	-	-	-	-	-	X	X			
White Perch *(Morone americana)*	Least concern	-	-	-	-	-	X	X	X	X	X[1]
White Bass *(Morone chrysops)*	-	-	-	-	-	-	X	X			
Brook Silverside *(Labidesthes sicculus)*	Least concern	-	-	-	-	-	X	X	X	X	
Brook Stickleback *(Culaea inconstans)*	Least concern	-	-	-	-	-	X	X			
Three-spine Stickleback *(Gasterosteus aculeatus)*	Least concern	-	-	-	-	-	X	X			X
Trout-perch *(Percopsis omiscomaycus)*	Least concern	-	-	-	-	-	X	X	X		
Greenside Darter *(Etheostoma blennioides)*	Least concern	-	-	-	-	-	X	X			
Iowa Darter *(Etheostoma exile)*	Least concern	-	-	SGCN	-	-	X	X			
Rainbow Darter *(Etheostoma caeruleum)*	Least concern	-	-	-	-	-	X	X	X		
Fantail Darter *(Etheostoma flabellare)*	Least concern	-	-	-	-	-	X	X			
Blackside Darter *(Percina maculata)*	Least concern	-	-	-	-	-	X				
Tesselated Darter *(Etheostoma olmstedi)*	Least concern	-	-	-	-	-	X				

Johnny Darter *(Etheostoma nigrum)*	-	-	-	-	-	-	X	X	X	X	
Freshwater Drum *(Aplodinotus grunniens)*	Least concern	-	-	-	-	-	X	X			
Deepwater Sculpin *(Myoxocephalus thompsoni)*	Least concern	-	-	Endangered	-	-	X				
Mottled Sculpin *(Cottus bairdi)*	-	-	-	-	-	-	X	X		X	
Slimy Sculpin *(Cottus cognatus)*	Least concern	-	-	-	-	-		X			
Logperch *(Percina caprodes)*	Least concern	-	-	-	-	-	X	X		X	
Hornyhead Chub *(Nocomis biguttatus)*	Least concern	-	-	-	-	-	X	X		X	
River Chub *(Nocomis micropogon)*	Least concern	-	-	-	-	-	X	X			
Lake Chub *(Couesius plumbeus)*	Least concern	-	-	SGCN	-	-	X				
Fallfish *(Semotilus corporalis)*	Least concern	-	-	-	-	-	X				
Creek Chub *(Semotilus atromaculatus)*	Least concern	-	-	-	-	-	X	X			
Chub spp. *(Semotilus spp.)*	-	-	-	-	-	-	X				
Golden Shiner *(Notemigonus crysoleucas)*	Least concern	-	-	-	-	-	X	X	X	X	
Striped Shiner *(Luxilus chrysocephalus)*	Least concern	-	-	-	-	-	X	X			
Common Shiner *(Luxilus cornutus)*	Least concern	-	-	-	-	-	X	X	X	X	
Emerald Shiner *(Notropis atherinoides)*	Least concern	-	-	-	-	-	X	X	X	X	
Spottail Shiner *(Notropis hudsonius)*	Least concern	-	-	-	-	-	X	X	X	X	
Rosyface Shiner *(Notropis rubellus)*	Least concern	-	-	-	-	-	X	X			
Spotfin Shiner *(Cyprinella spiloterus)*	-	-	-	-	-	-	X	X			
Sand Shiner *(Notropis stramineus)*	Least concern	-	-	-	-	-	X	X			
Mimic Shiner *(Notropis volucellus)*	Least concern	-	-	-	-	-	X	X			
Blackchin Shiner *(Notropis heterodon)*	Least concern	-	-	SGCN	-	-	X	X		X	
Blacknose Shiner *(Notropis heterolepis)*	Least concern	-	-	SGCN	-	-	X	X		X	
Bridle Shiner *(Notropis bifrenatus)*	Near Threatened	-	-	SGCN	Special concern	Special concern		X			
Redfin Shiner *(Lythrurus umbratilis)*	-	-	-	Special concern	-	-	X	X			
Fathead Minnow *(Pimephales promelas)*	Least concern	-	-	-	-	-	X	X		X	
Bluntnose Minnow *(Pimephales notatus)*	Least concern	-	-	-	-	-	X	X	X	X	
Longnose Dace *(Rhinichthys cataractae)*	Least concern	-	-	-	-	-	X	X			
Blacknose Dace *(Rhinichthys atratulus)*	Least concern	-	-	-	-	-	X	X			
Central Stoneroller *(Campostoma anomalum)*	Least concern	-	-	-	-	-	X	X			
Atlantic Salmon *(Salmo salar)*	Least concern	-	-	SGCN	-	-	X				X
Lake Trout *(Salvelinus namaycush)*	-	-	-	SGCN	-	-	X	X	X		
Northern Pike *(Esox lucius)*	Least concern	-	-	-	-	-	X	X		X	
Muskellunge *(Esox masquinongy)*	Least concern	-	-	SGCN	-	-	X	X		X	
Smallmouth Bass *(Micropterus dolomieui)*	-	-	-	-	-	-	X	X	X	X	
Largemouth Bass *(Micropterus salmoides)*	Least concern	-	-	-	-	-	X	X	X	X	
White Crappie *(Pomoxis annularis)*	Least concern	-	-	-	-	-	X	X			
Black Crappie *(Pomoxis nigromaculatus)*	Least concern	-	-	-	-	-	X	X		X	
Yellow Perch *(Perca flavescens)*	Least concern	-	-	-	-	-	X	X	X	X	
Sauger *(Sander canadensis)*	Least concern	-	-	SGCN*; Presumed Extirpated	-	-	X	X			
Walleye *(Sander vitreus)*	Least concern	-	-	-	-	-	X	X			
Rock Bass *(Ambloplites rupestris)*	Least concern	-	-	-	-	-	X	X	X	X	
Green Sunfish *(Lepomis cyanellus)*	Least concern	-	-	-	-	-	X	X		X	
Pumpkinseed *(Lepomis gibbosus)*	Least concern	-	-	-	-	-	X	X	X	X	
Bluegill *(Lepomis macrochirus)*	Least concern	-	-	-	-	-	X	X		X	
Longear Sunfish *(Lepomis megalotis)*	Least concern	-	-	Threatened	-	-	X				

Sea Lamprey *(Petromyzon marinus)*	Least concern	-	-	-	-	-	X	X			X
Alewife *(Alosa pseudoharengus)*	Least concern	-	-	-	-	-	X	X	X	X	X
Coho Salmon *(Oncorhynchus kisutch)*	-	-	-	-	-	-	X				X
Chinook Salmon *(Oncorhynchus tshawytscha)*	-	-	-	-	-	-	X	X			X
Rainbow Trout *(Oncorhynchus mykiss)*	-	-	-	-	-	-	X	X			X
Brown Trout *(Salmo trutta)*	Least concern	-	-	-	-	-	X				X
Goldfish *(Carassius auratus)*	Least concern	-	-	-	-	-	X	X		X	X
Common Carp *(Cyprinus carpio)*	Vulnerable	-	-	-	-	-	X	X	X	X	X
Round Goby *(Neogobius melanostomus)*	Least concern	-	-	-	-	-	X	X	X	X	X
Banded Killifish *(Fundulus diaphanus)*	Least concern	-	-	-	-	-	X	X	X	X	X[1]
Rudd *(Scardinius erythrophthalmus)*	Least concern	-	-	-	-	-	X	X		X	X
Bigmouth Buffalo *(Ictiobus cyprinellus)*	Least concern	-	-	-	Special concern	-		X			
Bigeye Chub (*Hybopsis amblops*)	Least concern	-	-	SGCN*	-	-		X			
Silver Chub (*Macrhybopsis storeriana*)	Least concern	-	-	Endangered	Endangered	Threatened		X			
Spoonhead Sculpin (*Cottus ricei*)	Least concern	-	-	Presumed Extirpated	-	-		X			
Longhead Darter (*Percina macrocephala*)	Data Deficient	-	-	Threatened	-	-		X			
Eastern Sand Darter (*Ammocrypta pellucida*)	Least concern	-	-	Threatened	Threatened	Endangered		X			
Northern Sunfish (*Lepomis peltastes*)	-	-	-	Threatened	Special concern	-		X			
Paddlefish (*Polyodon spathula*)	Vulnerable	-	-	Extirpated, currently being stocked	Extirpated	Extirpated		X			
Northern Brook Lamprey (*Ichthyomyzon fossor*)	Least concern	-	-	-	Special concern	Special concern	X	X			
Silver Lamprey (*Ichthyomyzon unicuspis*)	Least concern	-	-	-	-	-		X			
Northern Redbelly Dace (*Chrosomus eos*)	Least concern	-	-	-	-	-		X			
Bigmouth Shiner (*Notropis dorsalis*)	Least concern	-	-	SGCN	-	-		X			
Brook Trout (*Salvelinus fontinalis*)	-	-	-	SGCN	-	-	X	X			
Cisco (*Coregonus artedi*)	Least concern	-	-	SGCN	-	-		X			
Pirate Perch (*Aphredoderus sayanus*)	Least concern	-	-	SGCN	-	-		X			
Redside Dace (*Clinostomus elongatus*)	Least concern	-	-	-	Endangered	Endangered		X			
Grass Carp (*Ctenopharyngodon idella*)	Least concern	-	-	-	-	-		X			X
Allegheny Pearl Dace (*Margariscus margarita*)	Least concern	-	-	-	-	-		X			
Western Blacknose Dace (*Rhinichthys obtusus*)	Least concern	-	-	-	-	-		X			
Spotted Sucker (*Minytrema melanops*)	Least concern	-	-	-	Special Concern	Special Concern		X			
Pink Salmon (*Oncorhynchus gorbuscha*)	-	-	-	-	-	-		X			X
Tiger Muskellunge (*Esox lucius x Esox masquinongy*)	-	-	-	-	-	-		X			X
Chain Pickerel (*Esox niger*)	Least concern	-	-	-	-	-		X			X
Channel Darter (*Percina copelandi*)	Least concern	-	-	-	-	Threatened		X			

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

New York State (Department of Environmental Conservation) - Species of Greatest Conservation Need (http://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf)

New York State (Department of Environmental Conservation) - Species of Potential Conservation Need (http://www.dec.ny.gov/docs/wildlife_pdf/spnc2015list.pdf)

Sources of Records

content/uploads/NIAGARA-RIVER-WATERSHED-FISH-COMMUNITY-FINAL-Aug-2013.pdf) (Canada records only)

B - NYS Department of Environmental Conservation website. "Fish Atlas Maps of New York". Retrieved on July 29, 2014. (http://www.dec.ny.gov/animals/84622.html) (U.S. records only)

C - Trometer, Betsy. 2011. Larval and young-of-the-year fishes found in the Upper and Lower Niagara River - Draft. USFWS – Lower Great Lakes Fish and Wildlife Conservation Office. (U.S. records only)

D - Kapuscinski, Kevin. 2014. Unpublished fish sampling data from the lower & upper Niagara. SUNY, College of Environmental Science and Forestry. (U.S. records only)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

Species marked with X[1] are found in both the lower and upper Niagara River, and are considered native to the lower Niagara River but introduced in the upper Niagara River.

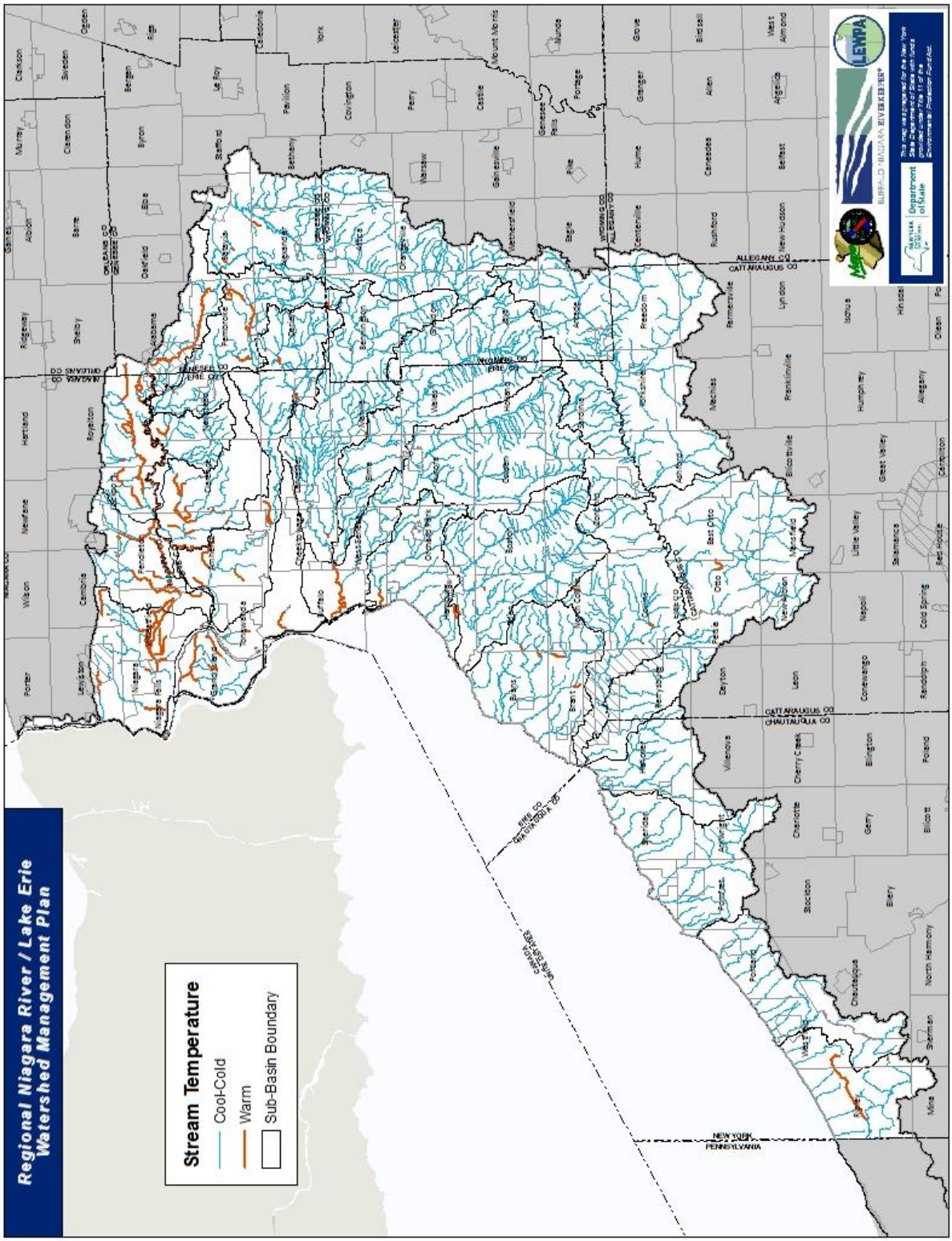


Figure 5.4: Stream Temperature in the Niagara River/Lake Erie Watershed
(Source: NYSDEC Classifications, USGS National Hydrography Dataset)

Loss of fish habitat within the watershed has been significant, resulting from human activities including development, dredging, water diversions, and bulk heading. This loss is most dramatic in the upper Niagara River, where valuable habitat including submerged aquatic vegetation and coastal wetlands have been destroyed and degraded. The Niagara River Remedial Action Plan lists the loss of both fish and wildlife habitat as a Beneficial Use Impairment for both the Buffalo and Niagara Rivers that need to be addressed before they can be delisted as Areas of Concern (AOC). However, improving trends have been observed within the past 20 years, as more sensitive fish species are showing recovery within the Niagara River.[4]

Water temperature is another factor affecting the viability of certain fish species in the watershed. The U.S. Geological Survey tracks water temperature data from its stream gauge locations and identifies which streams fall into warm and cold categories. Figure 5.4 outlines the water temperature classifications for the sub-watersheds from the research conducted as part of the Niagara River Greenway Habitat Conservation Strategy.[5]

Birds

A total of 338 bird species were documented in the Niagara River Watershed as part of the Niagara River Corridor Ramsar Site[6] nomination package, 2016 and was used in the Niagara River Habitat Conservation Strategy. A master list of bird species is provided in Chart 5.2.[7] The Niagara River corridor is currently designated as an Important Bird Area, signifying it is internationally recognized for its ability to support large populations of migratory gulls and waterfowl. A number of species flock to this area and rely on the resources it provides for both wintering and breeding activities. The sensitive bird areas that exist along the Niagara River corridor are detailed in the Table 5.1. Information on bird species was not updated for the Phase 2 watershed expansion to the Lake Erie portion of the Niagara River/Lake Erie Watershed as it was beyond the scope of this project.

[5] NYSDEC Classifications, USGS National Hydrography Dataset
[6] https://www.ramsar.org/about-the-ramsar-convention
[7] In this report we use the English capitalization standard for all species common names except birds. Cornell and Audubon have set a standard that bird common names should be written in title case.

Chart 5.2 Birds of the Niagara River/Lake Erie Watershed

BIRDS

Species	Status						Records			Nesting Records			Waterbirds	Overwintering	Migratory	Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	D	E	F				
Greater White-fronted Goose *(Anser albifrons)*	Least Concern	-	-	-	-	-			X				X		X	
Snow Goose *(Chen caerulescens)*	Least Concern	-	-	-	-	-	X		X				X		X	
Ross's Goose *(Chen rossii)*	Least Concern	-	-	-	-	-	X		X				X			
Brant *(Branta bernicla)*	Least Concern	-	-	-	-	-	X		X				X		X	
Cackling Goose *(Branta hutchinsii)*	Least Concern	-	-	-	-	-	X		X				X			
Canada Goose *(Branta canadensis)*	Least Concern	-	-	-	-	-	X		X		X	X	X	X	X	
Mute Swan *(Cygnus olor)*	Least Concern	-	-	-	-	-	X		X		X		X	X		X
Trumpeter Swan *(Cygnus buccinator)*	Least Concern	-	-	-	-	-	X		X				X			
Tundra Swan *(Cygnus columbianus)*	Least Concern	-	-	-	-	-	X		X				X	X	X	
Wood Duck *(Aix sponsa)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X		X	
Gadwall *(Anas strepera)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X	X	X	
Eurasian Wigeon *(Anas penelope)*	Least Concern	-	-	-	-	-			X				X			
American Wigeon *(Anas americana)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X	X	X	
American Black Duck *(Anas rubripes)*	Least Concern	-	-	SGCN*	-	-	X	X	X		X	X	X	X	X	
Mallard *(Anas platyrhynchos)*	Least Concern	-	-	-	-	-	X	X	X		X	X	X	X	X	
Blue-winged Teal *(Anas discors)*	Least Concern	-	-	SGCN	-	-	X	X	X		X	X	X		X	
Cinnamon Teal *(Anas cyanoptera)*	Least Concern	-	-	-	-	-			X				X			
Northern Shoveler *(Anas clypeata)*	Least Concern	-	-	-	-	-	X	X	X		X		X		X	
Northern Pintail *(Anas acuta)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Green-winged Teal *(Anas crecca)*	Least Concern	-	-	-	-	-	X	X	X		X		X		X	
Canvasback *(Aythya valisineria)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Redhead *(Aythya americana)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Ring-necked Duck *(Aythya collaris)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Tufted Duck *(Aythya fuligula)*	Least Concern	-	-	-	-	-	X		X				X			
Greater Scaup *(Aythya marila)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Lesser Scaup *(Aythya affinis)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
King Eider *(Somateria spectabilis)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Common Eider *(Somateria mollissima)*	Near Threatened	-	-	SGCN	-	-	X	X	X				X			
Harlequin Duck *(Histrionicus histrionicus)*	Least Concern	-	-	SGCN	Special Concern	-	X	X	X				X	X	X	
Surf Scoter *(Melanitta perspicillata)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
White-winged Scoter *(Melanitta deglandi)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Black Scoter *(Melanitta americana)*	Near Threatened	-	-	SGCN	-	-	X	X	X				X		X	
Long-tailed Duck *(Clangula hyemalis)*	Vulnerable	-	-	SGCN	-	-	X	X	X				X	X	X	
Bufflehead *(Bucephala albeola)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Common Goldeneye *(Bucephala clangula)*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Barrow's Goldeneye *(Bucephala islandica)*	Least Concern	-	-	-	Special Concern	-		X	X				X			
Hooded Merganser *(Lophodytes cucullatus)*	Least Concern	-	-	-	-	-	X	X	X		X		X	X	X	
Common Merganser *(Mergus merganser)*	Least Concern	-	-	-	-	-	X	X	X		X		X	X	X	
Red-breasted Merganser *(Mergus serrator)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Ruddy Duck *(Oxyura jamaicensis)*	Least Concern	-	-	SGCN	-	-	X	X	X				X		X	
Northern Bobwhite *(Colinus virginianus)*	Near Threatened	-	-	SGCN*	Endangered	Endangered		X	X							
Ring-necked Pheasant *(Phasianus colchicus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		X

Ruffed Grouse *(Bonasa umbellus)*	Least Concern	-	-	SGCN	-	-			X					X		
Wild Turkey *(Meleagris gallopavo)*	Least Concern	-	-	-	-	-	X		X		X			X		
Red-throated Loon *(Gavia stellata)*	Least Concern	-	-	-	-	-	X		X				X		X	
Pacific Loon *(Gavia pacifica)*	Least Concern	-	-	-	-	-			X				X			
Common Loon *(Gavia immer)*	Least Concern	-	-	Special Concern	-	-	X	X	X				X	X	X	
Pied-billed Grebe *(Podilymbus podiceps)*	Least Concern	-	-	Threatened	-	-	X	X	X		X	X	X	X	X	
Horned Grebe *(Podiceps auritus)*	Vulnerable	-	-	SGCN	Special Concern	Special Concern	X		X				X	X	X	
Red-necked Grebe *(Podiceps grisegena)*	Least Concern	-	-	-	-	-	X		X				X		X	
Eared Grebe *(Podiceps nigricollis)*	Least Concern	-	-	-	-	-	X		X				X			
Western Grebe *(Aechmophorus occidentalis)*	Least Concern	-	-	-	-	-			X				X			
Black-capped Petrel *(Pterodroma hasitata)*	Endangered	-	-	-	-	-			X				X			
Wilson's Storm-Petrel *(Oceanites oceanicus)*	Least Concern	-	-	-	-	-			X				X			
Leach's Storm-Petrel *(Oceanodroma leucorhoa)*	Least Concern	-	-	-	-	-			X				X			
Brown Booby *(Sula leucogaster)*	Least Concern	-	-	-	-	-	X		X				X			
Northern Gannet *(Morus bassanus)*	Least Concern	-	-	-	-	-	X		X				X			
Double-crested Cormorant *(Phalacrocorax auri*	Least Concern	-	-	-	-	-	X		X	X	X		X	X	X	
Great Cormorant *(Phalacrocorax carbo)*	Least Concern	-	-	-	-	-			X				X			
American White Pelican *(Pelecanus erythrorhync*	Least Concern	-	-	-	-	Threatened	X		X				X			
Brown Pelican *(Pelecanus occidentalis)*	Least Concern	-	-	-	-	-	X		X				X			
American Bittern *(Botaurus lentiginosus)*	Least Concern	-	-	Special Concern	-	-	X		X		X	X	X		X	
Least Bittern *(Ixobrychus exilis)*	Least Concern	-	-	Threatened	Threatened	Threatened		X	X		X	X	X		X	
Great Blue Heron *(Ardea herodias)*	Least Concern	-	-	-	-	-	X		X	X	X	X	X	X	X	
Great Egret *(Ardea alba)*	Least Concern	-	-	SGCN	-	-	X		X	X	X		X		X	
Snowy Egret *(Egretta thula)*	Least Concern	-	-	SGCN	-	-	X		X		X		X			
Little Blue Heron *(Egretta caerulea)*	Least Concern	-	-	SGCN	-	-			X				X			
Tricolored Heron *(Egretta tricolor)*	Least Concern	-	-	SGCN	-	-			X				X			
Cattle Egret *(Bubulcus ibis)*	Least Concern	-	-	SGCN*	-	-			X				X			
Green Heron *(Butorides virescens)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Black-crowned Night-Heron *(Nycticorax nycticor*	Least Concern	-	-	SGCN	-	-	X		X	X	X		X		X	
Yellow-crowned Night-Heron *(Nyctanassa violac*	Least Concern	-	-	SGCN	-	-			X				X			
Glossy Ibis *(Plegadis falcinellus)*	Least Concern	-	-	SGCN	-	-			X				X			
White-faced Ibis *(Plegadis chihi)*	Least Concern	-	-	-	-	-			X				X			
Black Vulture *(Coragyps atratus)*	Least Concern	-	-	-	-	-	X		X							
Turkey Vulture *(Cathartes aura)*	Least Concern	-	-	-	-	-	X		X		X				X	
Osprey *(Pandion haliaetus)*	Least Concern	Appendix II	-	Special Concern	-	-	X	X	X		X		X		X	
Golden Eagle *(Aquila chrysaetos)*	Least Concern	Appendix II	-	Endangered	-	Endangered			X				-			
Northern Harrier *(Circus cyaneus)*	Least Concern	Appendix II	-	Threatened	-	-	X	X	X		X	X	X	X	X	
Sharp-shinned Hawk *(Accipiter striatus)*	Least Concern	Appendix II	-	Special Concern	-	-	X		X		X	X		X	X	
Cooper's Hawk *(Accipiter cooperii)*	Least Concern	Appendix II	-	Special Concern	-	-	X		X		X			X	X	
Northern Goshawk *(Accipiter gentilis)*	Least Concern	Appendix II	-	Special Concern	-	-	X		X							
Bald Eagle *(Haliaeetus leucocephalus)*	Least Concern	Appendix II	-	Threatened	-	Special Concern	X	X	X		X		X	X		
Red-shouldered Hawk *(Buteo lineatus)*	Least Concern	Appendix II	-	Special Concern	Special Concern	-		X	X						X	
Broad-winged Hawk *(Buteo platypterus)*	Least Concern	Appendix II	-	-	-	-			X		X				X	
Red-tailed Hawk *(Buteo jamaicensis)*	Least Concern	Appendix II	-	-	-	-	X		X		X	X		X		
Rough-legged Hawk *(Buteo lagopus)*	Least Concern	Appendix II	-	-	-	-	X		X					X	X	

Yellow Rail *(Coturnicops noveboracensis)*	Least Concern	-	-	-	Special Concern	Special Concern		X					X			
King Rail *(Rallus elegans)*	Near Threatened	-	-	Threatened	Endangered	Endangered		X					X			
Virginia Rail *(Rallus limicola)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Sora *(Porzana carolina)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Common Gallinule *(Gallinula galeata)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
American Coot *(Fulica americana)*	Least Concern	-	-	-	-	-	X		X		X	X	X	X	X	
Sandhill Crane *(Grus canadensis)*	Least Concern	Appendix II	-	-	-	-	X		X				X		X	
American Avocet *(Recurvirostra americana)*	Least Concern	-	-	-	-	-	X		X				X		X	
Black-bellied Plover *(Pluvialis squatarola)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
American Golden-Plover *(Pluvialis dominica)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Semipalmated Plover *(Charadrius semipalmatus*	Least Concern	-	-	-	-	-	X		X				X		X	
Piping Plover *(Charadrius melodus)*	Near Threatened	-	Endangered	Endangered	Endangered	Endangered		X	X				X			
Killdeer *(Charadrius vociferus)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Spotted Sandpiper *(Actitis macularius)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Solitary Sandpiper *(Tringa solitaria)*	Least Concern	-	-	-	-	-	X		X				X		X	
Greater Yellowlegs *(Tringa melanoleuca)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Willet *(Tringa semipalmata)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Lesser Yellowlegs *(Tringa flavipes)*	Least Concern	-	-	-	-	-	X		X				X		X	
Upland Sandpiper *(Bartramia longicauda)*	Least Concern	-	-	Threatened	-	-		X	X			X	X		X	
Whimbrel *(Numenius phaeopus)*	Least Concern	-	-	SGCN*	-	-			X				X		X	
Hudsonian Godwit *(Limosa haemastica)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Marbled Godwit *(Limosa fedoa)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Ruddy Turnstone *(Arenaria interpres)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Red Knot *(Calidris canutus)*	Near Threatened	-	-	SGCN*	Endangered	Endangered			X				X		X	
Ruff *(Calidris pugnax)*	Least Concern	-	-	-	-	-			X				X			
Stilt Sandpiper *(Calidris himantopus)*	Least Concern	-	-	-	-	-			X				X		X	
Curlew Sandpiper *(Calidris ferruginea)*	Least Concern	-	-	-	-	-			X				X			
Sanderling *(Calidris alba)*	Least Concern	-	-	SPCN	-	-	X		X				X		X	
Dunlin *(Calidris alpina)*	Least Concern	-	-	-	-	-	X		X				X		X	
Purple Sandpiper *(Calidris maritima)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Baird's Sandpiper *(Calidris bairdii)*	Least Concern	-	-	-	-	-			X				X		X	
Least Sandpiper *(Calidris minutilla)*	Least Concern	-	-	-	-	-	X		X				X		X	
White-rumped Sandpiper *(Calidris fuscicollis)*	Least Concern	-	-	-	-	-			X				X		X	
Buff-breasted Sandpiper *(Calidris subruficollis)*	Near Threatened	-	-	SGCN*	-	-			X				X		X	
Pectoral Sandpiper *(Calidris melanotos)*	Least Concern	-	-	-	-	-	X		X				X		X	
Semipalmated Sandpiper *(Calidris pusilla)*	Near Threatened	-	-	SGCN*	-	-	X		X				X		X	
Western Sandpiper *(Calidris mauri)*	Least Concern	-	-	-	-	-	X		X				X		X	
Short-billed Dowitcher *(Limnodromus griseus)*	Least Concern	-	-	SGCN*	-	-	X		X				X		X	
Long-billed Dowitcher *(Limnodromus scolopace*	Least Concern	-	-	-	-	-			X				X			
Wilson's Snipe *(Gallinago delicata)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
American Woodcock *(Scolopax minor)*	Least Concern	-	-	SGCN	-	-	X		X		X	X	X		X	
Wilson's Phalarope *(Phalaropus tricolor)*	Least Concern	-	-	-	-	-			X				X		X	
Red-necked Phalarope *(Phalaropus lobatus)*	Least Concern	-	-	SPCN	-	-			X				X		X	
Red Phalarope *(Phalaropus fulicarius)*	Least Concern	-	-	-	-	-	X		X				X		X	
Pomarine Jaeger *(Stercorarius pomarinus)*	Least Concern	-	-	-	-	-	X		X				X			

Parasitic Jaeger *(Stercorarius parasiticus)*	Least Concern	-	-	-	-	-	X		X				X		X	
Long-tailed Jaeger *(Stercorarius longicaudus)*	Least Concern	-	-	-	-	-			X				X			
Thick-billed Murre *(Uria lomvia)*	Least Concern	-	-	-	-	-	X						X			
Razorbill *(Alca torda)*	Near Threatened	-	-	SGCN	-	-	X		X				X			
Black-legged Kittiwake *(Rissa tridactyla)*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Ivory Gull *(Pagophila eburnea)*	Near Threatened	-	-	-	Endangered	-		X	X				X			
Sabine's Gull *(Xema sabini)*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Bonaparte's Gull *(Chroicocephalus philadelphia*	Least Concern	-	-	SGCN	-	-	X	X	X				X	X	X	
Black-headed Gull *(Chroicocephalus ridibundus*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Little Gull *(Hydrocoloeus minutus)*	Least Concern	-	-	SGCN*	-	-	X	X	X				X	X	X	
Ross's Gull *(Rhodostethia rosea)*	Least Concern	-	-	-	Threatened	-	X	X	X				X			
Laughing Gull *(Leucophaeus atricilla)*	Least Concern	-	-	SGCN	-	-		X	X				X			
Franklin's Gull *(Leucophaeus pipixcan)*	Least Concern	-	-	-	-	-	X	X	X				X		X	
Mew Gull *(Larus canus)*	Least Concern	-	-	-	-	-	X	X	X				X			
Ring-billed Gull *(Larus delawarensis)*	Least Concern	-	-	-	-	-	X	X	X	X	X	X	X	X		
California Gull *(Larus californicus)*	Least Concern	-	-	-	-	-	X	X	X				X			
Herring Gull *(Larus argentatus)*	Least Concern	-	-	-	-	-	X	X	X	X	X	X	X	X		
Thayer's Gull *(Larus thayeri)*	Least Concern	-	-	SPCN	-	-	X	X	X				X	X	X	
Iceland Gull *(Larus glaucoides)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Lesser Black-backed Gull *(Larus fuscus)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Slaty-backed Gull *(Larus schistisagus)*	Least Concern	-	-	-	-	-	X	X	X				X			
Glaucous Gull *(Larus hyperboreus)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Great Black-backed Gull *(Larus marinus)*	Least Concern	-	-	-	-	-	X	X	X				X	X	X	
Caspian Tern *(Hydroprogne caspia)*	Least Concern	-	-	SGCN	-	-	X	X	X				X		X	
Black Tern *(Chlidonias niger)*	Least Concern	-	-	Endangered	-	Special Concern	X	X	X			X	X		X	
Common Tern *(Sterna hirundo)*	Least Concern	-	-	Threatened	-	-	X	X	X	X	X	X	X		X	
Forster's Tern *(Sterna forsteri)*	Least Concern	-	-	SGCN	-	-	X		X				X		X	
Elegant Tern *(Thalasseus elegans)*	Near Threatened	-	-	-	-	-	X		X				X			
Rock Pigeon *(Columba livia)*	Least Concern	-	-	-	-	-	X				X	X		X		X
Mourning Dove *(Zenaida macroura)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Yellow-billed Cuckoo *(Coccyzus americanus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Black-billed Cuckoo *(Coccyzus erythropthalmus)*	Least Concern	-	-	SGCN	-	-	X		X		X	X			X	
Barn Owl *(Tyto alba)*	Least Concern	Appendix II	-	SGCN*	Endangered	Endangered		X	X			X				
Eastern Screech-Owl *(Megascops asio)*	Least Concern	Appendix II	-	-	-	-	X		X		X	X		X		
Great Horned Owl *(Bubo virginianus)*	Least Concern	Appendix II	-	-	-	-	X		X		X	X		X		
Snowy Owl *(Bubo scandiacus)*	Least Concern	Appendix II	-	-	-	-	X		X					X	X	
Long-eared Owl *(Asio otus)*	Least Concern	Appendix II	-	SGCN	-	-	X		X					X	X	
Short-eared Owl *(Asio flammeus)*	Least Concern	Appendix II	-	Endangered	Special Concern	Special Concern	X	X	X					X	X	
Boreal Owl *(Aegolius funereus)*	Least Concern	Appendix II	-	-	-	-			X							
Northern Saw-whet Owl *(Aegolius acadicus)*	Least Concern	Appendix II	-	-	-	-	X		X						X	
Common Nighthawk *(Chordeiles minor)*	Least Concern	-	-	Special Concern	Threatened	Special Concern	X		X		X	X			X	
Eastern Whip-poor-will *(Antrostomus vociferus)*	Least Concern	-	-	Special Concern	Threatened	Threatened			X						X	
Chimney Swift *(Chaetura pelagica)*	Near Threatened	-	-	-	Threatened	Threatened	X		X		X	X			X	
Ruby-throated Hummingbird *(Archilochus colubi*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Rufous Hummingbird *(Selasphorus rufus)*	Least Concern	-	-	-	-	-										

Belted Kingfisher *(Megaceryle alcyon)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Red-headed Woodpecker *(Melanerpes erythroce*	Near Threatened	-	-	Special Concern	Threatened	Special Concern	X	X	X		X	X			X	
Red-bellied Woodpecker *(Melanerpes carolinus*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Yellow-bellied Sapsucker *(Sphyrapicus varius)*	Least Concern	-	-	-	-	-	X		X		X				X	
Downy Woodpecker *(Picoides pubescens)*	Least Concern	-	-	-	-	-	X				X	X		X		
Hairy Woodpecker *(Picoides villosus)*	Least Concern	-	-	-	-	-	X				X	X		X		
American Three-toed Woodpecker *(Picoides dor*	Least Concern	-	-	-	-	-	X		X							
Northern Flicker *(Colaptes auratus)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Pileated Woodpecker *(Dryocopus pileatus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
American Kestrel *(Falco sparverius)*	Least Concern	Appendix II	-	SGCN	-	-	X		X		X	X		X		
Merlin *(Falco columbarius)*	Least Concern	Appendix II	-	-	-	-	X		X		X				X	
Gyrfalcon *(Falco rusticolus)*	Least Concern	Appendix I	-	-	-	-			X							
Peregrine Falcon *(Falco peregrinus)*	Least Concern	Appendix I	-	Endangered	Special Concern	Special Concern	X	X	X		X				X	
Olive-sided Flycatcher *(Contopus cooperi)*	Near Threatened	-	-	-	Threatened	Special Concern			X						X	
Eastern Wood-Pewee *(Contopus virens)*	Least Concern	-	-	-	-	Special Concern	X		X		X	X			X	
Yellow-bellied Flycatcher *(Empidonax flaviventr*	Least Concern	-	-	-	-	-	X		X						X	
Acadian Flycatcher *(Empidonax virescens)*	Least Concern	-	-	-	Endangered	Endangered			X						X	
Alder Flycatcher *(Empidonax alnorum)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Willow Flycatcher *(Empidonax traillii)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Least Flycatcher *(Empidonax minimus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Eastern Phoebe *(Sayornis phoebe)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Great Crested Flycatcher *(Myiarchus crinitus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Eastern Kingbird *(Tyrannus tyrannus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Loggerhead Shrike *(Lanius ludovicianus)*	Least Concern	-	-	Endangered	Endangered	Endangered	X	X	X							
Northern Shrike *(Lanius excubitor)*	Least Concern	-	-	-	-	-	X		X					X	X	
White-eyed Vireo *(Vireo griseus)*	Least Concern	-	-	-	-	-			X						X	
Yellow-throated Vireo *(Vireo flavifrons)*	Least Concern	-	-	-	-	-	X		X		X				X	
Blue-headed Vireo *(Vireo solitarius)*	Least Concern	-	-	-	-	-	X		X						X	
Warbling Vireo *(Vireo gilvus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Philadelphia Vireo *(Vireo philadelphicus)*	Least Concern	-	-	-	-	-	X		X						X	
Red-eyed Vireo *(Vireo olivaceus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Blue Jay *(Cyanocitta cristata)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Black-billed Magpie *(Pica hudsonia)*	Least Concern	-	-	-	-	-			X							
American Crow *(Corvus brachyrhynchos)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Fish Crow *(Corvus ossifragus)*	Least Concern	-	-	-	-	-	X		X							
Common Raven *(Corvus corax)*	Least Concern	-	-	-	-	-			X							
Horned Lark *(Eremophila alpestris)*	Least Concern	-	-	Special Concern	-	-	X		X		X	X		X	X	
Northern Rough-winged Swallow *(Stelgidopteryx*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Purple Martin *(Progne subis)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Tree Swallow *(Tachycineta bicolor)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Bank Swallow *(Riparia riparia)*	Least Concern	-	-	-	-	Threatened	X		X		X	X			X	
Barn Swallow *(Hirundo rustica)*	Least Concern	-	-	-	-	Threatened	X		X		X	X			X	
Cliff Swallow *(Petrochelidon pyrrhonota)*	Least Concern	-	-	-	-	-	X		X		X				X	
Cave Swallow *(Petrochelidon fulva)*	Least Concern	-	-	-	-	-			X							
Boreal Chickadee *(Poecile hudsonicus)*	Least Concern	-	-	-	-	-			X							

Black-capped Chickadee *(Poecile atricapillus)*	Least Concern	-	-	-	-	-	X				X	X		X		
Tufted Titmouse *(Baeolophus bicolor)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Red-breasted Nuthatch *(Sitta canadensis)*	Least Concern	-	-	-	-	-	X		X		X			X		
White-breasted Nuthatch *(Sitta carolinensis)*	Least Concern	-	-	-	-	-	X				X	X		X		
Brown Creeper *(Certhia americana)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
House Wren *(Troglodytes aedon)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Winter Wren (*Troglodytes hiemalis)*	Least Concern	-	-	-	-	-	X		X		X				X	
Sedge Wren *(Cistothorus platensis)*	Least Concern	-	-	Threatened	-	-		X	X						X	
Marsh Wren *(Cistothorus palustris)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Carolina Wren *(Thryothorus ludovicianus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Blue-gray Gnatcatcher *(Polioptila caerulea)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Golden-crowned Kinglet *(Regulus satrapa)*	Least Concern	-	-	-	-	-	X		X					X	X	
Ruby-crowned Kinglet *(Regulus calendula)*	Least Concern	-	-	-	-	-	X		X						X	
Eastern Bluebird *(Sialia sialis)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Townsend's Solitaire *(Myadestes townsendi)*	Least Concern	-	-	-	-	-	X		X							
Veery *(Catharus fuscescens)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Gray-cheeked Thrush *(Catharus minimus)*	Least Concern	-	-	-	-	-	X		X						X	
Swainson's Thrush *(Catharus ustulatus)*	Least Concern	-	-	-	-	-	X		X						X	
Hermit Thrush *(Catharus guttatus)*	Least Concern	-	-	-	-	-	X		X						X	
Wood Thrush *(Hylocichla mustelina)*	Near Threatened	-	-	SGCN	-	Special Concern	X		X		X	X			X	
American Robin *(Turdus migratorius)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Varied Thrush *(Ixoreus naevius)*	Least Concern	-	-	-	-	-	X		X							
Gray Catbird *(Dumetella carolinensis)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Brown Thrasher *(Toxostoma rufum)*	Least Concern	-	-	SGCN*	-	-	X		X		X	X			X	
Northern Mockingbird *(Mimus polyglottos)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
European Starling *(Sturnus vulgaris)*	Least Concern	-	-	-	-	-	X		X		X	X		X		X
American Pipit *(Anthus rubescens)*	Least Concern	-	-	-	-	-	X		X						X	
Bohemian Waxwing *(Bombycilla garrulus)*	Least Concern	-	-	-	-	-			X							
Cedar Waxwing *(Bombycilla cedrorum)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Lapland Longspur *(Calcarius lapponicus)*	Least Concern	-	-	-	-	-	X		X					X	X	
Snow Bunting *(Plectrophenax nivalis)*	Least Concern	-	-	-	-	-	X		X					X	X	
Ovenbird *(Seiurus aurocapilla)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Worm-eating Warbler *(Helmitheros vermivorum)*	Least Concern	-	-	SGCN	-	-			X						X	
Louisiana Waterthrush *(Parkesia motacilla)*	Least Concern	-	-	SGCN	Special Concern	Special Concern	X		X				X		X	
Northern Waterthrush *(Parkesia noveboracensis)*	Least Concern	-	-	SGCN	-	-	X		X		X		X		X	
Blue-winged Warbler *(Vermivora cyanoptera)*	Least Concern	-	-	SGCN	-	-	X		X		X	X			X	
Golden-winged Warbler *(Vermivora chrysoptera)*	Near Threatened	-	-	Special Concern	Threatened	Special Concern			X						X	
Black-and-white Warbler *(Mniotilta varia)*	Least Concern	-	-	-	-	-	X		X						X	
Prothonotary Warbler *(Protonotaria citrea)*	Least Concern	-	-	SGCN*	Endangered	Endangered	X	X	X				X		X	
Swainson's Warbler *(Limnothlypis swainsonii)*	Least Concern	-	-	-	-	-			X							
Tennessee Warbler *(Oreothlypis peregrina)*	Least Concern	-	-	SPCN	-	-	X		X						X	
Orange-crowned Warbler *(Oreothlypis celata)*	Least Concern	-	-	-	-	-	X		X						X	
Nashville Warbler *(Oreothlypis ruficapilla)*	Least Concern	-	-	-	-	-	X		X			X			X	
Connecticut Warbler *(Oporornis agilis)*	Least Concern	-	-	-	-	-			X						X	
Mourning Warbler *(Geothlypis philadelphia)*	Least Concern	-	-	-	-	-	X		X			X				

Kentucky Warbler *(Geothlypis formosa)*	Least Concern	-	-	SGCN*	-	-			X							
Common Yellowthroat *(Geothlypis trichas)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
Hooded Warbler *(Setophaga citrina)*	Least Concern	-	-	-	Threatened	Special Concern	X		X						X	
American Redstart *(Setophaga ruticilla)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Cape May Warbler *(Setophaga tigrina)*	Least Concern	-	-	-	-	-	X		X						X	
Cerulean Warbler *(Setophaga cerulea)*	Vulnerable	-	-	Special Concern	Special Concern	Threatened	X	X	X						X	
Northern Parula *(Setophaga americana)*	Least Concern	-	-	-	-	-	X		X		X				X	
Magnolia Warbler *(Setophaga magnolia)*	Least Concern	-	-	-	-	-	X		X						X	
Bay-breasted Warbler *(Setophaga castanea)*	Least Concern	-	-	SGCN*	-	-	X		X						X	
Blackburnian Warbler *(Setophaga fusca)*	Least Concern	-	-	-	-	-	X		X						X	
Yellow Warbler *(Setophaga petechia)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Chestnut-sided Warbler *(Setophaga pensylvanica*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Blackpoll Warbler *(Setophaga striata)*	Least Concern	-	-	-	-	-	X		X						X	
Black-throated Blue Warbler *(Setophaga caerule*	Least Concern	-	-	SGCN	-	-	X		X						X	
Palm Warbler *(Setophaga palmarum)*	Least Concern	-	-	-	-	-	X		X						X	
Pine Warbler *(Setophaga pinus)*	Least Concern	-	-	-	-	-	X		X						X	
Yellow-rumped Warbler *(Setophaga coronata)*	Least Concern	-	-	-	-	-	X		X		X				X	
Yellow-throated Warbler *(Setophaga dominica)*	Least Concern	-	-	-	-	-			X							
Prairie Warbler *(Setophaga discolor)*	Least Concern	-	-	SGCN	-	-	X		X						X	
Black-throated Gray Warbler *(Setophaga nigresc*	Least Concern	-	-	-	-	-			X							
Black-throated Green Warbler *(Setophaga virens*	Least Concern	-	-	-	-	-	X		X						X	
Canada Warbler *(Cardellina canadensis)*	Least Concern	-	-	SGCN*	Threatened	Special Concern	X		X						X	
Wilson's Warbler *(Cardellina pusilla)*	Least Concern	-	-	-	-	-	X		X						X	
Yellow-breasted Chat *(Icteria virens)*	Least Concern	-	-	Special Concern	Special Concern	Endangered		X	X						X	
Eastern Towhee *(Pipilo erythrophthalmus)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
American Tree Sparrow *(Spizella arborea)*	Least Concern	-	-	-	-	-	X		X					X	X	
Chipping Sparrow *(Spizella passerina)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Clay-colored Sparrow *(Spizella pallida)*	Least Concern	-	-	-	-	-			X						X	
Field Sparrow *(Spizella pusilla)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Vesper Sparrow *(Pooecetes gramineus)*	Least Concern	-	-	Special Concern	-	-	X		X						X	
Lark Sparrow *(Chondestes grammacus)*	Least Concern	-	-	-	-	-			X							
Savannah Sparrow *(Passerculus sandwichensis)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Grasshopper Sparrow *(Ammodramus savannaru*	Least Concern	-	-	Special Concern	-	Special Concern	X	X	X			X			X	
Henslow's Sparrow *(Ammodramus henslowii)*	Near Threatened	-	-	Threatened	Endangered	Endangered		X	X						X	
Fox Sparrow *(Passerella iliaca)*	Least Concern	-	-	-	-	-	X		X						X	
Song Sparrow *(Melospiza melodia)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Lincoln's Sparrow *(Melospiza lincolnii)*	Least Concern	-	-	-	-	-			X						X	
Swamp Sparrow *(Melospiza georgiana)*	Least Concern	-	-	-	-	-	X		X		X	X	X		X	
White-throated Sparrow *(Zonotrichia albicollis)*	Least Concern	-	-	-	-	-	X		X					X	X	
Harris's Sparrow *(Zonotrichia querula)*	Least Concern	-	-	-	-	-			X							
White-crowned Sparrow *(Zonotrichia leucophry*	Least Concern	-	-	-	-	-	X		X						X	
Dark-eyed Junco *(Junco hyemalis)*	Least Concern	-	-	-	-	-	X		X		X			X	X	
Summer Tanager *(Piranga rubra)*	Least Concern	-	-	-	-	-			X							
Scarlet Tanager *(Piranga olivacea)*	Least Concern	-	-	SGCN	-	-	X		X		X	X			X	
Northern Cardinal *(Cardinalis cardinalis)*	Least Concern	-	-	-	-	-	X		X		X	X		X		

Rose-breasted Grosbeak *(Pheucticus ludovician*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Blue Grosbeak *(Passerina caerulea)*	Least Concern	-	-	-	-	-			X							
Indigo Bunting *(Passerina cyanea)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Painted Bunting *(Passerina ciris)*	Near Threatened	-	-	-	-	-			X							
Dickcissel *(Spiza americana)*	Least Concern	-	-	-	-	-			X						X	
Bobolink *(Dolichonyx oryzivorus)*	Least Concern	-	-	SGCN*	-	Threatened	X		X		X	X			X	
Red-winged Blackbird *(Agelaius phoeniceus)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Eastern Meadowlark *(Sturnella magna)*	Least Concern	-	-	SGCN*	-	Threatened	X		X		X	X			X	
Yellow-headed Blackbird *(Xanthocephalus xanth*	Least Concern	-	-	-	-	-			X							
Rusty Blackbird *(Euphagus carolinus)*	Vulnerable	-	-	SGCN*	Special Concern	-	X		X						X	
Brewer's Blackbird *(Euphagus cyanocephalus)*	Least Concern	-	-	-	-	-			X							
Common Grackle *(Quiscalus quiscula)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Brown-headed Cowbird *(Molothrus ater)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Orchard Oriole *(Icterus spurius)*	Least Concern	-	-	-	-	-	X		X		X				X	
Baltimore Oriole *(Icterus galbula)*	Least Concern	-	-	-	-	-	X		X		X	X			X	
Pine Grosbeak *(Pinicola enucleator)*	Least Concern	-	-	-	-	-			X						X	
House Finch *(Haemorhous mexicanus)*	Least Concern	-	-	-	-	-	X		X		X	X		X		X
Purple Finch *(Haemorhous purpureus)*	Least Concern	-	-	-	-	-	X		X		X	X		X	X	
Red Crossbill *(Loxia curvirostra)*	Least Concern	-	-	-	-	-	X		X							
White-winged Crossbill *(Loxia leucoptera)*	Least Concern	-	-	-	-	-	X		X						X	
Common Redpoll *(Acanthis flammea)*	Least Concern	-	-	-	-	-	X		X					X	X	
Hoary Redpoll *(Acanthis hornemanni)*	-	-	-	-	-	-	X		X							
Pine Siskin *(Spinus pinus)*	Least Concern	-	-	-	-	-	X		X					X	X	
American Goldfinch *(Spinus tristis)*	Least Concern	-	-	-	-	-	X		X		X	X		X		
Evening Grosbeak *(Coccothraustes vespertinus)*	Least Concern	-	-	-	-	-	X		X					X	X	
House Sparrow *(Passer domesticus)*	Least Concern	-	-	-	-	-	X				X	X		X		X

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.d

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSI

Sources of Records

A - eBird data for the Niagara River Corridor IBA. Retrieved on February 1, 2014. (www.ebird.org) (U.S. and Canada Records)

B - Niagara River Corridor IBA Working Group. 2002. Niagara River Corridor Important bird Area Conservation Plan. Bird Studies Canada, Birdlife

C - DiTommaso, Dean, and David Suggs. B.O.S. Noteworthy Records Database, 1964-2013. "The Prothonotary." vols. 30-79. Buffalo Ornithological Society.

D - Moore, Dave, Francie Cuthbert, Chip Weseloh, and Linda Wires. Colonial Waterbirds Nesting on the Niagara River, 1976-2011. (PowerPoint Presentation at

E - NYS Department of Environmental Conservation website. "NYS Breeding Bird Atlas (2000-2005) ." Confirmed, probable and possible records. Retrieved

Additional Notes

Waterbirds are defined by Audubon as birds predominantly associated with water, either ecologically or taxonomically.

Overwintering birds are those listed as common, fairly common, or uncommon in records from: Seasonal Checklist of the Birds, Niagara Frontier Region. 2002.

Migratory birds are those that show significant changes in abundance by season, excluding those only listed as very rare or exceptional, in records from:

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

6/6/2017: Jo J

I did not attempt to update additional birds onto this list. Instead I searched DEC status, to update whether or not some plants have switched to threatened/endangered/SGCN in the last 4 years.

I did the same for SARA (queried only endangered, threatened, etc. birds inhabiting Ontario)

While most of the water bird species are located along the river, the species that rely on other habitats such as early successional forests, grass and shrub lands, and deciduous and mixed forests exist in the outer regions of the watershed where these land cover types are more abundant. Sources of species data around the watershed come from wildlife surveys related to the Niagara River and Buffalo River AOCs, NYS Natural Heritage Program occurrences, and lists that are developed by wildlife preserves including Beaver Meadow Audubon Center. This master list also includes data collected in the Niagara River corridor from Canadian resources.

Table 5.1 Sensitive Bird Areas along Niagara River Corridor

Location	Type of Bird Species
Buffalo Harbor: Donnelly's Wall, South Breakwall and Short Breakwall	Approximately 1,300 pairs of Common Tern
Former Bethlehem Steel Site	Gulls: Ring-billed, Herring, Great Black Backed
Motor Island	Great Egret, Black-crowned Night Heron, Great-blue Heron, Double-crested Cormorant
Strawberry Island	Cormorant and Great-blue Heron
Tonawanda and North Tonawanda Intake	12-75 pairs of Common Tern
Buckhorn Weir	Historical Tern colony, abandoned c. 1988. Ring-billed and Herring gulls, Double-crested Cormorants
Near Crib/Far Crib (NYPA-owned parcels)	2-80 pair of Common Tern
Tower Island	Historical Tern colonies, abandoned c. 1998.
Goat Island	Ring-billed gulls, Herring Gulls, Double-crested Cormorants, Peregrine Falcon nest.

Source: NYSDEC, 2006 (HAB43)

The Great Lakes Marsh Monitoring Program (MMP) examines the presence of indicator bird and amphibian species associated with the AOCs in order to gauge the restoration status of wetland and marsh habitats. Indicator species are those which are sensitive to degraded ecosystems, so their presence suggests that a marsh or wetland is functionally adequate to host these sensitive species. The MMP results from 1995 to 2002 suggest that marsh nesting birds within these areas are at a moderate level of diversity. For the Niagara River AOC, nine out of twelve indicator species were found during surveys completed in 2009-2010. These species include the American Coot, Black Rail, Common Moorhen, Least Bittern, Marsh Wren, Pied-billed Grebe, Sora Rail, and Swamp sparrow. Only one site was

Figure 5.5: Great Blue Herron nesting on Strawberry Island

monitored for bird species within the Buffalo River AOC, however no indicator species were recorded. Recommendations from the MMP stress the need to further improve marsh conditions within both the Niagara and Buffalo River AOCs in order to support more robust marsh bird communities.[8]

Several studies on grassland birds within the watershed have been published by Norment et al. (2002, 2006).[9] [10] Grassland bird species have been decreasing throughout the region. Within the Lake Erie Basin, 16 out of 22 Species of Greatest Conservation Need, which rely on grassland and shrubland habitat are said to be experiencing a decreasing trend according to the New York State Comprehensive Wildlife Conservation Strategy. Norment et al. conducted two studies regarding grassland birds and their habitats in order to evaluate the status of populations and breeding success and provide management recommendations. Both studies took place at Iroquois National Wildlife Refuge and Tonawanda and Oak Orchard Wildlife Management Areas, portions of which are in the Niagara River/ Lake Erie Watershed. In most of the fields assessed, four or fewer species were observed, and Savannah Sparrow and Bobolink were the two most commonly seen. Results show that nest success was generally high in the Northeast (study area) compared to other comparable regions in the Midwest, however this could be improved through management practices such as increasing field area, controlling the presence of shrubs, encouraging the growth of cool-season grasses, and haying or mowing either early or late in the season when birds are not nesting. If managed correctly, areas of the watershed have a great potential to offer high-quality breeding habitat for obligate grassland bird species.

Macroinvertebrates

According to the U.S. Environmental Protection Agency, macroinvertebrates are organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate). They inhabit all types of running water and include such varieties as crayfish, clams, snails, and worms. Table 5.2 outlines the variety of macroinvertebrate groups found in New York State. Many of these taxa include up to several hundred species families within their biological classification as well.

Table 5.2 Freshwater Macroinvertebrates of New York

Flatworms (Platyhelminthes)
Mussels and Clams (Pelecypoda)
Snails (Mollusca: Gastropoda)
Worms (Oligochaeta)
Leeches (Hirundinea)
Scuds or Side Swimmers (Amphipoda)
Crayfish (Decapoda)
Sow Bugs (Isopoda)
Mayflies (Ephermeroptera)
Dragonfiles and Damselflies (Odonata)
Stoneflies (Plecoptera)
True Bugs (Hemiptera)
Dobsonflies, Hellgrammites, Fishfiles, Alderflies (Megaloptera)
Beetles (Coleoptera)
Caddisflies (Trichoptera)
True flies, mosquitoes, gnats, midges (Diptera)

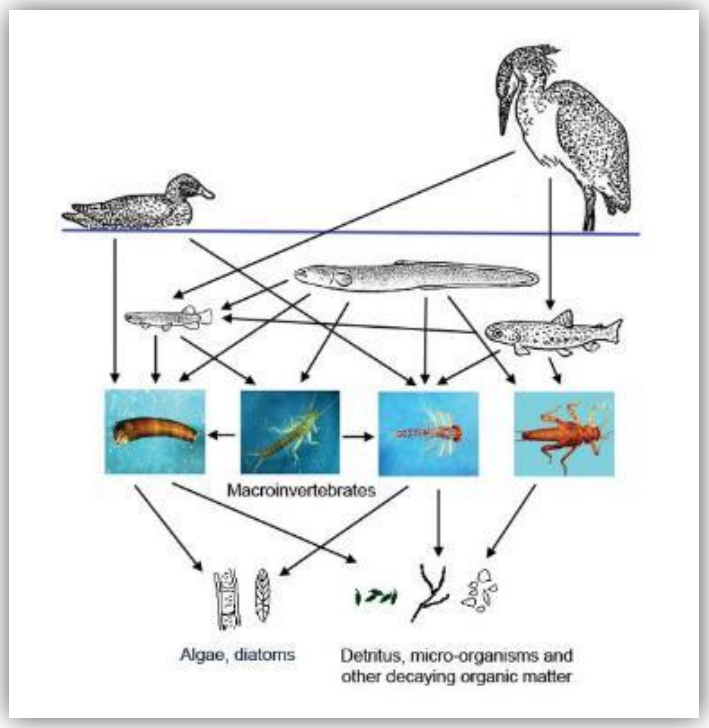
Source: NYSDEC

[8] Legacy Conserving New York State Biodiversity (American Museum of Natural History NYS Biodiversity Research Institute, 2012) & Bi National Assessments of Marsh Habitat Quality for the Niagara River and Buffalo River Areas of Concern (Archer, Rankin 2011)

[9] Norment, C. J. 2002. Grassland bird conservation in the Northeast. Auk 119: 271-279.

[10] Norment, C.J. and Saskia Windig. 2006. Influence of distance to habitat edge on depredation rates of simulates grassland bid nests. Final Report, Challenge Cost Share Agreement between the Research Foundation of SUNY Brockport and USFWS.

Figure 5.6 General Water-based Food Web Structure



Macroinvertebrates are important indicators of ecosystem health and often utilized to track water quality conditions over time, such as with NYSDEC's Stream Biomonitoring Program. Different species of macroinvertebrates are affected by certain levels of pollution. Absence of the most sensitive species indicates lower water quality conditions in a given waterway. Macroinvertebrate data specific to the Niagara River/Lake Erie Watershed is collected and documented by the NYSDEC's Stream Biomonitoring Unit and includes period Biotic Assessment Profiles (BAP), which are documented in Chapter 4: Water Quality.

The presence and diversity of macroinvertebrates reflects the health of waterways ecosystems, and thus they are commonly recognized as good water quality indicators. Aside from their extremely important role in the food web (Figure 5.6), many of these species are very susceptible to pollution and water quality, such as abrupt changes in temperature or oxygen levels. Current trends highlighted in the Niagara River Habitat Conservation Strategy have indicated that there has been a slight increase in macroinvertebrate levels in the Niagara River Watershed between the 2005 and 2010 BAP scoring. The BAP model accounts for four commonly accepted metrics that describe macroinvertebrate community composition (species richness, EPT richness, biotic index, and percent model affinity), where a higher BAP score indicates a healthier system.

Figure 5.7: Macroinvertebrate sampling

Chart 5.3: Mollusks of the Niagara River/Lake Erie Watershed

Mollusks

Species	Status						Records		Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	
Eastern Pondmussel *(Ligumia nasuta)*	Near Threatened	-	-	SGCN	Endangered	Endangered	X		
Fragile Papershell *(Leptodea fragilis)*	-	-	-	-	-	-	X		
Hickorynut *(Obovaria olivaria)*	Least concern	-	-	SPCN	-	Endangered	X		
Kidneyshell *(Ptychobranchus fasciolaris)*	Least concern	-	-	SGCN	Endangered	Endangered	X		
Pink heelsplitter *(Potamilus alatus)*	Least concern	-	-	SGCN	-	-	X		
Rainbow *(Villosa iris)*	-	-	-	SGCN*	Endangered	Threatened	X		
Round Pigtoe *(Pleurobema sintoxia)*	Least concern	-	-	SGCN	Endangered	Endangered	X		
Slippershell Mussel *(Alasmidonta viridis)*	Least concern	-	-	SGCN*	-	-	X		
Threeridge *(Amblema plicata)*	Least concern	-	-	SGCN	-	-	X		
Wabash Pigtoe *(Fusconaia flava)*	Least concern	-	-	SGCN*	-	-	X		
Quagga Mussel *(Dreissena rostriformis bugensis)*	Least concern	-	-	-	-	-		X	X
Zebra Mussel *(Dreissena polymorpha)*	Least concern	-	-	-	-	-		X	X

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - From a list compiled by Margaret Wooster at Buffalo Niagara Riverkeeper from NYS Natural Heritage Program data and NYS Species of Greatest Conservation Need data. (U.S. Records)

B - U.S. Geological Survey website. "NAS - Nonindigenous Aquatic Species". Retrieved on August 12, 2014. (http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/) (U.S. records only)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

* beside some SGCN species is a designation for those in highest priority, DEC knows they are declining and require stabilization in the next ten years

[11]

[11] Mollusk table created as part of Niagara River Corridor Ramsar Site nomination package, 2016.

There is great concern regarding native mussel populations. Some invasive species of mussels, particularly Dreissenids, exceed native populations, and directly harm natives by using native mussel shells as a substrate for their own growth. Additionally, there has been decline in the populations of some host fishes necessary for native freshwater mussel dispersal. Unionidae, a native mussel family that historically dominated the Great Lakes, has a parasitic larval life stage, in which it attaches to free-moving fish in order to disperse throughout the watershed. Certain mussels have extremely high host-specificity and can only attach to a certain species of fish.[12] With increased fragmentation of streams, the loss of free movement among connecting channels for a fish also means the loss of movement for native mussels. Increased siltation and other pollution sources such as agriculture runoff, wastewater, and urban stormwater runoff are also suspected as a threat to mussel populations in the region.[13]

Herptiles

Herptiles, or herps for short, refer to both amphibian species such as frogs, toads, and salamanders, and reptile species such as snakes, lizards, turtles, and tortoises. Much of the data regarding amphibians within the region come from the Marsh Monitoring Program (MMP), the NYSDEC, and Niagara Parks Commission Authority. A chart documenting amphibians and reptiles in the Niagara River region is provided on the following page and includes 31 documented species.

Figure 5.8: Northern Spring Peeper

It's important to note that the presence or absence of indicator species can be used to determine the health of marsh habitats in the watershed, and to make inferences about the restoration status of specific areas. In the Niagara River AOC, MMP sampling between 2009 and 2010 found six total amphibian species, including three out of four indicator species (bullfrog, northern leopard frog, and spring peeper). Similarly, within the Buffalo River AOC three indicator species were recorded (bullfrog, western chorus frog, and northern leopard frog), and five total species were found. Results from amphibian Index of Biotic Integrity calculations showed that Niagara River AOC sites were classified as "good" to "fair", whereas Buffalo River sites were "fair" and "poor". Within the

[12] Paterson, W.L., Griffith, T.A., Krebs, R.A., Burlakova, L.E., & D.T. Zanatta. 2015. An evaluation of the genetic structure of mapleleaf mussels (*Quadrula quadrula*) in the Lake Erie watershed. Journal of Great Lakes Research. 41:1123-1130.
[13] https://www.dec.ny.gov/docs/wildlife_pdf/sgcnfreshwatermollusks.pdf

Chart 5.4: Amphibians of the Niagara River/Lake Erie Watershed

Amphibians

Species	Status						Records				
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	D	E
Salamanders											
Jefferson Salamander *(Ambystoma jeffersonianum)*	Least concern	-	-	Special concern	Threatened	Endangered		X			
Spotted Salamander (*Ambystoma maculatum*)	Least concern	-	-	-	-	-		X			
Blue-spotted Salamander *(Ambystoma laterale)*	Least concern	-	-	Special concern	-	-		X	X	X	
Northern Dusky Salamander *(Desmognathus fuscus)*	Least concern	-	-	-	-	Endangered			X	X	
Allegheny Mountain Dusky Salamander *(Desmognathus ochrophaeus)*	Least concern	-	-	-	-	Endangered			X	X	
Northern Two-lined Salamander (*Eurycea bislineata*)	Least concern	-	-	-	-	-					
Northern Spring Salamander (*Gyrinophilus porphyriticus*)	Least concern	-	-	-	Special Concern	Extirpated					
Four-toed Salamander (*Hemidactylium scutatum*)	Least concern	-	-	SGCN*	-	-		X			
Mudpuppy *(Necturus maculosus)*	Least concern	-	-	SGCN	-	-		X	X		
Eastern Newt *(Notophthalmus viridescens)*	Least concern	-	-	-	-	-		X	X		
Red-backed Salamander *(Plethodon cinereus)*	Least concern	-	-	-	-	-		X	X	X	X
Northern Slimy Salamander (*Plethodon glutinosus*)	Least concern	-	-	-	-	-		X			
Frogs and Toads											
Eastern American Toad *(Anaxyrus americanus)*	Least concern	-	-	-	-	-	X	X	X	X	X
Fowler's Toad *(Anaxyrus fowleri)*	Least concern	-	-	SGCN	Endangered	Endangered			X	X	
Gray Treefrog *(Hyla versicolor)*	Least concern	-	-	-	-	-		X	X		
American Bullfrog *(Lithobates catesbeianus)*	Least concern	-	-	-	-	-	X	X	X		X
Green Frog *(Lithobates clamitans)*	Least concern	-	-	-	-	-	X	X	X	X	X
Pickerel Frog *(Lithobates palustris)*	Least concern	-	-	-	-	-		X	X		
Northern Leopard Frog *(Lithobates pipiens)*	Least concern	-	-	-	-	-	X	X	X	X	X
Wood Frog *(Lithobates sylvaticus)*	Least concern	-	-	-	-	-		X	X	X	X
Spring Peeper *(Pseudacris crucifer)*	Least concern	-	-	-	-	-	X	X	X	X	X
Western Chorus Frog *(Pseudacris triseriata)*	Least concern	-	-	SGCN	Threatened	-	X	X	X	X	X

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - Marsh Bird and Amphibian Communities in the Niagara River (Canada and USA) AOC, 1995 – 2002. Results of the Marsh Monitoring Program. (U.S records only)

B - NYS Department of Environmental Conservation website. "Herp Atlas Project". Retrieved on July 23, 2014. (http://www.dec.ny.gov/animals/7140.html) (U.S. records only)

C - Ontario Nature website. "Ontario Reptile and Amphibian Atlas Program". Retrieved on June 30, 2014. (http://www.ontarionature.org/protect/species/reptiles_and_amphibians/index.php#lizard) (Canada records only)

D - Yagi A.R, A.Brant and R.Tervo. 2009. Niagara Region Natural Areas Inventory Reptile and Amphibian Study 2006 to 2008. Ontario Ministry of Natural Resources and Land Care Niagara unpublished report for the Natural Areas Inventory prepared for the Niagara Peninsula Conservation Authority. (http://www.npca.ca/wp-content/uploads/12.0-Reptile-and-Amphibian-Study-2006-to-2008.pdf) (Canada records only)

Accessed 6/5/2017: https://npca.ca/sites/default/files/NAI-Vol-2.pdf **Source C**

Accessed 6/5/2017http://niagara.nypa.gov/RelicensingGreenwayFunds/EcologicalGreenway/NGR_AppendixB.pdf **Source D**

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

SGCN* are species of greatest conservation need with high priority, those without asterisk are of conservation need, but not high priority (DEC)

SPCN are species of potential conservation need, may be declining but it is not well understood (DEC)

Marsh Monitoring Program- Ontario Herpetofaunal (Margaret)

Ontario Nature http://www.ontarionature.org/protect/species/reptiles_and_amphibians/index.php#turtles

Department of Environmental Conservation- New York http://www.dec.ny.gov/animals/7494.htm

Niagara Parks Commission Authority (NPCA) http://www.npca.ca/wp-content/uploads/12.0-Reptile-and-Amphibian-Study-2006-to-2008.pdf

Niagara River, amphibian communities exceeded expectations while Buffalo River sites showed species richness levels lower than that of reference communities.[14]

In 2012, a wildlife survey was conducted within the Lower Buffalo River AOC for the purpose of developing a baseline assessment of species to aid in determining management actions associated with the Buffalo River Remedial Action Plan. Herpetofauna observed were mostly species that are highly adaptive and can be found in urban settings with the exception of the eastern spiny softshell. This species is intolerant of degraded water quality and low oxygen conditions, making its presence and re-colonization within the area a good metric for water quality and river bank habitat conditions. No salamander species were observed although they have been previously documented in the area. Results from the survey suggest breeding pools for amphibians as a restoration opportunity in order to increase frog and toad populations.[15]

Salamanders prefer dark, damp areas as habitat, including vegetative stream banks, swampy woodland, and vernal pools, but have also been found in coniferous forests and fields. Like many other herpetiles, salamanders are extremely sensitive to water quality conditions. They can easily absorb toxins found in water because their skin is very thin and permeable to water, and they typically cannot survive in highly polluted waterways. Because of their sensitivity and environmental needs, salamanders are a good indicator of habitat and water quality where they are found.

Figure 5.9: Blue-spotted Salamander

As part of two studies conducted within the watershed,[16] three species of salamander have been documented; the blue-spotted salamander, the eastern redback salamander, and the Jefferson salamander. Only the blue-spotted salamander was found at Tifft Nature Preserve in the Buffalo River sub-watershed. Both the Jefferson and the blue spotted salamanders were found along the Niagara River and in its tributaries, from the southern tip of Grand Island downstream to its mouth at Lake Ontario. The blue-spotted salamander is significant because it is on the NYSDEC Special Concern species list, and requires a hearty organic layer of

[14] Bi National Assessments of Marsh Habitat Quality for the Niagara River and Buffalo River Areas of Concern (Archer, Rankin 2011)

[15] Eckel, P. Regional Economic Growth Through Ecological Restoration of the Niagara Gorge Rim, Niagara Falls, New York, Syracuse: EDR Companies, December 2011.

[16] Studies include the *Buffalo River Wildlife Survey* (Riverkeeper 2012) conducted for areas in and around the Buffalo River AOC; and the *Assessment of the Potential Effects of Water Level Fluctuations and Land Management Practices on Rare, Threatened, and Endangered Species and Significant Occurrences of Natural Communities at the Niagara Power Project* (Riveredge Associates, LLC 2005) conducted for the NYPA Greenway Commission communities.

Chart 5.5 Reptiles of the Niagara River/Lake Erie Watershed

Reptiles

Species	Status						Records					Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	D	E	
Turtles												
Eastern Spiny Softshell (*Apalone spinifera*)	Least concern	Appendix III		Special concern	Threatened	Threatened	X		X		X	
Snapping Turtle (*Chelydra serpentina*)	Least concern	Appendix III	-	SGCN	Special concern	Special concern	X	X	X	X	X	
Painted Turtle (*Chrysemys picta*)	Least concern	-	-	-	-	-	X	X	X		X	
Midland Painted Turtle (*Chrysemys picta marginata*)	-	-	-	-	-	-			X			
Spotted Turtle (*Clemmys guttata*)	Endangered	Appendix II	-	Special concern	Endangered	Endangered	X		X			
Common Map Turtle (*Graptemys geographica*)	Least concern	Appendix III	-	SGCN	Special concern	Special concern	X		X			
Wood Turtle (*Glyptemys insculpta*)	Endangered	Appendix II	-	Special concern	Threatened	Endangered	X					
Eastern Box Turtle (*Terrapene carolina*)	Vulnerable	Appendix II	-	Special concern	-	Extirpated		X	X			
Red-eared Slider (*Trachemys scripta elegans*)	-	-	-	-	-	-	X					X
Snakes												
Northern Ringneck Snake (*Diadophis punctatus*)	Least concern	-	-	-	-	-	X			X		
Black Rat Snake (*Elaphe alleganiensis*)	-	-	-	-	-	-	X			X		
Eastern Milksnake (*Lampropeltis triangulum*)	Least concern	-	-	-	Special concern	-	X	X	X			
Common Watersnake (*Nerodia sipedon*)	Least concern	-	-	-	Endangered	Endangered	X	X	X	X		
Smooth Green Snake (*Opheodrys vernalis*)	Least concern	-	-	SGCN	-	-	X	X	X			
Queensnake (*Regina septemvittata*)	Least concern	-	-	Endangered	Endangered	Endangered	X		X		X	
Northern Brownsnake (*Storeria dekayi*)	Least concern	-	-	-	-	-	X		X			
Northern Red-bellied Snake (*Storeria occipitomaculata*)	Least concern	-	-	-	-	-	X		X			
Shorthead Garter Snake (*Thamnophis brachystoma*)	Least concern	-	-	-	-	-					X	
Eastern Ribbon Snake (*Thamnophis sauritus*)	Least concern	-	-	SGCN	Special concern	Special concern	X					
Eastern Gartersnake (*Thamnophis sirtalis*)	Least concern	-	-	-	-	-	X	X	X	X	X	

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - NYS Department of Environmental Conservation website. "Herp Atlas Project". Retrieved on July 23, 2014. (http://www.dec.ny.gov/animals/7140.html) (U.S. records only)

B - Ontario Nature website. "Ontario Reptile and Amphibian Atlas Program". Retrieved on June 30, 2014. (http://www.ontarionature.org/protect/species/reptiles_and_amphibians/index.php#lizard) (Canada

C - Yagi A.R, A.Brant and R.Tervo. 2009. Niagara Region Natural Areas Inventory Reptile and Amphibian Study 2006 to 2008. Ontario Ministry of Natural Resources and Land Care Niagara unpublished report for the Natural Areas Inventory prepared for the Niagara Peninsula Conservation Authority. (http://www.npca.ca/wp-content/uploads/12.0-Reptile-and-Amphibian-Study-2006-to-2008.pdf) (Canada records only)

D - Environmental Design & Research, Landscape Architecture, Planning, Environmental Services, Engineering and Surveying, P.C. (EDR). 2010. Ecological Inventory of the Niagara River Gorge and Rim - Draft. (Species identified during on-site ecological surveys conducted by EDR in June 2010 only) (U.S. Records)

Accessed 6/5/2017: https://npca.ca/sites/default/files/NAI-Vol-2.pdf **Source C**

Accessed 6/5/2017http://niagara.nypa.gov/RelicensingGreenwayFunds/EcologicalGreenway/NGR_AppendixB.pdf **Source D**

E - Applied Ecological Services, Inc. 2012. A Wildlife Survey of the Lower Buffalo River Area of Concern, Buffalo, Erie County, New York. (http://www.bnriverkeeper.org/buffalo-river-wildlife-survey) (U.S. Records)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

Chrysemys picta marginata doesn't have any distribution data

DEC: SGCN - Species of Greatest Conservation Need List

woody debris at various states of decay, plus fishless ephemeral ponds for breeding and egg laying.[17] The eastern red back salamander is a more adaptive species, tolerating a wider array of habitat conditions, but still requires decaying woody debris. The eastern redback salamander was documented in the Buffalo River AOC. For salamanders to increase their extent and numbers within the watershed, contiguous healthy forested riparian buffers are needed, along with low toxicity waters.

Mammals

Many of the mammals found within the watershed are common species found in similar northern suburban-rural areas of the United States, such as deer, mink, bats, mice, squirrels, and fox. Other less common species such as river otter, grey fox, some bat species, and opossum have also been documented in the Niagara River corridor. A full list of mammals is provided as Chart 5.6.

Figure 5.10: Buck at Riverbend (Buffalo River)

In recent years, some of the urban water courses have seen mammal populations return as water quality and food supplies have improved. One example of this is the Buffalo River AOC within the City of Buffalo. Once an industrialized corridor, vacant land has been replaced with vegetation, while populations of beaver, deer, and fox have become more prevalent in the area. This can be both good and bad, as certain rebounding species, such as deer and beaver, are good indicators for improved ecosystems. However these same populations can also threaten restoration projects with their excessive browsing and grazing.

According to a 2012 report, a total of 20 mammal species were identified in the Niagara River Watershed.[18] Chart 5.6 has been updated to reflect the inclusion of seven additional sub-watersheds flowing to Lake Erie, particularly because of the presence of black bears and bobcats in those areas. The 2012 survey outlined small mammals, mink, bats and deer as species that require various considerations as land use patterns change along the Buffalo River AOC. For example, mink were

[17] Petranka, J. W. Salamanders of the United States and Canada. Washington and London: Smithsonian Institution Press. 1998.
[18] Buffalo Niagara RIVERKEEPER, *A Wildlife Survey of the Lower Buffalo River Area of Concern*, Buffalo: (Applied Ecological Services, Inc.) 2012.

Chart 5.6 Mammals of the Niagara River/Lake Erie Watershed

Mammals

Species	Status						Records					Introduced
	IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Environmental Conservation Law)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B	C	D	E	
Bats												
Big Brown Bat *(Eptesicus fuscus)*	Least Concern	-	-	-	-	-	X	X				
Eastern Red Bat (*Lasiurus borealis*)	Least Concern	-	-	SGCN	-	-					X	
Hoary Bat (*Lasiurus cinereus*)	Least Concern	-	-	SGCN	-	-					X	
Silver-haired Bat *(Lasionycteris noctivagans)*	Least Concern	-	-	SGCN*	-	-	X					
Little Brown Bat *(Myotis lucifugus)*	Least Concern	-	-	SGCN	Endangered	Endangered		X	X			
Northern Long-eared Bat (*Myotis septentrionalis*)				Threatened	Endangered	Endangered				X		
Large Mammals												
Coyote *(Canis latrans)*	Least Concern	-	-	-	-	-	X					
Bobcat (*Lynx rufus*)	Least Concern	Appendix II								X		
Striped Skunk *(Mephitis mephitis)*	Least Concern	-	-	-	-	-	X	X	X			
Ermine *(Mustela erminea)*	Least Concern	-	-	-	-	-		X				
Canadian Lynx (*Lynx canadensis*)	Least Concern	Appendix II		Threatened						X		X[1]
White-tailed Deer *(Odocoileus virginianus)*	Least Concern	-	-	-	-	-	X	X	X			
Black Bear (*Ursus americanus*)	Least Concern	Appendix II	-	-	-	-				X		
Gray Fox *(Urocyon cinereoargenteus)*	Least Concern	-	-	-	Threatened	Threatened	X					
Red Fox *(Vulpes vulpes)*	Least Concern	-	-	-	-	-	X	X	X			
Small Mammals												
Northern Short-tailed Shrew *(Blarina brevicauda)*	Least Concern	-	-	-	-	-	X	X				
Beaver *(Castor canadensis)*	Least Concern	-	-	-	-	-	X	X				
Star-nosed Mole *(Condylura cristata)*	Least Concern	-	-	-	-	-		X	X			
Virginia Opossum *(Didelphis virginiana)*	Least Concern	-	-	-	-	-	X	X	X			
Ferel Cat (*Felis catus*)	Least Concern	-	-	-	-	-					X	X
River Otter (*Lontra canadensis*)	Least Concern	Appendix II	-	-	-	-				X		
Groundhog or Woodchuck (*Marmota monax*)	Least Concern	-	-	-	-	-	X	X	X		X	
Fisher (*Martes pennanti*)	Least Concern	-	-	-	-	-				X		
Meadow Vole *(Microtus pennsylvanicus)*	Least Concern	-	-	-	-	-	X	X	X			
Hoary Mouse (*Mus musculus*)	Least Concern	-	-	-	-	-					X	
Long-tailed Weasel *(Mustela frenata)*	Least Concern	-	-	-	-	-		X				
American Mink *(Mustela vison)*	Least Concern	-	-	-	-	-	X	X				
Woodland Jumping Mouse *(Napaeozapus insignis)*	Least Concern	-	-	-	-	-		X				
Muskrat *(Ondatra zibethicus)*	Least Concern	-	-	-	-	-	X	X				
Hairytail Mole *(Parascalops breweri)*	Least Concern	-	-	-	-	-			X			
White-footed Mouse *(Peromyscus leucopus)*	Least Concern	-	-	-	-	-	X	X				
Deer Mouse *(Peromyscus maniculatus)*	Least Concern	-	-	-	-	-		X	X			
Raccoon *(Procyon lotor)*	Least Concern	-	-	-	-	-	X	X	X			
Norway Rat *(Rattus norvegicus)*	Least Concern	-	-	-	-	-		X				X

Eastern Mole *(Scalopus aquaticus)*	Least Concern	-	-	-	Special Concern	Special Concern			X			
Gray Squirrel *(Sciurus carolinensis)*	Least Concern	-	-	-	-	-	X	X	X			
Fox Squirrel *(Sciurus niger)*	Least Concern	-	-	-	-	-				X		
Masked Shrew *(Sorex cinereus)*	Least Concern	-	-	-	-	-		X				
Smoky Shrew *(Sorex fumeus)*	Least Concern	-	-	-	-	-	X					
Pigmy Shrew *(Sorex hoyi)*	Least Concern	-	-	SPCN	-	-		X				
Eastern Cottontail Rabbit *(Sylvilagus floridanus)*	Least Concern	-	-	-	-	-	X	X	X			
Southern Bog Lemming *(Synaptomys cooperi)*	Least Concern	-	-	-	-	-		X				
Red Squirrel *(Tamiasciurus hudsonicus)*	Least Concern	-	-	-	-	-	X		X			
Eastern Chipmunk *(Tamias striatus)*	Least Concern	-	-	-	-	-	X	X	X			

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Environmental Conservation Law) - List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State (http://www.dec.ny.gov/animals/7494.html)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - Dobbyn, Jon. 1994. Atlas of the Mammals of Ontario. Ontario: Federation of Ontario Naturalists. (http://www.ontarionature.org/discover/resources/publications.php#atlases) (Canada Records)

B - Rising, Gerry, and Bob Andrle. Fauna of Times Beach Nature Preserve from 1994 to 2004. Unpublished. (U.S. Records)

C - Environmental Design & Research, Landscape Architecture, Planning, Environmental Services, Engineering and Surveying, P.C. (EDR). 2010. Ecological Inventory of the Niagara River Gorge and Rim - Draft. (Species identified during on-site ecological surveys conducted by EDR in June 2010 only) (U.S. Records)

D - DePriest, Tim. Recent NYS DEC Niagara River records. Unpublished. (U.S. Records)

E - Applied Ecological Services, Inc. 2012. A Wildlife Survey of the Lower Buffalo River Area of Concern, Buffalo, Erie County, New York. (http://www.bnriverkeeper.org/buffalo-river-wildlife-survey) (U.S. Records)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental.

X[1]: Canadian Lynx are occasional visitors because they can travel long distances and have been verified a few times, but they are not resident to NY

identified as a factor in the Common Tern colony losses at the Lake Erie break wall, just outside of the AOC. As a mid-size carnivore, mink has the ability to influence prey source populations. However, the lack of apex predators (that would typically consume mink) causes an imbalance which exacerbates the effects of mink predation of prey species. The lack of shoreline connectivity creates fragmentation, and mink become concentrated in certain areas, leading to over predation of Common Terns and other valuable species.

Botanicals

The botanical species documented within the Niagara River Watershed are provided in Chart 5.7 and includes 734 species. Much of the literature within the region regarding vegetation was written by a botanist Patricia Eckel, who specialized in the unique gorge and island habitats of the Niagara River. Studies containing vegetation occurrences can also be found related to NYPA relicensing documents, habitat surveys in relation to Niagara and Buffalo River AOC work. Adding species to this list for the Lake Erie portion of the watershed was beyond the scope of work for this project.

Figure 5.11: Niagara River Gorge

The Niagara Gorge and the Niagara Falls vicinity is noted for its exceptionally rich flora, which despite impacts from development and tourism is still in good condition, containing a variety of rare species. The forest communities (calcareous cliff community and talus slope woodland) along the gorge are of statewide significance regarding the specificity of the conditions required for their existence and the diversity of species that rely on them. The vegetative community on Goat Island is also of particular importance. Located directly above the falls, a river mist microclimate on the island presents conditions favorable for seed deposition, making its vegetative character of national significance.[19]

[19] Buffalo Niagara Rivers Habitat Assessment Strategy and Conservation Framework (Buffalo Niagara Riverkeeper, 2011)

Chart 5.7 Botanicals of the Niagara River/Lake Erie Watershed

PLANTS											
Species		Status						Records		Introduced	
		IUCN Red List	CITES Appendix	US (Endangered Species Act)	New York State (Natural Heritage Program)	Canada (Species at Risk Act)	Ontario (Endangered Species Act)	A	B		Origin
Balsam Fir	*Abies balsamea (L.) Miller*	Least Concern	-	-	-	-	-	X		X	Native/Introduced
Three-seeded Mercury	*Acalypha rhomboidea Raf.*	-	-	-	-	-	-	X			Native
Manitoba Maple	*Acer negundo L.*	-	-	-	-	-	-	X	X		Native
Norway Maple	*Acer platanoides L.*	-	-	-	-	-	-	X	X	X	Invasive
Sycamore Maple	*Acer pseudoplatanus L.*	-	-	-	-	-	-	X	X	X	Invasive
Red Maple	*Acer rubrum L.*	-	-	-	-	-	-	X	X		Native
Silver Maple	*Acer saccharinum L.*	-	-	-	-	-	-	X			Native
Black Maple	*Acer saccharum Marshall subsp. nigrum (Michaux f.) Desmarais*	-	-	-	-	-	-	X	X		Native
Sugar Maple	*Acer saccharum Marshall subsp. saccharum*	-	-	-	-	-	-	X	X		Native
Mountain Maple	*Acer spicatum Lam.*	-	-	-	-	-	-	X	X		Native
Yarrow	*Achillea millefolium L.*	-	-	-	-	-	-	X	X	X	Native/Introduced
White Baneberry	*Actaea pachypoda Elliott*	-	-	-	-	-	-	X	X		Native
Black Cohosh	*Actaea racemosa L.*	-	-	-	-	-	-	X			Native
Red Baneberry	*Actaea rubra (Aiton) Willd.*	-	-	-	Vulnerable	-	-	X	X		Native
(A. pachypoda X A. rubra)	*Actaea x ludovicii B. Boivin*	-	-	-	-	-	-	X			Native
Northern Maidenhair	*Adiantum pedatum L.*	-	-	-	Vulnerable	-	-	X			Native
Horse-chestnut	*Aesculus hippocastanum L.*	Near Threatened	-	-	-	-	-	X	X	X	Introduced
Slender-leaved Agalinis	*Agalinis tenuifolia (M. Vahl) Raf.*	-	-	-	-	-	-	X			Native
Purple Giant Hyssop	*Agastache scrophulariifolia (Willd.) Kuntze*	-	-	-	-	-	-	X			Native
Agrimony	*Agrimonia gryposepala Wallr.*	-	-	-	-	-	-	X			Native
Small-flowered Agrimony	*Agrimonia parviflora Aiton*	-	-	-	Rare	-	-	X			Native
Creeping Bent Grass	*Agrostis stolonifera L.*	Least Concern	-	-	-	-	-	X			Native
Tree-of-Heaven	*Ailanthus altissima (Miller) Swingle*	-	-	-	-	-	-	X	X	X	Introduced
Garlic Mustard	*Alliaria petiolata (M. Bieb.) Cavara & Grande*	-	-	-	-	-	-	X	X	X	Invasive
Wild Garlic	*Allium canadense L.*	-	-	-	-	-	-	X			Native
Wild Leek	*Allium tricoccum Aiton*	-	-	-	-	-	-	X			Native
Black Alder	*Alnus glutinosa (L.) Gaertner*	Least Concern	-	-	-	-	-	X		X	Invasive
Foxtail	*Alopecurus sp.*	-	-	-	-	-	-		X	X	
Pale Alyssum	*Alyssum alyssoides (L.) L.*	-	-	-	-	-	-	X		X	Introduced
Common Ragweed	*Ambrosia artemisiifolia L.*	-	-	-	-	-	-	X	X		Native
Juneberry	*Amelanchier amabalis Wieg.*	-	-	-	-	-	-	X			Native
Juneberry	*Amelanchier arborea (Michaux f.) Fern.*	-	-	-	-	-	-	X			Native
Juneberry	*Amelanchier sanguinea (Pursh) DC.*	-	-	-	-	-	-	X			Native
Low Juneberry	*Amelanchier stolonifera Wieg.*	-	-	-	-	-	-	X			Native
Hog-peanut	*Amphicarpaea bracteata (L.) Fern.*	-	-	-	-	-	-	X			Native
Blue Bugloss	*Anchusa arvensis (L.) M. Bieb.*	-	-	-	-	-	-	X		X	Introduced
Big Bluestem	*Andropogon gerardii Vitman*	-	-	-	-	-	-	X			Native
Sharp-lobed Hepatica	*Anemone acutiloba (DC.) Lawson*	-	-	-	-	-	-	X			Native
Round-lobed Hepatica	*Anemone americana (DC.) Hara*	-	-	-	-	-	-	X			Native
Canada Anemone	*Anemone canadensis L.*	-	-	-	-	-	-	X			Native
Long-fruited Thimbleweed	*Anemone cylindrica A. Gray*	-	-	-	-	-	-	X			Native
Wood Anemone	*Anemone quinquefolia L. var. quinquefolia*	-	-	-	-	-	-	X			Native
Thimbleweed	*Anemone virginiana L. var. alba (Oakes) Wood*	-	-	-	-	-	-	X			Native
Thimbleweed	*Anemone virginiana L. var. virginiana*	-	-	-	-	-	-	X			Native
Pussytoes	*Antennaria howellii E. Greene*	-	-	-	-	-	-	X			Native
Field Pussytoes	*Antennaria neglecta*	-	-	-	-	-	-		X		
Plantain-leaved Everlasting	*Antennaria parlinii Fern. subsp. fallax (E. Greene) R.J. Bayer &*	-	-	-	-	-	-	X			Native

Groundnut	*Apios americana Medicus*	-	-	-	-	-	-	X			Native
Putty-root	*Aplectrum hyemale (Muhlenb. ex Willd.) Nutt*	-	Appendix II	-	Endangered	-	-	X			Native
Spreading Dogbane	*Apocynum androsaemifolium L. subsp. androsaemifolium*	-	-	-	-	-	-	X	X		Native
Indian Hemp	*Apocynum cannabinum L.*	-	-	-	-	-	-	X			Native
Wild Columbine	*Aquilegia canadensis L.*	-	-	-	-	-	-	X	X		Native
Garden Columbine	*Aquilegia vulgaris L.*	-	-	-	-	-	-	X		X	Introduced
Sickle-pod	*Arabis canadensis L.*	-	-	-	-	-	-	X			Native
Divaricate Rock-cress	*Arabis divaricarpa A. Nels.*	-	-	-	-	-	-	X			Native
Drummond's Rock-cress	*Arabis drummondii A. Gray*	-	-	-	-	-	-	X			Native
Hairy Rock-cress	*Arabis hirsuta (L.) Scop.*	-	-	-	-	-	-	X			Native
Holboel's Rock-cress	*Arabis holboelii Hornem.*	-	-	-	-	-	-	X			Native
Smooth Rock-cress	*Arabis laevigata (Muhlenb. ex Willd.) Poiret*	-	-	-	-	-	-	X			Native
Lyre-leaved Rock-cress	*Arabis lyrata L. var. lyrata*	-	-	-	-	-	-	X			Native
Wild Sarsaparilla	*Aralia nudicaulis L.*	-	-	-	-	-	-	X	X		Native
Spikenard	*Aralia racemosa L. subsp. racemosa*	-	-	-	-	-	-	X	X		Native
Common Burdock	*Arctium minus (Hill) Bernh. subsp. minus*	-	-	-	-	-	-	X		X	Introduced
Bear-berry	*Arctostaphylos uva-ursi (L.) Sprengel*	-	-	-	-	-	-	X			Native
Thyme-leaved Sandwort	*Arenaria serpyllifolia L.*	-	-	-	-	-	-	X		X	Introduced
Jack-in-the-pulpit	*Arisaema triphyllum (L.) Schott*	-	-	-	Vulnerable	-	-	X	X		Native
Tall Oat Grass	*Arrhenatherum elatius (L.) P. Beauv. ex J.S. & C. Presl*	-	-	-	-	-	-	X		X	Introduced
Mugwort	*Artemisia vulgaris L.*	-	-	-	-	-	-	X	X	X	Introduced
Wild-ginger	*Asarum canadense L.*	-	-	-	-	-	-	X	X		Native
Poke Milkweed	*Asclepias exaltata L.*	-	-	-	-	-	-	X			Native
Swamp Milkweed	*Asclepias incarnata L. subsp. incarnata*	-	-	-	-	-	-	X	X		Native
Four-leaved Milkweed	*Asclepias quadrifolia Jacq.*	-	-	-	-	-	Endangered	X			Native
Common Milkweed	*Asclepias syriaca L.*	-	-	-	-	-	-	X	X		Native
Butterfly-weed	*Asclepias tuberosa L.*	-	-	-	Vulnerable	-	-	X			Native
Whorled Milkweed	*Asclepias verticillata L.*	-	-	-	Rare	-	-	X			Native
Garden Asparagus	*Asparagus officinalis L.*	-	-	-	-	-	-	X		X	Introduced
Ebony Spleenwort	*Asplenium platyneuron (L.) Britton, Sterns*	-	-	-	Vulnerable	-	-	X			Native
Walking Fern	*Asplenium rhizophyllum L.*	-	-	-	Vulnerable	-	-	X			Native
American Hart's-tongue	*Asplenium scolopendrium L. var. americanum (Fern.) Kartesz &*	-	-	-	Threatened	-	-	X		X	Introduced
Maidenhair Spleenwort	*Asplenium trichomanes L.*	-	-	-	Vulnerable	-	-	X	X		Native
Cooper's Milk-vetch	*Astragalus neglectus (Torrey & A. Gray) E.*	-	-	-	Endangered	-	-	X			Native
Northeastern Lady Fern	*Athyrium filix-femina (L.) Roth subsp. angustum (Willd.) Clausen*	-	-	-	-	-	-	X			Native
Yellow False Foxglove	*Aureolaria flava (L.) Farw.*	-	-	-	-	-	-	X			Native
Downy False Foxglove	*Aureolaria virginica (L.) Pennell*	-	-	-	-	-	-	X			Native
Winter Cress	*Barbarea vulgaris R. Br.*	-	-	-	-	-	-	X	X	X	Invasive
English Daisy	*Bellis perennis*	-	-	-	-	-	-		X	X	
Japanese Barberry	*Berberis thunbergii DC.*	-	-	-	-	-	-	X	X	X	Invasive
Common Barberry	*Berberis vulgaris L.*	-	-	-	-	-	-	X	X	X	Introduced
Yellow Birch	*Betula alleghaniensis Britton*	-	-	-	-	-	-	X	X		Native
Cherry Birch	*Betula lenta L.*	-	-	-	-	Endangered	Endangered	X			Native
River Birch	*Betula nigra*	-	-	-	Rare	-	-		X	X	
Paper Birch	*Betula papyrifera Marshall*	-	-	-	-	-	-	X	X		Native
Gray Birch	*Betula populifolia*	-	-	-	-	-	-		X		
Nodding Beggarticks	*Bidens cernuus L.*	-	-	-	-	-	-	X			Native
Devil's Beggarticks	*Bidens frondosus L.*	-	-	-	-	-	-	X			Native
Dissected Grapefern	*Botrychium dissectum Sprengel*	-	-	-	Vulnerable	-	-	X			Native
Common Moonwort	*Botrychium lunaria (L.) Sw.*	-	-	-	Endangered	-	-	X			Native

Rattlesnake Fern	*Botrychium virginianum (L.) Sw.*	-	-	-	Vulnerable	-	-	X	X		Native
Bearded Shorthusk	*Brachyelytrum erectum (Schreber) Beauv. var. erectum*	-	-	-	-	-	-	X			Native
Fringed Brome	*Bromus ciliatus L.*	-	-	-	-	-	-	X			Native
Smooth Brome	*Bromus inermis*	-	-	-	-	-	-		X	X	
Kalm's Brome	*Bromus kalmii A. Gray*	-	-	-	-	-	-	X			Native
Brome Grass	*Bromus nottowayanus Fern.*	-	-	-	Endangered	-	-	X			Native
Canada Brome	*Bromus pubescens Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Downy Chess	*Bromus tectorum L.*	-	-	-	-	-	-	X		X	Invasive
Largeleaf Brunnera	*Brunnera macrophylla*	-	-	-	-	-	-		X	X	
Corn Gromwell	*Buglossoides arvensis (L.) I.M. Johnston*	-	-	-	-	-	-	X		X	Introduced
Canada Blue-joint	*Calamagrostis canadensis (Michaux) P. Beauv*	-	-	-	-	-	-	X			Native
Low Bindweed	*Calystegia spithamaea (L.) R.Br. subsp. spithamaea*	-	-	-	-	-	-	X			Native
Tall Bellflower	*Campanula americana L.*	-	-	-	-	-	-	X			Native
Harebell	*Campanula rotundifolia L.*	-	-	-	Vulnerable	-	-	X			Native
Shepherd's-purse	*Capsella bursa-pastoris (L.) Medicus*	-	-	-	-	-	-	X		X	Introduced
Spring Cress	*Cardamine bulbosa (Schreber ex Muhl.) Britton, Sterns & Pogg.*	-	-	-	-	-	-	X			Native
Cut-leaved Toothwort	*Cardamine concatenata (Michaux) Schwein.*	-	-	-	-	-	-	X	X		Native
Two-leaved Toothwort	*Cardamine diphylla (Michaux) Wood*	-	-	-	-	-	-	X	X		Native
Purple Spring Cress	*Cardamine douglassii (Torr.) Britton*	-	-	-	Threatened	-	-	X	X		Native
Sedge	*Carex albicans Willd. ex Spreng. var. albicans*	-	-	-	-	-	-	X			Native
White-bear Sedge	*Carex albursina E. Sheldon*	-	-	-	-	-	-	X			Native
Golden-fruit Sedge	*Carex aurea Nutt.*	-	-	-	-	-	-	X			Native
Woodland Sedge	*Carex blanda Dewey*	-	-	-	-	-	-	X			Native
Oval-leaf Sedge	*Carex cephalophora Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Common Sedge	*Carex communis L. Bailey var. communis*	-	-	-	-	-	-	X			Native
Bearded Sedge	*Carex comosa Boott*	-	-	-	-	-	-	X			Native
Crawe's Sedge	*Carex crawei Dewey*	-	-	-	Threatened	-	-	X			Native
Fringed Sedge	*Carex crinita Lam.*	-	-	-	-	-	-	X			Native
Finger Sedge	*Carex digitalis Willd.*	-	-	-	-	-	-	X			Native
Bristle-leaf Sedge	*Carex eburnea Boott ex Hooker*	-	-	-	-	-	-	X			Native
Elk Sedge	*Carex garberi Fern.*	-	-	-	Endangered	-	-	X			Native
Sedge	*Carex gracilescens Steudel*	-	-	-	-	-	-	X			Native
Meadow Sedge	*Carex granularis Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Sedge	*Carex grisea Wahlenb.*	-	-	-	-	-	-	X			Native
Sedge	*Carex hirsutella Mackenzie*	-	-	-	-	-	-	X			Native
Hitchcock's Sedge	*Carex hitchcockiana Dewey*	-	-	-	-	-	-	X			Native
Porcupine Sedge	*Carex hystericina Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Inland Sedge	*Carex interior L. Bailey*	-	-	-	-	-	-	X			Native
Distant-flowered Sedge	*Carex laxiflora Lam.*	-	-	-	-	-	-	X			Native
Muhlenberg's Sedge	*Carex muehlenbergii Schkuhr ex Willd.*	-	-	-	Rare	-	-	X			Native
Few-flowered Sedge	*Carex oligocarpa Schk. ex Willd.*	-	-	-	-	-	-	X			Native
Peduncled Sedge	*Carex pedunculata Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Pennsylvania Sedge	*Carex pensylvanica Lam.*	-	-	-	-	-	-	X	X		Native
Plantain-leaved Sedge	*Carex plantaginea Lam.*	-	-	-	-	-	-	X			Native
Broad-leaved Sedge	*Carex platyphylla J. Carey*	-	-	-	-	-	-	X			Native
Drooping Sedge	*Carex prasina Wahlenb.*	-	-	-	-	-	-	X			Native
Sedge	*Carex radiata (Wahlenb.) Small*	-	-	-	-	-	-	X			Native
Sedge	*Carex rosea Schkuhr ex Willd.*	-	-	-	-	-	-	X			Native
Rough Sedge	*Carex scabrata Schwein.*	-	-	-	-	-	-	X			Native
Spiked Sedge	*Carex spicata Hudson*	-	-	-	-	-	-	X		X	Introduced

Awl-fruited Sedge	*Carex stipata Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Slender Sedge	*Carex tenera Dewey var. tenera*	-	-	-	-	-	-	X			Native
Rigid Sedge	*Carex tetanica Schk. ex Willd.*	-	-	-	-	-	-	X			Native
Wrinkled-seeded Sedge	*Carex tonsa (Fern.) Bickn. var. rugosperma (Mack.) Crins*	-	-	-	-	-	-	X			Native
Hairy-fruited Sedge	*Carex trichocarpa Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Umbellate Sedge	*Carex umbellata Schkuhr ex Willd.*	-	-	-	-	-	-	X			Native
Fox Sedge	*Carex vulpinoidea Michaux*	-	-	-	-	-	-	X			Native
Wood's Sedge	*Carex woodii Dewey*	-	-	-	-	-	-	X			Native
Blue-beech	*Carpinus caroliniana Walter subsp. virginiana (Marsh.) Furlow*	-	-	-	-	-	-	X			Native
Bitternut Hickory	*Carya cordiformis (Wang.) K. Koch*	-	-	-	-	-	-	X	X		Native
Shagbark Hickory	*Carya ovata (Miller) K. Koch var. ovata*	-	-	-	-	-	-	X	X		Native
Indian Paintbrush	*Castilleja coccinea (L.) Sprengel*	-	-	-	Endangered	-	-	X			Native
Catalpa	*Catalpa speciosa*	-	-	-	-	-	-		X	X	
Blue Cohosh	*Caulophyllum giganteum (Farw.) Leconte & Blackwell*	-	-	-	-	-	-	X			Native
New Jersey Tea	*Ceanothus americanus L.*	-	-	-	-	-	-	X			Native
Oriental Bittersweet	*Celastrus orbiculatus Thunb.*	-	-	-	-	-	-	X	X	X	Invasive
Climbing Bittersweet	*Celastrus scandens L.*	-	-	-	Rare	-	-	X			Native
Common Hackberry	*Celtis occidentalis L.*	-	-	-	-	-	-	X	X		Native
Spotted Knapweed	*Centaurea maculosa Lam.*	-	-	-	-	-	-	X	X	X	Invasive
Buttonbush	*Cephalanthus occidentalis L.*	-	-	-	-	-	-	X			Native
Field Chickweed	*Cerastium arvense L.*	-	-	-	-	-	-	X		X	Introduced
Mouse-eared Chickweed	*Cerastium fontanum Baumg.*	-	-	-	-	-	-	X	X	X	Introduced
Chickweed	*Cerastium glomeratum Thuill.*	-	-	-	-	-	-	X		X	Introduced
Nodding Chickweed	*Cerastium nutans Raf. var. nutans*	-	-	-	-	-	-	X			Native
Curtis Mouse-eared Chickweed	*Cerastium pumilum Curtis*	-	-	-	-	-	-	X		X	Introduced
Spring Mouse-eared Chickweed	*Cerastium semidecandrum L.*	-	-	-	-	-	-	X		X	Introduced
Eastern Redbud	*Cercis canadensis*	Least Concern	-	-	-	-	-		X	X	
Dwarf Snapdragon	*Chaenorrhinum minus (L.) Lange*	-	-	-	-	-	-	X		X	Introduced
Devil's Bit	*Chamaelirium luteum (L.) A. Gray*	-	-	-	Endangered	-	-	X			Native
Hairy-fruited Spurge	*Chamaesyce maculata (L.) Small*	-	-	-	-	-	-	X		X	Introduced
Eyebane	*Chamaesyce nutans (Lagasca) Small*	-	-	-	-	-	-	X		X	Native/Introduced
Celandine	*Chelidonium majus L.*	-	-	-	-	-	-	X	X	X	Invasive
Turtlehead	*Chelone glabra L.*	-	-	-	Vulnerable	-	-	X			Native
Lamb's-quarters	*Chenopodium album L. var. album*	-	-	-	-	-	-	X	X	X	Introduced
Oak-leaved Goosefoot	*Chenopodium glaucum L. subsp. glaucum*	-	-	-	-	-	-	X		X	Introduced
Maple-leaved Goosefoot	*Chenopodium simplex (Torrey) Raf.*	-	-	-	-	-	-	X			Native
Ox-eye Daisy	*Chrysanthemum leucanthemum L.*	-	-	-	-	-	-	X	X	X	Invasive
Chicory	*Cichorium intybus L.*	-	-	-	-	-	-	X	X	X	Introduced
Small Enchanter's-nightshade	*Circaea alpina L.*	-	-	-	-	-	-	X			Native
Enchanter's-nightshade	*Circaea lutetiana L.*	-	-	-	-	-	-	X	X		Native
Canada Thistle	*Cirsium arvense (L.) Scop.*	-	-	-	-	-	-	X	X	X	Invasive
Swamp Thistle	*Cirsium muticum*	-	-	-	-	-	-		X		
Bull Thistle	*Cirsium vulgare (Savi) Tenore*	-	-	-	-	-	-	X	X	X	Invasive
Spring Beauty	*Claytonia caroliniana Michaux*	-	-	-	-	-	-	X			Native
Narrow-leaved Spring Beauty	*Claytonia virginica L.*	-	-	-	-	-	-	X	X		Native
Virgin's-bower	*Clematis virginiana L.*	-	-	-	-	-	-	X	X		Native
Bluebead Lily	*Clintonia borealis (Aiton) Raf.*	-	-	-	-	-	-	X			Native
Horsebalm	*Collinsonia canadensis L.*	-	-	-	-	-	-	X			Native
Bastard-toadflax	*Comandra umbellata (L.) Nutt.*	-	-	-	-	-	-	X			Native
Squawroot	*Conopholis americana (L.) Wallr.*	-	-	-	Vulnerable	-	-	X	X		Native

Lily-of-the-valley	*Convallaria majalis L.*	-	-	-	-	-	-	X		X	Introduced
Field Bindweed	*Convolvulus arvensis*	-	-	-	-	-	-		X	X	
Horseweed	*Conyza canadensis (L.) Cronq.*	-	-	-	-	-	-	X			Native
Goldthread	*Coptis trifolia (L.) Salisb.*	-	-	-	-	-	-	X			Native
Spotted Coral-root	*Corallorhiza maculata (Raf.) Raf.*	-	-	-	Vulnerable	-	-	X			Native
Lance-leaved Coreopsis	*Coreopsis lanceolata L.*	-	-	-	-	-	-	X		X	Introduced
Alternate-leaved Dogwood	*Cornus alternifolia L.f.*	-	-	-	-	-	-	X	X		Native
Silky Dogwood	*Cornus amomum*	-	-	-	-	-	-		X		
Bunchberry	*Cornus canadensis L.*	-	-	-	-	-	-	X			Native
Rough-leaved Dogwood	*Cornus drummondii C. Meyer*	-	-	-	Endangered	-	-	X			Native
Flowering Dogwood	*Cornus florida L.*	-	-	-	Vulnerable	Endangered	Endangered	X			Native
Grey Dogwood	*Cornus foemina Miller subsp. racemosa (Lam.) J.S. Wilson*	-	-	-	-	-	-	X	X		Native
Round-leaved Dogwood	*Cornus rugosa Lam.*	-	-	-	-	-	-	X	X		Native
Red-osier Dogwood	*Cornus stolonifera Michaux*	-	-	-	-	-	-	X			Native
Crown Vetch	*Coronilla varia*	-	-	-	-	-	-		X	X	
European Hazelnut	*Corylus avellana*	Least Concern	-	-	-	-	-		X	X	
Beaked Hazel	*Corylus cornuta Marshall subsp. cornuta*	-	-	-	-	-	-	X			Native
Hawthorn	*Crataegus intricata Lange*	-	-	-	-	-	-	X			Native
Oneseed Hawthorn	*Crataegus monogyna*	-	-	-	-	-	-		X	X	
Slender Cliff-brake	*Cryptogramma stelleri (S. Gmelin) Prantl*	-	-	-	Vulnerable	-	-	X			Native
Ivy-leaved Toadflax	*Cymbalaria muralis P. Gaertner, Meyer & Scherb.*	-	-	-	-	-	-	X		X	Introduced
Northern Wild Comfrey	*Cynoglossum boreale Fern.*	-	-	-	Endangered	-	-	X			Native
Hound's-tongue	*Cynoglossum officinale L.*	-	-	-	-	-	-	X		X	Invasive
Yellow Lady's-slipper	*Cypripedium calceolus L.*	Least Concern	Appendix II	-	-	-	-	X	X		Native
Bulblet Bladder Fern	*Cystopteris bulbifera (L.) Bernh.*	-	-	-	Vulnerable	-	-	X	X		Native
Mackay's Brittle Fern	*Cystopteris tenuis (Michaux) Desv.*	-	-	-	Vulnerable	-	-	X			Native
Orchard Grass	*Dactylis glomerata L.*	-	-	-	-	-	-	X	X	X	Introduced
Flat-stemmed Danthonia	*Danthonia compressa Austin*	-	-	-	-	-	-	X			Native
Poverty Oat Grass	*Danthonia spicata (L.) P. Beauv. ex Roemer & Schultes*	-	-	-	-	-	-	X			Native
Wild Carrot	*Daucus carota L.*	-	-	-	-	-	-	X	X	X	Invasive
Hay-scented Fern	*Dennstaedtia punctilobula (Michaux) T. Moore*	-	-	-	-	-	-	X			Native
Silvery-spleenwort	*Deparia acrostichoides (Swartz) M. Kato*	-	-	-	Vulnerable	-	-	X			Native
Showy Tick-trefoil	*Desmodium canadense (L.) DC.*	-	-	-	-	-	-	X			Native
Tick-trefoil	*Desmodium cuspidatum (Muhlenb. ex Willd.) DC. ex Loudon*	-	-	-	-	-	-	X			Native
Pointed-leaved Tick-trefoil	*Desmodium glutinosum (Muhlenb. ex Willd.) Alph. Wood*	Least Concern	-	-	-	-	-	X	X		Native
Deptford Pink	*Dianthus armeria L.*	-	-	-	-	-	-	X		X	Introduced
Squirrel-corn	*Dicentra canadensis (Goldie) Walp.*	-	-	-	-	-	-	X			Native
Dutchman's-breeches	*Dicentra cucullaria (L.) Bernh.*	-	-	-	-	-	-	X			Native
Bush-honeysuckle	*Diervilla lonicera Miller*	-	-	-	-	-	-	X	X		Native
Smooth Crab Grass	*Digitaria ischaemum (Schreber ex Schwein.) Schreber ex Muhlenb.*	-	-	-	-	-	-	X		X	Introduced
Wild Yam	*Dioscorea quaternata J. Gmelin*	-	-	-	-	-	-	X			Native
Northern Running-pine	*Diphasiastrum complanatum (L.) Holub*	-	-	-	Endangered	-	-	X			Native
Narrow-leaved Glade Fern	*Diplazium pycnocarpon (Sprengel) M. Broun*	-	-	-	Vulnerable	-	-	X			Native
Narrow-leaved Wall Rocket	*Diplotaxis tenuifolia (L.) DC.*	-	-	-	-	-	-	X		X	Introduced
Common Teasel	*Dipsacus fullonum L.*	-	-	-	-	-	-	X	X	X	Invasive
Leatherwood	*Dirca palustris L.*	-	-	-	-	-	-	X			Native
Yellow Mandarin	*Disporum lanuginosum (Michaux) Nicholson*	-	-	-	-	-	-	X			Native
Flat-topped White Aster	*Doellingeria umbellata (Mill.) Nees*	-	-	-	-	-	-	X			Native
Spinulose Wood Fern	*Dryopteris carthusiana (Villars) H.P. Fuchs*	-	-	-	-	-	-	X	X		Native
Crested Wood Fern	*Dryopteris cristata (L.) A. Gray*	-	-	-	Vulnerable	-	-	X			Native

Goldie's Wood Fern	*Dryopteris goldiana (Hook. ex Goldie) A. Gray*	-	-	-	Vulnerable	-	-	X			Native
Evergreen Wood Fern	*Dryopteris intermedia (Muhlenb. ex Willd.) A. Gray*	-	-	-	Vulnerable	-	-	X			Native
Marginal Wood Fern	*Dryopteris marginalis (L.) A. Gray*	-	-	-	Vulnerable	-	-	X	X		Native
Indian Strawberry	*Duchesnea indica (Andrz.) Focke*	-	-	-	-	-	-	X	X	X	Introduced
Barnyard Grass	*Echinochloa crusgalli (L.) P. Beauv.*	-	-	-	-	-	-	X		X	Introduced
Viper's-bugloss	*Echium vulgare L.*	-	-	-	-	-	-	X		X	Invasive
Autumn Olive	*Elaeagnus umbellata*	-	-	-	-	-	-		X	X	
Intermediate Spike-rush	*Eleocharis intermedia (Muhl.) Schult.*	-	-	-	-	-	-	X			Native
Canada Wild-rye	*Elymus canadensis L.*	-	-	-	-	-	-	X			Native
Bottlebrush Grass	*Elymus hystrix L.*	-	-	-	-	-	-	X			Native
Western Wheat Grass	*Elymus smithii (Rydb.) Gould*	-	-	-	-	-	-	X		X	Introduced
Hairy Wild-rye	*Elymus villosus Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Virginia Wild-rye	*Elymus virginicus L. var. virginicus*	-	-	-	-	-	-	X			Native
Wiegand's Wild-rye	*Elymus wiegandii Fern.*	-	-	-	-	-	-	X			Native
Purple-leaved Willow-herb	*Epilobium coloratum Biehler*	-	-	-	-	-	-	X			Native
Small-flowered Willow-herb	*Epilobium parviflorum Schreber*	-	-	-	-	-	-	X		X	Introduced
Helleborine	*Epipactis helleborine (L.) Crantz*	-	Appendix II	-	-	-	-	X	X	X	Introduced
Field Horsetail	*Equisetum arvense L.*	-	-	-	-	-	-	X	X		Native
Common Scouring-rush	*Equisetum hyemale L. subsp. affine (Engelm.) Stone*	Least Concern	-	-	-	-	-	X			Native
Variegated Scouring-rush	*Equisetum variegatum Schleicher ex Weber & Mohr*	-	-	-	-	-	-	X			Native
Tufted Love Grass	*Eragrostis pectinacea (Michaux) Nees var. pectinacea*	-	-	-	-	-	-	X			Native
Daisy Fleabane	*Erigeron annuus (L.) Pers.*	-	-	-	-	-	-	X	X		Native
Philadelphia Fleabane	*Erigeron philadelphicus L. subsp. philadelphicus*	-	-	-	-	-	-	X	X		Native
Robin's-plantain	*Erigeron pulchellus Michaux*	-	-	-	-	-	-	X			Native
Spreading Fleabane	*Erigeron strigosus Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Stork's-bill	*Erodium cicutarium (L.) L'Her. subsp. cicutarium*	-	-	-	-	-	-	X		X	Introduced
Whitlow-grass	*Erophila verna (L.) Chevall.*	-	-	-	-	-	-	X		X	Introduced
White Trout Lily	*Erythronium albidum Nutt.*	-	-	-	-	-	-	X			Native
Yellow Trout Lily	*Erythronium americanum Ker Gawler subsp. americanum*	-	-	-	-	-	-	X	X		Native
Winged Euonymus	*Euonymus alata (Thunb.) Siebold*	-	-	-	-	-	-	X		X	Invasive
Burning Bush	*Euonymus atropurpurea Jacq. var. atropurpurea*	-	-	-	-	-	-	X			Native
Wintercreeper	*Euonymus fortunei (Turcz.) Hand.-Mazz.*	-	-	-	-	-	-	X		X	Introduced
Running Strawberry-bush	*Euonymus obovata Nutt.*	-	-	-	Vulnerable	-	-	X			Native
Spotted Joe-Pye-weed	*Eupatorium maculatum L.*	-	-	-	-	-	-	X	X		Native
Boneset	*Eupatorium perfoliatum L.*	-	-	-	-	-	-	X	X		Native
Sweet Joe-Pye-weed	*Eupatorium purpureum L. var. purpureum*	-	-	-	-	-	-	X			Native
White Snakeroot	*Eupatorium rugosum Houtt.*	-	-	-	-	-	-	X			Native
Cypress Spurge	*Euphorbia cyparissias L.*	-	-	-	-	-	-	X		X	Introduced
Sun Spurge	*Euphorbia helioscopia L.*	-	-	-	-	-	-	X		X	Introduced
White Wood Aster	*Eurybia divaricata (L.) Nesom*	-	-	-	-	Threatened	Threatened	X			Native
Large-leaved Aster	*Eurybia macrophylla (L.) Cass. in Cuvier*	-	-	-	-	-	-	X	X		Native
Grass-leaved Goldenrod	*Euthamia graminifolia (L.) Nutt. ex Cass.*	-	-	-	-	-	-	X			Native
American Beech	*Fagus grandifolia Ehrh.*	-	-	-	-	-	-	X	X		Native
European Beech	*Fagus sylvatica*	-	-	-	-	-	-		X	X	
Red Fescue	*Festuca rubra L.*	-	-	-	-	-	-	X		X	Introduced
Nodding Fescue	*Festuca subverticillata (Pers.) E. Alexeev*	-	-	-	-	-	-	X			Native
Woodland Strawberry	*Fragaria vesca L. subsp. americana (Porter) Staudt*	-	-	-	-	-	-	X			Native
Wild Strawberry	*Fragaria virginiana Miller*	-	-	-	-	-	-	X	X		Native
White Ash	*Fraxinus americana L.*	-	-	-	-	-	-	X	X		Native
European Ash	*Fraxinus excelsior L.*	-	-	-	-	-	-	X		X	Introduced

Black Ash	*Fraxinus nigra Marshall*	-	-	-	-	-	-	X			Native
Red/Green Ash	*Fraxinus pennsylvanica Marshall*	-	-	-	-	-	-	X	X		Native
Showy Orchis	*Galearis spectabilis (L.) Raf.*	-	-	-	Vulnerable	-	-	X			Native
Cleavers	*Galium aparine L.*	-	-	-	-	-	-	X		X	Native/Introduced
Northern Bedstraw	*Galium boreale L.*	-	-	-	-	-	-	X			Native
Wild Licorice	*Galium circaezans Michaux*	-	-	-	-	-	-	X			Native
Lance-leaved Wild Licorice	*Galium lanceolatum Torrey*	-	-	-	-	-	-	X			Native
Wild Madder	*Galium mollugo*	-	-	-	-	-	-		X	X	
Sweet-scented Bedstraw	*Galium triflorum Michaux*	-	-	-	-	-	-	X			Native
Wintergreen	*Gaultheria procumbens L.*	-	-	-	-	-	-	X			Native
Black Huckleberry	*Gaylussacia baccata (Wang.) K. Koch*	-	-	-	-	-	-	X			Native
Closed Gentian	*Gentiana andrewsii Griseb. var. andrewsii*	-	-	-	Vulnerable	-	-	X			Native
Narrow-leaved Fringed Gentian	*Gentianopsis virgata (Raf.) Holub*	-	-	-	Endangered	-	-	X			Native
Wild Geranium	*Geranium maculatum L.*	-	-	-	-	-	-	X	X		Native
Herb Robert	*Geranium robertianum L.*	-	-	-	-	-	-	X	X	X	Introduced
Yellow Avens	*Geum aleppicum Jacq.*	-	-	-	-	-	-	X	X		Native
White Avens	*Geum canadense Jacq.*	-	-	-	-	-	-	X	X		Native
Cut-leaved Avens	*Geum laciniatum Murray*	-	-	-	-	-	-	X			Native
Herb Bennett	*Geum urbanum L.*	-	-	-	-	-	-	X		X	Invasive
Gill-over-the-ground	*Glechoma hederacea L.*	-	-	-	-	-	-	X	X	X	Invasive
Honey Locust	*Gleditsia triacanthos*	-	-	-	-	-	-		X	X	
Fowl Manna Grass	*Glyceria striata (Lam.) A.S. Hitchc.*	-	-	-	-	-	-	X			Native
Fragrant Cudweed	*Gnaphalium obtusifolium L.*	-	-	-	-	-	-	X			Native
Stickseed	*Hackelia virginiana (L.) I.M. Johnston*	-	-	-	-	-	-	X			Native
Witch-hazel	*Hamamelis virginiana L.*	-	-	-	-	-	-	X	X		Native
American Pennyroyal	*Hedeoma pulegioides (L.) Pers.*	-	-	-	-	-	-	X			Native
English Ivy	*Hedera helix*	-	-	-	-	-	-		X	X	
Sneezeweed	*Helenium autumnale L.*	-	-	-	-	-	-	X			Native
Common Sunflower	*Helianthus annuus L.*	-	-	-	-	-	-	X		X	Introduced
Thin-leaved Sunflower	*Helianthus decapetalus L.*	-	-	-	-	-	-	X			Native
Woodland Sunflower	*Helianthus divaricatus L.*	-	-	-	-	-	-	X			Native
Orange Day Lily	*Hemerocallis fulva (L.) L.*	-	-	-	-	-	-	X	X	X	Introduced
Dame's Rocket	*Hesperis matronalis L.*	-	-	-	-	-	-	X	X	X	Invasive
King Devil	*Hieracium caespitosum Dum.*	-	-	-	-	-	-	X	X	X	Introduced
Canada Hawkweed	*Hieracium canadense Michaux*	-	-	-	-	-	-	X			Native
Hawkweed	*Hieracium gronovii L.*	-	-	-	-	-	-	X			Native
Yellow Hawkweed	*Hieracium piloselloides Villars*	-	-	-	-	-	-	X	X	X	Introduced
Rattlesnake Weed	*Hieracium venosum L. var. nudicaule (Michx.) Farw.*	-	-	-	-	-	-	X			Native
(H. caespitosum X H. lactucella)	*Hieracium x floribundum Wimmer & Graeb.*	-	-	-	-	-	-	X		X	Introduced
Foxtail Barley	*Hordeum jubatum L. subsp. jubatum*	-	-	-	-	-	-	X		X	Invasive
Fringed Houstonia	*Houstonia canadensis Willd.*	-	-	-	-	-	-	X			Native
Longleaf Bluet	*Houstonia longifolia*	-	-	-	-	-	-		X		
Shining Fir-moss	*Huperzia lucidula (Michaux) Trevisan*	-	-	-	Vulnerable	-	-	X			Native
Green Violet	*Hybanthus concolor (T. Forster) Sprengel*	-	-	-	-	-	-	X			Native
GoldenSeal	*Hydrastis canadensis L.*	-	Appendix II	-	Threatened	Threatened	Threatened	X			Native
Canada Waterleaf	*Hydrophyllum canadense L.*	-	-	-	-	-	-	X			Native
Virginia Waterleaf	*Hydrophyllum virginianum L.*	-	-	-	-	-	-	X	X		Native
Common St. John's-wort	*Hypericum perforatum L.*	-	-	-	-	-	-	X	X	X	Invasive
Spotted St. John's-wort	*Hypericum punctatum Lam.*	-	-	-	-	-	-	X			Native
Yellow Stargrass	*Hypoxis hirsuta (L.) Coville*	-	-	-	-	-	-	X			Native

American Holly	*Ilex opaca*	-	-	-	Vulnerable	-	-		X		
Spotted Touch-me-not	*Impatiens capensis Meerb.*	-	-	-	-	-	-	X	X		Native
Pale Touch-me-not	*Impatiens pallida Nutt.*	-	-	-	-	-	-	X	X		Native
Yellow-flag	*Iris pseudacorus L.*	-	-	-	-	-	-	X		X	Invasive
Butternut	*Juglans cinerea L.*	-	-	-	Vulnerable	Endangered	Endangered	X	X		Native
Black Walnut	*Juglans nigra L.*	-	-	-	-	-	-	X	X		Native
Jointed Rush	*Juncus articulatus L.*	Least Concern	-	-	-	-	-	X			Native
Baltic Rush	*Juncus balticus Willd.*	-	-	-	-	-	-	X			Native
Dudley's Rush	*Juncus dudleyi Wieg.*	-	-	-	-	-	-	X			Native
Soft Rush	*Juncus effusus L.*	Least Concern	-	-	-	-	-	X	X		Native
Path Rush	*Juncus tenuis Willd. var. tenuis*	-	-	-	-	-	-	X	X		Native
Torrey's Rush	*Juncus torreyi Cov.*	-	-	-	-	-	-	X			Native
Common Juniper	*Juniperus communis L.*	Least Concern	-	-	-	-	-	X			Native
Red Cedar	*Juniperus virginiana L. var. virginiana*	Least Concern	-	-	-	-	-	X	X		Native
Canada-lettuce	*Lactuca canadensis L.*	-	-	-	-	-	-	X			Native
Prickly-lettuce	*Lactuca serriola L.*	-	-	-	-	-	-	X		X	Introduced
Henbit	*Lamium amplexicaule L.*	-	-	-	-	-	-	X		X	Introduced
Purple Dead-nettle	*Lamium purpureum L.*	-	-	-	-	-	-	X		X	Introduced
Wood-nettle	*Laportea canadensis (L.) Wedd.*	-	-	-	-	-	-	X			Native
Burseed	*Lappula squarrosa (Retz.) Dumort. subsp. squarrosa*	-	-	-	-	-	-	X		X	Introduced
Nipplewort	*Lapsana communis L.*	-	-	-	-	-	-	X	X	X	Introduced
Tamarack	*Larix laricina (Du Roi) K. Koch*	Least Concern	-	-	-	-	-	X			Native
Pale Vetchling	*Lathyrus ochroleucus Hook.*	-	-	-	Rare	-	-	X			Native
Rice Cut Grass	*Leersia oryzoides (L.) Swartz*	-	-	-	-	-	-	X			Native
White Grass	*Leersia virginica Willd.*	-	-	-	-	-	-	X			Native
Motherwort	*Leonurus cardiaca L. subsp. cardiaca*	-	-	-	-	-	-	X	X	X	Introduced
Field Pepper-grass	*Lepidium campestre (L.) R. Br.*	-	-	-	-	-	-	X	X	X	Introduced
Wandlike Bush-clover	*Lespedeza intermedia (S. Watson) Britton*	-	-	-	-	-	-	X			Native
Violet Bush-clover	*Lespedeza violacea (L.) Pers.*	-	-	-	-	-	-	X			Native
Cylindric Blazing-star	*Liatris cylindracea Michaux*	-	-	-	Endangered	-	-	X			Native
Privet	*Ligustrum vulgare L.*	-	-	-	-	-	-	X	X	X	Invasive
Canada Lily	*Lilium canadense L.*	-	-	-	Vulnerable	-	-	X			Native
Wood Lily	*Lilium philadelphicum L.*	-	-	-	Vulnerable	-	-	X			Native
Butter-and-eggs	*Linaria vulgaris Miller*	-	-	-	-	-	-	X	X	X	Invasive
Spicebush	*Lindera benzoin (L.) Blume*	-	-	-	-	-	-	X	X		Native
Tulip-tree	*Liriodendron tulipifera L.*	-	-	-	-	-	-	X	X		Native
European Gromwell	*Lithospermum officinale L.*	-	-	-	-	-	-	X		X	Introduced
Indian-tobacco	*Lobelia inflata L.*	-	-	-	-	-	-	X			Native
Kalm's Lobelia	*Lobelia kalmii L.*	-	-	-	-	-	-	X			Native
Great Lobelia	*Lobelia siphilitica L.*	-	-	-	-	-	-	X			Native
Tall Fescue	*Lolium arundinaceus (Schreber) Darbysh.*	-	-	-	-	-	-	X		X	Introduced
Perennial Rye Grass	*Lolium perenne L.*	-	-	-	-	-	-	X		X	Introduced
Fly Honeysuckle	*Lonicera canadensis Bartram*	-	-	-	-	-	-	X			Native
Wild Honeysuckle	*Lonicera dioica L.*	-	-	-	-	-	-	X			Native
Amur Honeysuckle	*Lonicera maackii (Rupr.) Maxim.*	-	-	-	-	-	-	X	X	X	Invasive
Morrow's Honeysuckle	*Lonicera morrowii A. Gray*	-	-	-	-	-	-	X	X	X	Invasive
Tartarian Honeysuckle	*Lonicera tatarica L.*	-	-	-	-	-	-	X	X	X	Invasive
Bird's Foot Trefoil	*Lotus corniculatus*	-	-	-	-	-	-		X	X	
Money Plant	*Lunaria annua*	-	-	-	-	-	-		X	X	
Wild Lupine	*Lupinus perennis L. subsp. perennis*	-	-	-	Rare	-	-	X			Native

Flat-branched Tree Club-moss	*Lycopodium obscurum L.*	-	-	-	-	-	-	X			Native
American Water-horehound	*Lycopus americanus Muhlenb. ex Bartram*	-	-	-	-	-	-	X			Native
European Water-horehound	*Lycopus europaeus L.*	-	-	-	-	-	-	X		X	Introduced
Bugleweed	*Lycopus uniflorus Michaux*	-	-	-	-	-	-	X			Native
Virginia Water-horehound	*Lycopus virginicus L.*	-	-	-	-	-	-	X			Native
Fringed Loosestrife	*Lysimachia ciliata L.*	-	-	-	-	-	-	X	X		Native
Creeping Jennie	*Lysimachia nummularia*	-	-	-	-	-	-		X	X	
Spotted Loosestrife	*Lysimachia punctata L.*	-	-	-	-	-	-	X		X	Introduced
Purple Loosestrife	*Lythrum salicaria L.*	Least Concern	-	-	-	-	-	X	X	X	Invasive
Wild Lily-of-the-valley	*Maianthemum canadense Desf.*	-	-	-	-	-	-	X			Native
False Solomon's-seal	*Maianthemum racemosum (L.) Link subsp. racemosum*	-	-	-	-	-	-	X	X		Native
Starry False Solomon's-seal	*Maianthemum stellatum (L.) Link*	-	-	-	-	-	-	X	X		Native
Wild Crab	*Malus coronaria (L.) Miller*	-	-	-	-	-	-	X			Native
Apple	*Malus pumila Miller*	-	-	-	-	-	-	X		X	Introduced
Common Mallow	*Malva neglecta*	-	-	-	-	-	-		X	X	
Pineapple Weed	*Matricaria matricarioides (Less.) Porter*	-	-	-	-	-	-	X		X	Introduced
Indian Cucumber-root	*Medeola virginiana L.*	-	-	-	-	-	-	X			Native
Black Medick	*Medicago lupulina L.*	-	-	-	-	-	-	X		X	Invasive
Cow-wheat	*Melampyrum lineare Desr.*	-	-	-	-	-	-	X			Native
White Sweet-clover	*Melilotus alba Medicus*	-	-	-	-	-	-	X		X	Invasive
Common Balm	*Melissa officinalis L. subsp. officinalis*	-	-	-	-	-	-	X	X	X	Introduced
Moonseed	*Menispermum canadense L.*	-	-	-	-	-	-	X			Native
Field Mint	*Mentha arvensis L.*	-	-	-	-	-	-	X			Native
Wood Millet	*Milium effusum L.*	-	-	-	-	-	-	X			Native
Partridge-berry	*Mitchella repens L.*	-	-	-	-	-	-	X			Native
Bishop's-cap	*Mitella diphylla L.*	-	-	-	-	-	-	X			Native
Oswego Tea	*Monarda didyma L.*	-	-	-	Vulnerable	-	-	X			Native
Wild Bergamot	*Monarda fistulosa L.*	-	-	-	-	-	-	X			Native
Indian Pipe	*Monotropa uniflora L.*	-	-	-	-	-	-	X			Native
White Mulberry	*Morus alba L.*	-	-	-	-	-	-	X	X	X	Invasive
Red Mulberry	*Morus rubra L.*	-	-	-	-	Endangered	Endangered	X			Native
Wire-stemmed Muhly	*Muhlenbergia frondosa (Poiret) Fern.*	-	-	-	-	-	-	X			Native
Satin Grass	*Muhlenbergia mexicana (L.) Trin.*	-	-	-	-	-	-	X			Native
Nimble Will	*Muhlenbergia schreberi J.F. Gmelin*	-	-	-	-	-	-	X			Native
Muhly	*Muhlenbergia sylvatica (Torrey) Torrey ex A. Gray*	-	-	-	-	-	-	X			Native
Slender Satin Grass	*Muhlenbergia tenuiflora (Willd.) BSP.*	-	-	-	-	-	-	X			Native
Field Scorpion Grass	*Myosotis arvensis (L) Hill*	-	-	-	-	-	-	X		X	Introduced
Catnip	*Nepeta cataria L.*	-	-	-	-	-	-	X	X	X	Introduced
Black-gum	*Nyssa sylvatica Marshall*	-	-	-	-	-	-	X			Native
Hairy Yellow Evening-primrose	*Oenothera biennis L.*	-	-	-	-	-	-	X	X		Native
Sundrops	*Oenothera perennis L.*	-	-	-	-	-	-	X			Native
One-flowered Cancer-root	*Orobanche uniflora L.*	-	-	-	-	-	-	X			Native
One-sided Pyrola	*Orthilia secunda (L.) House*	-	-	-	-	-	-	X			Native
Rough-leaved Mountain-rice	*Oryzopsis asperifolia Michaux*	-	-	-	-	-	-	X			Native
Mountain-rice	*Oryzopsis racemosa (Smith) Ricker ex A. Hitchc.*	-	-	-	-	-	-	X			Native
Sweet-cicely	*Osmorhiza claytonii (Michaux) C.B. Clarke*	-	-	-	-	-	-	X			Native
Long-styled Sweet-cicely	*Osmorhiza longistylis (Torrey) DC.*	-	-	-	-	-	-	X			Native
Interrupted Fern	*Osmunda claytoniana L.*	-	-	-	Vulnerable	-	-	X			Native
American Royal Fern	*Osmunda regalis L. var. spectabilis (Willd.) Gray*	-	-	-	-	-	-	X			Native
Hop-hornbeam	*Ostrya virginiana (Miller) K. Koch*	-	-	-	-	-	-	X	X		Native

European Wood-sorrel	*Oxalis stricta L.*	-	-	-	-	-	-	X	X		Native
American Ginseng	*Panax quinquefolius*	-	Appendix II	-	Vulnerable	Endangered	Endangered	X			Native
Dwarf Ginseng	*Panax trifolius L.*	-	-	-	-	-	-	X			Native
Panic Grass	*Panicum acuminatum Sw.*	-	-	-	-	-	-	X			Native
Forked Panic Grass	*Panicum dichotomum L. var. dichotomum*	-	-	-	-	-	-	X			Native
Broadleaf Panic Grass	*Panicum latifolium L.*	-	-	-	-	-	-	X			Native
Lindheimer's Panic Grass	*Panicum lindheimeri Nash*	-	-	-	-	-	-	X			Native
Switch Grass	*Panicum virgatum L.*	-	-	-	-	-	-	X			Native
Pellitory	*Parietaria pensylvanica Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Grass-of-Parnassus	*Parnassia glauca Raf.*	-	-	-	Vulnerable	-	-	X			Native
Virginia Creeper	*Parthenocissus inserta (A. Kerner) Fritsch*	-	-	-	-	-	-	X			Native
Virginia Creeper	*Parthenocissus quinquefolia (L.) Planchon ex DC.*	-	-	-	-	-	-	X	X		Native
Purple-stemmed Cliff-brake	*Pellaea atropurpurea (L.) Link*	-	-	-	Vulnerable	-	-	X			Native
Smooth Cliff-brake	*Pellaea glabella Mett. ex Kuhn subsp. glabella*	-	-	-	Threatened	-	-	X	X		Native
Foxglove Beard-tongue	*Penstemon digitalis Nutt. ex Sims*	-	-	-	-	-	-	X			Native
Hairy Beard-tongue	*Penstemon hirsutus (L.) Willd.*	-	-	-	-	-	-	X	X		Native
Mock-orange	*Philadelphus coronarius*								X	X	
Timothy	*Phleum pratense L.*	-	-	-	-	-	-	X	X	X	Introduced
Blue Phlox	*Phlox divaricata L.*	-	-	-	-	-	-	X			Native
Common Reed	*Phragmites australis (Cav.) Trin. ex Steudel*	Least Concern	-	-	-	-	-	X	X	X	Invasive
Ninebark	*Physocarpus opulifolius (L.) Maxim.*	-	-	-	-	-	-	X	X		Native
False Dragonhead	*Physostegia virginiana (L.) Benth.*	-	-	-	-	-	-	X			Native
Pokeweed	*Phytolacca americana L.*	-	-	-	-	-	-	X			Native
Blue Spruce	*Picea pungens*	Least Concern	-	-	-	-	-		X	X	
Black-seeded Clearweed	*Pilea fontana (Lunell) Rydb.*	-	-	-	-	-	-	X			Native
Clearweed	*Pilea pumila (L.) A. Gray*	-	-	-	-	-	-	X			Native
Jack Pine	*Pinus banksiana Lambert*	Least Concern	-	-	Rare	-	-	X		X	Introduced
Red Pine	*Pinus resinosa*	Least Concern	-	-	-	-	-		X		
Eastern White Pine	*Pinus strobus L.*	Least Concern	-	-	-	-	-	X	X		Native
Scots Pine	*Pinus sylvestris L.*	Least Concern	-	-	-	-	-	X	X	X	Invasive
English Plantain	*Plantago lanceolata L.*	-	-	-	-	-	-	X	X	X	Introduced
Common Plantain	*Plantago major L.*	-	-	-	-	-	-	X	X	X	Introduced
Rugel's Plantain	*Plantago rugelii Decne.*	-	-	-	-	-	-	X	X		Native
Tubercled Orchid	*Platanthera flava (L.) Lindley var. herbiola (R. Br. ex Ait. f.) Luer*	-	Appendix II	-	Vulnerable	-	-	X			Native
Hooker's Orchid	*Platanthera hookeri (Torr. ex Gray) Lindl.*	-	Appendix II	-	Endangered	-	-	X			Native
Tall Northern Green Orchid	*Platanthera hyperborea (L.) Lindley var. hyperborea*	-	Appendix II	-	-	-	-	X			Native
Ragged Fringed-orchid	*Platanthera lacera (Michaux) G. Don var. lacera*	-	Appendix II	-	Vulnerable	-	-	X			Native
Sycamore	*Platanus occidentalis L.*	-	-	-	-	-	-	X	X		Native
Annual Blue Grass	*Poa annua L.*	-	-	-	-	-	-	X		X	Introduced
Bulbous Poa	*Poa bulbosa L.*	-	-	-	-	-	-	X		X	Introduced
Canada Blue Grass	*Poa compressa L.*	-	-	-	-	-	-	X			Native
Wood Blue Grass	*Poa nemoralis L.*	-	-	-	-	-	-	X		X	Introduced
Kentucky Blue Grass	*Poa pratensis L. subsp. pratensis*	-	-	-	-	-	-	X			Native
Rough Blue Grass	*Poa trivialis L.*	-	-	-	-	-	-	X		X	Introduced
May-apple	*Podophyllum peltatum L.*	-	-	-	-	-	-	X	X		Native
Seneca Snakeroot	*Polygala senega L.*	-	-	-	-	-	-	X			Native
Solomon's-seal	*Polygonatum biflorum (Walter) Elliott*	-	-	-	-	-	-	X	X		Native
Hairy Solomon's-seal	*Polygonatum pubescens (Willd.) Pursh*	-	-	-	-	-	-	X	X		Native
Halberd-leaved Tear-thumb	*Polygonum arifolium L.*	-	-	-	-	-	-	X			Native
Prostrate Knotweed	*Polygonum aviculare L.*	-	-	-	-	-	-	X		X	Introduced

Japanese Knotweed	*Polygonum cuspidatum Siebold & Zucc.*	-	-	-	-	-	-	X	X	X	Invasive
Pinkweed	*Polygonum pensylvanicum L.*	-	-	-	-	-	-	X			Native
Lady's-thumb	*Polygonum persicaria L.*	-	-	-	-	-	-	X		X	Introduced
Jumpseed	*Polygonum virginianum L.*	-	-	-	Vulnerable	-	-	X	X		Native
Leafcup	*Polymnia canadensis L.*	-	-	-	-	-	-	X	X		Native
Rock Polypody	*Polypodium virginianum L.*	-	-	-	Vulnerable	-	-	X			Native
Christmas Fern	*Polystichum acrostichoides (Michaux) Schott*	-	-	-	Vulnerable	-	-	X			Native
Holly Fern	*Polystichum lonchitis (L.) Roth*	-	-	-	Endangered	-	-	X			Native
White Poplar	*Populus alba L.*	-	-	-	-	-	-	X		X	Invasive
Balsam Poplar	*Populus balsamifera L. subsp. balsamifera*	-	-	-	-	-	-	X			Native
Cottonwood	*Populus deltoides Bartram ex Marshall*	-	-	-	-	-	-	X	X		Native
Large-toothed Aspen	*Populus grandidentata Michaux*	-	-	-	-	-	-	X	X		Native
Trembling Aspen	*Populus tremuloides Michaux*	-	-	-	-	-	-	X	X		Native
Silverweed	*Potentilla anserina L. subsp. anserina*	-	-	-	-	-	-	X			Native
Silvery Cinquefoil	*Potentilla argentea L.*	-	-	-	-	-	-	X		X	Introduced
Rough Cinquefoil	*Potentilla norvegica L.*	-	-	-	-	-	-	X		X	Introduced
Rough-fruited Cinquefoil	*Potentilla recta L.*	-	-	-	-	-	-	X	X	X	Invasive
Common Cinquefoil	*Potentilla simplex Michaux*	-	-	-	-	-	-	X	X		Native
White-lettuce	*Prenanthes alba L.*	-	-	-	-	-	-	X			Native
Tall White-lettuce	*Prenanthes altissima L.*	-	-	-	-	-	-	X			Native
Heal-all	*Prunella vulgaris L.*	-	-	-	-	-	-	X	X	X	Introduced
Wild Plum	*Prunus americana Marshall*	-	-	-	-	-	-	X			Native
Sweet Cherry	*Prunus avium (L.) L.*	-	-	-	-	-	-	X	X	X	Introduced
Perfumed Cherry	*Prunus mahaleb L.*	-	-	-	-	-	-	X	X	X	Introduced
Peach	*Prunus persica (L.) Batsch*	-	-	-	-	-	-	X		X	Introduced
Wild Black Cherry	*Prunus serotina Ehrh.*	-	-	-	-	-	-	X	X		Native
Choke Cherry	*Prunus virginiana L. subsp. virginiana*	-	-	-	-	-	-	X	X		Native
Hop-tree	*Ptelea trifoliata L. var. trifoliata*	-	-	-	Endangered	Threatened	Threatened	X		X	Native/Introduced
Eastern Bracken	*Pteridium aquilinum (L.) Kuhn var. latiusculum (Desv.) Underw. ex*	-	-	-	-	-	-	X			Native
Reflexed Saltmarsh Grass	*Puccinellia distans (Jacq.) Parl. subsp. distans*	-	-	-	-	-	-	X		X	Introduced
Virginia Mountain-mint	*Pycnanthemum virginianum (L.) Durand & Jackson ex Fernald &*	-	-	-	-	-	-	X			Native
Round-leaved Pyrola	*Pyrola americana Sweet*	-	-	-	-	-	-	X			Native
Greenish Pyrola	*Pyrola chlorantha Sw.*	-	-	-	-	-	-	X			Native
Shinleaf	*Pyrola elliptica Nutt.*	-	-	-	-	-	-	X			Native
White Oak	*Quercus alba L.*	-	-	-	-	-	-	X	X		Native
Swamp White Oak	*Quercus bicolor Willd.*	-	-	-	-	-	-	X			Native
Bur Oak	*Quercus macrocarpa Michaux*	Least Concern	-	-	-	-	-	X			Native
Chinquapin Oak	*Quercus muhlenbergii Engelm.*	-	-	-	-	-	-	X			Native
Pin Oak	*Quercus palustris Muenchh.*	-	-	-	-	-	-	X			Native
Northern Red Oak	*Quercus rubra L.*	-	-	-	-	-	-	X	X		Native
Black Oak	*Quercus velutina Lam.*	-	-	-	-	-	-	X			Native
Kidney-leaved Buttercup	*Ranunculus abortivus L.*	-	-	-	-	-	-	X	X		Native
Common Buttercup	*Ranunculus acris L.*	-	-	-	-	-	-	X	X	X	Invasive
Fig Buttercup	*Ranunculus ficaria*	-	-	-	-	-	-		X	X	
Hispid Buttercup	*Ranunculus hispidus Michaux var. hispidus*	-	-	-	-	-	-	X			Native
Bristly Crowfoot	*Ranunculus pensylvanicus L.f.*	-	-	-	-	-	-	X	X		Native
Hooked Buttercup	*Ranunculus recurvatus Poiret var. recurvatus*	-	-	-	-	-	-	X			Native
Creeping Buttercup	*Ranunculus repens L.*	-	-	-	-	-	-	X		X	Invasive
Cursed Crowfoot	*Ranunculus sceleratus L. var. sceleratus*	-	-	-	-	-	-	X			Native
Common Buckthorn	*Rhamnus cathartica L.*	-	-	-	-	-	-	X	X	X	Invasive

Glossy Buckthorn	*Rhamnus frangula L.*	-	-	-	-	-	-	X	X	X	Invasive
Jetbead	*Rhodotypos scandens (Thunb.) Makino*	-	-	-	-	-	-	X		X	Introduced
Fragrant Sumac	*Rhus aromatica Aiton*	-	-	-	-	-	-	X	X		Native
Climbing Poison-ivy	*Rhus radicans L. subsp. negundo (E. Greene) McNeill*	-	-	-	-	-	-	X			Native
Rydberg's Poison-ivy	*Rhus radicans L. subsp. rydbergii (Small ex Rydb.) McNeill*	-	-	-	-	-	-	X			Native
Staghorn Sumac	*Rhus typhina L.*	-	-	-	-	-	-	X	X		Native
Hair-like Beak-rush	*Rhynchospora capillacea Torrey*	-	-	-	-	-	-	X			Native
Wild Black Currant	*Ribes americanum Miller*	-	-	-	-	-	-	X	X		Native
Prickly Gooseberry	*Ribes cynosbati L.*	-	-	-	-	-	-	X			Native
Garden Red Currant	*Ribes rubrum L.*	-	-	-	-	-	-	X		X	Introduced
Black Locust	*Robinia pseudoacacia L.*	Least Concern	-	-	-	-	-	X	X	X	Invasive
Clammy Locust	*Robinia viscosa Vent. ex Vauq.*	-	-	-	-	-	-	X		X	Invasive
Dog Rose	*Rosa canina L.*	-	-	-	-	-	-	X		X	Introduced
Carolina Rose	*Rosa carolina L.*	-	-	-	-	-	-	X			Native
Small-flower Sweetbrier	*Rosa micrantha Borrer ex Smith in Sowerby*	-	-	-	-	-	-	X		X	Introduced
Multiflora Rose	*Rosa multiflora Thunb. ex Murray*	-	-	-	-	-	-	X	X	X	Invasive
Sweetbrier	*Rosa rubiginosa L.*	-	-	-	-	-	-	X		X	Introduced
Common Blackberry	*Rubus allegheniensis Porter*	-	-	-	-	-	-	X	X		Native
Northern Dewberry	*Rubus flagellaris Willd.*	-	-	-	-	-	-	X			Native
Wild Red Raspberry	*Rubus idaeus L. subsp. melanolasius (Dieck) Focke*	-	-	-	-	-	-	X			Native
Black Raspberry	*Rubus occidentalis L.*	-	-	-	-	-	-	X	X		Native
Purple-flowering Raspberry	*Rubus odoratus L.*	-	-	-	-	-	-	X	X		Native
Wineberry	*Rubus phoenicolasius*	-	-	-	-	-	-		X	X	
Curly Dock	*Rumex crispus L.*	-	-	-	-	-	-	X	X	X	Introduced
Bitter Dock	*Rumex obtusifolius L. subsp.. obtusifolius*	-	-	-	-	-	-	X		X	Introduced
Pearlwort	*Sagina procumbens L.*	-	-	-	-	-	-	X		X	Introduced
White Willow	*Salix alba L.*	Least Concern	-	-	-	-	-	X		X	Introduced
Bebb's Willow	*Salix bebbiana Sarg.*	-	-	-	-	-	-	X			Native
Pussy Willow	*Salix discolor Muhlenb.*	-	-	-	-	-	-	X			Native
Heart-leaved Willow	*Salix eriocephala Michaux*	-	-	-	-	-	-	X			Native
Sandbar Willow	*Salix exigua Nutt. subsp. interior (Rowlee)*	-	-	-	-	-	-	X			Native
Upland Willow	*Salix humilis Marshall*	-	-	-	-	-	-	X			Native
(S. alba X S. fragilis)	*Salix x rubens Schrank*	-	-	-	-	-	-	X		X	Introduced
Common Elder	*Sambucus canadensis L.*	-	-	-	-	-	-	X			Native
Red-berried Elder	*Sambucus racemosa L.*	-	-	-	-	-	-	X	X		Native
Bloodroot	*Sanguinaria canadensis L.*	-	-	-	Vulnerable	-	-	X	X		Native
Garden Burnet	*Sanguisorba minor Scop.*	-	-	-	-	-	-	X		X	Introduced
Black Snakeroot	*Sanicula marilandica L.*	-	-	-	-	-	-	X			Native
Large-fruited Snakeroot	*Sanicula trifoliata Bickn.*	-	-	-	-	-	-	X			Native
Bouncing Bet	*Saponaria officinalis L.*	-	-	-	-	-	-	X		X	Introduced
Pitcher-plant	*Sarracenia purpurea L.*	-	Appendix II	-	Vulnerable	-	-	X			Native
Sassafras	*Sassafras albidum (Nutt.) Nees*	-	-	-	-	-	-	X	X		Native
Early Saxifrage	*Saxifraga virginiensis Michaux*	-	-	-	-	-	-	X	X		Native
Purple Melic Grass	*Schizachne purpurascens (Torrey) Swallen*	-	-	-	-	-	-	X			Native
Little Bluestem	*Schizachyrium scoparium (Michaux) Nees*	-	-	-	-	-	-	X			Native
Dark Green Bulrush	*Scirpus atrovirens Willd.*	-	-	-	-	-	-	X	X		Native
Wool Grass	*Scirpus cyperinus*	-	-	-	-	-	-		X		
Nodding Bulrush	*Scirpus pendulus Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Carpenter's-square	*Scrophularia marilandica L.*	-	-	-	-	-	-	X			Native
Common Skullcap	*Scutellaria galericulata L.*	-	-	-	Rare	-	-	X			Native

Mad-dog Skullcap	*Scutellaria lateriflora L.*	-	-	-	-	-	-	X			Native
Small Skullcap	*Scutellaria parvula Michx. var. parvula*	-	-	-	-	-	-	X			Native
Mossy Stonecrop	*Sedum acre L.*	-	-	-	-	-	-	X		X	Introduced
Live-forever	*Sedum sarmentosum Bunge*	-	-	-	-	-	-	X		X	Introduced
Buck's Meadow Spikemoss	*Selaginella eclipes Buck*	-	-	-	-	-	-	X			Native
Golden Ragwort	*Senecio aureus L.*	-	-	-	-	-	-	X			Native
Balsam Ragwort	*Senecio pauperculus Michaux*	-	-	-	-	-	-	X			Native
Common Groundsel	*Senecio vulgaris L.*	-	-	-	-	-	-	X		X	Introduced
Yellow Foxtail	*Setaria pumila (Poiret) Schultes*	-	-	-	-	-	-	X		X	Introduced
Green Foxtail	*Setaria viridis (L.) P. Beauv.*	-	-	-	-	-	-	X		X	Introduced
Soapberry	*Shepherdia canadensis (L.) Nutt.*	-	-	-	-	-	-	X			Native
Sleepy Catchfly	*Silene antirrhina L.*	-	-	-	-	-	-	X			Native
Tall Tumblemustard	*Sisymbrium altissimum*	-	-	-	-	-	-		X	X	
Narrow-leaved Blue-eyed Grass	*Sisyrinchium angustifolium Miller*	-	-	-	-	-	-	X			Native
Water-parsnip	*Sium suave Walter*	-	-	-	-	-	-	X			Native
Carrion-flower	*Smilax herbacea L.*	-	-	-	-	-	-	X			Native
Bristly Greenbrier	*Smilax hispida Muhlenb. ex Torrey*	-	-	-	-	-	-	X			Native
Climbing Nightshade	*Solanum dulcamara L.*	-	-	-	-	-	-	X	X	X	Introduced
Eastern Black Nightshade	*Solanum ptycanthum Dunal ex DC.*	-	-	-	-	-	-	X			Native
Late Goldenrod	*Solidago altissima L.*	-	-	-	-	-	-	X			Native
Sharp-leaved Goldenrod	*Solidago arguta Aiton var. arguta*	-	-	-	-	-	-	X			Native
Silverrod	*Solidago bicolor L.*	-	-	-	-	-	-	X			Native
Blue-stem Goldenrod	*Solidago caesia L.*	-	-	-	-	-	-	X			Native
Canada Goldenrod	*Solidago canadensis L.*	-	-	-	-	-	-	X			Native
Zig-zag Goldenrod	*Solidago flexicaulis L.*	-	-	-	-	-	-	X	X		Native
Hairy Goldenrod	*Solidago hispida Muhl.*	-	-	-	-	-	-	X			Native
Early Goldenrod	*Solidago juncea Aiton*	-	-	-	-	-	-	X			Native
Gray Goldenrod	*Solidago nemoralis Aiton subsp. nemoralis*	-	-	-	-	-	-	X			Native
Upland White Goldenrod	*Solidago ptarmicoides (Nees) B. Boivin*	-	-	-	-	-	-	X			Native
Stout Goldenrod	*Solidago squarrosa Muhlenb. ex Nutt.*	-	-	-	-	-	-	X			Native
Perennial Sow-thistle	*Sonchus arvensis L. subsp. arvensis*	-	-	-	-	-	-	X		X	Introduced
Spiny-leaved Sow-thistle	*Sonchus asper (L.) Hill subsp. asper*	-	-	-	-	-	-	X		X	Introduced
American Mountain-ash	*Sorbus americana Marshall*	-	-	-	-	-	-	X			Native
European Mountain-ash	*Sorbus aucuparia L.*	-	-	-	-	-	-	X	X	X	Introduced
Indian Grass	*Sorghastrum nutans (L.) Nash*	-	-	-	-	-	-	X			Native
Sand-spurrey	*Spergularia media (L.) C. Presl ex Griseb.*	-	-	-	-	-	-	X		X	Introduced
Sand-spurrey	*Spergularia salina J. & C. Presl.*	-	-	-	-	-	-	X		X	Introduced
Slender Wedge Grass	*Sphenopholis intermedia (Rydb.) Rydb.*	-	-	-	-	-	-	X			Native
Shining Ladies'-tresses	*Spiranthes lucida (H. Eaton) Ames*	-	Appendix II	-	Vulnerable	-	-	X			Native
Rough Dropseed	*Sporobolus asper (Michx.) Kunth*	-	-	-	-	-	-	X		X	Native/Introduced
Overlooked Dropseed	*Sporobolus neglectus Nash*	-	-	-	-	-	-	X			Native
Ensheathed Dropseed	*Sporobolus vaginiflorus (Torrey ex A. Gray) Torrey ex A. Wood*	-	-	-	-	-	-	X			Native
Bladdernut	*Staphylea trifolia L.*	-	-	-	-	-	-	X	X		Native
Common Chickweed	*Stellaria media (L.) Villars*	-	-	-	-	-	-	X		X	Introduced
Lesser Chickweed	*Stellaria pallida (Dumort) Crepin*	-	-	-	-	-	-	X		X	Introduced
Rose Twisted-stalk	*Streptopus roseus Michaux*	-	-	-	-	-	-	X			Native
Snowberry	*Symphoricarpos albus (L.) S.F. Blake*	-	-	-	-	-	-	X		X	Native/Introduced
Smooth Aster	*Symphyotrichum laeve (L.) Love & Love*	-	-	-	-	-	-	X			Native
Panicled Aster	*Symphyotrichum lanceolatum (Willd.) Nesom*	-	-	-	-	-	-	X			Native
Calico Aster	*Symphyotrichum lateriflorum (L.) Love & Love*	-	-	-	-	-	-	X			Native

New England Aster	*Symphyotrichum novae-angliae (L.) Nesom*	-	-	-	-	-	-	X			Native
Ontario Aster	*Symphyotrichum ontarione (Wieg.) Nesom*	-	-	-	Rare	-	-	X			Native
Azure Aster	*Symphyotrichum oolentangiense (Riddell) Nesom*	-	-	-	Endangered	-	-	X			Native
Hairy Aster	*Symphyotrichum pilosum (Willd.) Nesom var. pilosum*	-	-	-	-	-	-	X			Native
Pringle's Aster	*Symphyotrichum pilosum (Willd.) Nesom var. pringlei (A. Gray)*	-	-	-	-	-	-	X			Native
Arrow-leaved Aster	*Symphyotrichum urophyllum (Lindl. in DC.) Nesom*	-	-	-	-	-	-	X			Native
Common Lilac	*Syringa vulgaris L.*	-	-	-	-	-	-	X	X	X	Invasive
Yellow-pimpernel	*Taenidia integerrima (L.) Drude*	-	-	-	-	-	-	X			Native
Red-seeded Dandelion	*Taraxacum erythrospermum Andrz. ex Besser*	-	-	-	-	-	-	X		X	Introduced
Common Dandelion	*Taraxacum officinale G. Weber*	-	-	-	-	-	-	X	X	X	Introduced
Marsh Dandelion	*Taraxacum palustre (Lyons) DC. sensu lato*	-	-	-	-	-	-	X		X	Introduced
Canada Yew	*Taxus canadensis Marshall*	-	-	-	-	-	-	X	X		Native
Early Meadow-rue	*Thalictrum dioicum L.*	-	-	-	-	-	-	X	X		Native
Rue-anemone	*Thalictrum thalictroides (L.) Eames & B. Boivin*	-	-	-	-	-	-	X			Native
Hairy-jointed Meadow Parsnip	*Thaspium barbinode (Michaux) Nutt.*	-	-	-	Endangered	-	-	X			Native
White Cedar	*Thuja occidentalis L.*	Least Concern	-	-	-	-	-	X	X		Native
Foamflower	*Tiarella cordifolia L.*	-	-	-	-	-	-	X			Native
Basswood	*Tilia americana L.*	-	-	-	-	-	-	X	X		Native
Littleleaf Linden	*Tilia cordata*	-	-	-	-	-	-		X	X	
Poison Ivy	*Toxicodendron radicans*	-	-	-	-	-	-		X		
Goat's-beard	*Tragopogon dubius Scop.*	-	-	-	-	-	-	X		X	Invasive
Common Salsify	*Tragopogon porrifolius L.*	-	-	-	-	-	-	X	X	X	Introduced
Goat's-beard	*Tragopogon pratensis*	-	-	-	-	-	-		X	X	
Rabbit-foot Clover	*Trifolium arvense L.*	-	-	-	-	-	-	X		X	Introduced
Hop-clover	*Trifolium aureum*	-	-	-	-	-	-		X	X	
Small Clover	*Trifolium dubium Sibth.*	-	-	-	-	-	-	X		X	Introduced
Red Clover	*Trifolium pratense L.*	Least Concern	-	-	-	-	-	X	X	X	Introduced
White Clover	*Trifolium repens L.*	Least Concern	-	-	-	-	-	X	X	X	Introduced
Nodding Trillium	*Trillium cernuum L.*	-	-	-	Vulnerable	-	-	X			Native
Red Trillium	*Trillium erectum L.*	-	-	-	Vulnerable	-	-	X			Native
Bent Trillium	*Trillium flexipes Raf.*	-	-	-	Endangered	-	-	X			Native
White Trillium	*Trillium grandiflorum (Michaux) Salisb.*	-	-	-	Vulnerable	-	-	X			Native
Horse-gentian	*Triosteum aurantiacum E. Bickn.*	-	-	-	-	-	-	X			Native
Tinker's Weed	*Triosteum perfoliatum L.*	-	-	-	-	-	-	X			Native
Eastern Hemlock	*Tsuga canadensis (L.) Carriere*	Near Threatened	-	-	-	-	-	X	X		Native
Coltsfoot	*Tussilago farfara L.*	-	-	-	-	-	-	X	X	X	Invasive
Narrow-leaved Cattail	*Typha angustifolia L.*	-	-	-	-	-	-	X	X		
Common Cattail	*Typha latifolia L.*	-	-	-	-	-	-	X	X		Native
American Elm	*Ulmus americana L.*	-	-	-	-	-	-	X	X		Native
Siberian Elm	*Ulmus pumila L.*	-	-	-	-	-	-	X		X	Introduced
Slippery Elm	*Ulmus rubra Muhl.*	-	-	-	-	-	-	X			Native
Rock Elm	*Ulmus thomasii Sarg.*	-	-	-	Threatened	-	-	X			Native
Large-flowered Bellwort	*Uvularia grandiflora Smith*	-	-	-	-	-	-	X			Native
Perfoliate Bellwort	*Uvularia perfoliata L.*	-	-	-	-	-	-	X			Native
Merrybells	*Uvularia sessilifolia L.*	-	-	-	-	-	-	X			Native
Lowbush Blueberry	*Vaccinium angustifolium Aiton*	-	-	-	-	-	-	X			Native
Highbush Blueberry	*Vaccinium corymbosum L.*	-	-	-	-	-	-	X			Native
Dryland Blueberry	*Vaccinium pallidum Aiton*	-	-	-	-	-	-	X			Native
Deerberry	*Vaccinium stamineum L.*	-	-	-	-	Threatened	Threatened	X			Native
Tape-grass	*Vallisneria americana Michaux*	-	-	-	-	-	-	X			Native

Moth Mullein	*Verbascum blattaria L.*	-	-	-	-	-	-	X		X	Introduced
Common Mullein	*Verbascum thapsus L.*	-	-	-	-	-	-	X	X	X	Invasive
Blue Vervain	*Verbena hastata L.*	-	-	-	-	-	-	X			Native
White Vervain	*Verbena urticifolia L.*	-	-	-	-	-	-	X			Native
Corn Speedwell	*Veronica arvensis L.*	-	-	-	-	-	-	X		X	Introduced
Common Speedwell	*Veronica officinalis L.*	-	-	-	-	-	-	X	X	X	Introduced
Purslane Speedwell	*Veronica peregrina L. subsp. peregrina*	-	-	-	-	-	-	X		X	Introduced
Speedwell	*Veronica polita Fries*	-	-	-	-	-	-	X		X	Introduced
Thyme-leaved Speedwell	*Veronica serpyllifolia L. subsp. serpyllifolia*	-	-	-	-	-	-	X	X	X	Introduced
Maple-leaved Viburnum	*Viburnum acerifolium L.*	-	-	-	-	-	-	X	X		Native
Wayfaring Tree	*Viburnum lantana L.*	-	-	-	-	-	-	X	X	X	Introduced
Nannyberry	*Viburnum lentago L.*	-	-	-	-	-	-	X			Native
Snowball-tree	*Viburnum opulus L. var. americanum Ait.*	-	-	-	-	-	-	X			Native
European Highbush-cranberry	*Viburnum opulus L. var. opulus*	-	-	-	-	-	-	X		X	Invasive
Downy Arrow-wood	*Viburnum rafinesquianum Schultes*	-	-	-	-	-	-	X			Native
Vetch	*Vicia americana Muhlenb. ex Willd.*	-	-	-	-	-	-	X			Native
Carolina Vetch	*Vicia caroliniana Walt.*	-	-	-	-	-	-	X			Native
Cow Vetch	*Vicia cracca*	-	-	-	-	-	-		X	X	
Common Vetch	*Vicia sativa L. subsp. nigra (L.) Ehrh.*	-	-	-	-	-	-	X		X	Introduced
Common Periwinkle	*Vinca minor L.*	-	-	-	-	-	-	X	X	X	Invasive
Sweet White Violet	*Viola blanda Willd.*	-	-	-	-	-	-	X			Native
Canada Violet	*Viola canadensis L.*	-	-	-	-	-	-	X			Native
Dog Violet	*Viola conspersa Reichenb.*	-	-	-	-	-	-	X			Native
Wood Violet	*Viola palmata L.*	-	-	-	-	-	-	X			Native
Yellow Violet	*Viola pubescens Aiton*	-	-	-	-	-	-	X			Native
Long-spurred Violet	*Viola rostrata Pursh*	-	-	-	-	-	-	X			Native
Round-leaved Violet	*Viola rotundifolia Michaux*	-	-	-	-	-	-	X			Native
Common Blue Violet	*Viola sororia Willd.*	-	-	-	-	-	-	X	X		Native
Summer Grape	*Vitis aestivalis Michaux var. aestivalis*	-	-	-	-	-	-	X			Native
Fox Grape	*Vitis labrusca L.*	-	-	-	-	-	-	X		X	Native/Introduced
Riverbank Grape	*Vitis riparia Michaux*	-	-	-	-	-	-	X	X		Native
Six-weeks Fescue	*Vulpia octoflora (Walter) Rydb. var. glauca*	Least Concern	-	-	-	-	-	X			Native
Barren Strawberry	*Waldsteinia fragarioides (Michaux) Tratt.*	-	-	-	-	-	-	X			Native
Chinese Wisteria	*Wisteria sinensis*	-	-	-	-	-	-		X	X	
Cocklebur	*Xanthium strumarium L.*	-	-	-	-	-	-	X		X	Native/Introduced
Prickly-ash	*Zanthoxylum americanum Miller*	-	-	-	-	-	-	X			Native
White Camass	*Zigadenus elegans Pursh subsp. glaucus (Nutt.) Hulten*	-	-	-	-	-	-	X			Native

Sources of Status

IUCN Red List - "International Union for the Conservation of Nature, Red List of Threatened Species" (http://www.iucnredlist.org/)

CITES Appendix - "Convention on the International Trade in Endangered Species of Wild Flora and Fauna" (http://www.cites.org/)

US (Endangered Species Act) - "U.S. Fish and Wildlife Service, Endangered Species" (http://www.fws.gov/ENDANGERED/species/us-species.html)

New York State (Natural Heritage Program) - New York Rare Plant Status Lists, 2010, Edited by Stephen M. Young and Troy W. Weldy (http://www.dec.ny.gov/docs/fish_marine_pdf/2010rareplantstatus.pdf)

Canada (Species at Risk Act) - "Species at Risk Public Registry" (http://www.sararegistry.gc.ca/sar/index/default_e.cfm)

Ontario (Endangered Species Act) - "Species at Risk in Ontario (SARO) List" (http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/MNR_SAR_CSSR_SARO_LST_EN.html)

Sources of Records

A - Oldham, M. J. (2007). Vascular plants of the Niagara River, Ontario. Draft. Report for the Niagara Parks Commission. Unpublished manuscript. (Canada Records)

B - Environmental Design & Research, Landscape Architecture, Planning, Environmental Services, Engineering and Surveying, P.C. (EDR). (2010). Ecological Inventory of the Niagara River Gorge and Rim - Draft. Report for Wild Ones: Native Plants, Natural Landscapes. (U.S. Records)

Additional Notes

Introduced species are a species living outside their native distributional range, which have arrived there by human activity, either deliberate or accidental. Identified in: Oldham, M. J. (2007). Vascular plants of the Niagara River, Ontario. Draft. Report for the Niagara Parks Commission. Unpublished manuscript.[20]

[20] Botanicals table created as part of the Niagara River Corridor Ramsar Site nomination package, 2016.

Species Listed as Extirpated, Threatened, Endangered or of Special Concern

The U.S. Fish and Wildlife Service and NYS's Department of Environmental Conservation both identify species that are under threat of extinction as a means to combat these trends and support sustainable numbers. The official Federal designations include "Endangered Species" and "Threatened Species", but there are also species that are watched who are proposed for the lists or candidates. In these cases they're labeled "Proposed Endangered" or "Candidate". The NYSDEC designations also include those species identified by the state as Endangered and Threatened, but also list Species of Special Concern. In 2015, NYSDEC conducted a very thorough inventory of species distribution, population trends and habitat needs. Based off this extensive dataset, they developed three additional designations for species in decline.[21] These classifications are defined below:

Extinct - Species is no longer living or existing.

Extirpated - Species is not extinct, but no longer occurring in a wild state within New York, or no longer exhibiting patterns of use traditional for that species in New York (e.g. historical breeders no longer breeding here).

Endangered - Any native species in imminent danger of extirpation or extinction.

Threatened - Any native species likely to become an endangered species within the foreseeable future.

Special Concern - Any native species for which a welfare concern or risk of endangerment has been documented in New York State.

Species of Greatest Conservation Need with High Priority (SGCN*) - The status of these species is known and conservation action is needed in the next ten years. These species are experiencing a population decline, or have identified threats that may put them in jeopardy, and are in need of timely management intervention or they are likely to reach critical population levels in New York.

Species of Greatest Conservation Need (SGCN) - The status of these species is known and conservation action is needed. These species are experiencing some level of population decline, have identified threats that may put them in jeopardy, and need conservation actions to maintain stable population levels or sustain recovery.[22]

[21] All species lists have been fully updated as of June 2017 to reflect species distribution for all of the 18 sub-watersheds (seven new ones) and include SGCN/SPCN status, which has strong biological relevance for informing regional policy. Asterisks (*) indicate priority status for SGCN, both in this list and throughout species tables.

[22] http://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf

Species of Potential Conservation Need (SPCN)[23] - A species whose status is poorly known, but there is an identified threat to the species, or features of its life history that make it particularly vulnerable to threats. The species may be declining, or begin to experience declines within the next ten years, and studies are needed to determine their actual status.

Extirpated Species

The 2005 NYSDEC list for Species of Greatest Conservation Need (SGCN) included seven species that were confirmed extirpated from the Niagara River/ Lake Erie Watershed (highlighted in Table 5.3), and 31 species believed to be extirpated. Table 5.3 outlines the SGCN list and also incorporates information on those species that have been documented in the watershed from 1990-2005. However, this table warrants re-evaluation, as it may be inaccurate. For example, the extirpation of mayflies may no longer be the case.

The various species charts included in this chapter outline whether or not a species is listed as Threatened, Endangered or of Special Concern (federally or state classified). According to these species lists, there is currently only one species federally designated as Endangered and none listed as federally Threatened. State designations of Endangered and Threatened Species found in the watershed, includes 15 and 18 species, respectively. For Species of Special Concern (state designation), there are 21 species listed, 16 of which are birds. In fact, bird species hold the most designations according to these classifications, indicating they are the most threatened species type in the watershed.

[23] http://www.dec.ny.gov/docs/wildlife_pdf/spnc2015list.pdf

Table 5.3: Species that Historically Occurred in the Niagara River/Lake Erie Watershed Believed to be Extirpated

Taxa Group	Species name	Latin Name	Documented within the last 15 Years
Freshwater fish	Atlantic Salmon	Salmo salar	
Freshwater fish	Blackchin Shiner	Notropis heterodon	X
Freshwater fish	Deepwater Sculpin	Myoxocephalus thompsoni	
Freshwater fish	Lake Chubsucker	Erimyzon sucetta	X
Freshwater fish	Sauger	Stizostedion canadense	X
Freshwater fish	Shortjaw Cisco	Coregonus zenithicus	
Freshwater fish	Silver Chub	Macrhybopsis storeriana	
Freshwater fish	Spoonhead Sculpin	Cottus ricei	
Mollusk	Black Sandshell	Ligumia recta	X
Mollusk	Buffalo Pebble Snail	Gillia altilis	
Mollusk	Campeloma Spire Snail	Cincinnatia cincinnatiensis	
Mollusk	Eastern Pondmussel	Ligumia nasuta	X
Mollusk	Fawnsfoot	Truncilla donaciformis	
Mollusk	Globe Siltsnail	Birgella subglobosus	
Mollusk	Gravel Pyrg	Pyrgulopsis letsoni	
Mollusk	Lance Aplexa	Aplexa elongata	
Mollusk	Mapleleaf	Quadrula quadrula	
Mollusk	Mucket	Actinonaias ligamentina	
Mollusk	Pimpleback	Quadrula pustulosa	
Mollusk	Pocketbook	Lampsilis ovata	X
Mollusk	Salamander Mussel	Simpsonaias ambigua	
Mollusk	Snuffbox	Epioblasma triquetra	X
Mollusk	Spindle Lymnaea	Acella haldemani	
Mollusk	Watercress Snail	Fontigens nickliniana	
Mollusk	Yellow Sandshell	Lampsilis teres	
Insect	Mocha Emerald	Somatochlora linearis	
Insect	American Burying Beetle	Nicrophorus americanus	
Insect	Borer Moth		
Insect	Culvers Root Borer	Papaipema sciata	
Insect	Mayfly		
Insect	Midland Clubtail	Gomphus fraternus	
Mammal	Eastern Cougar	Felis concolor cougar	
Mammal	Gray Wolf	Canis lupus	
Mammal	Silver-haired Bat	Lasionycteris noctivagans	
Mammal	Least Shrew	Cryptotis parva	
Mammal	Least Weasel	Mustela nivalis	
Herpetofauna	Timber Rattlesnake	Crotalus horridus	
Bird	Loggerhead Shrike	Lanius ludovicianus	X

*Table adapted from the Comprehensive Wildlife Conservation Strategy for New York , Lake Erie Table 11. SGNC that historically occrured in Lake Erie Basin, but are now believed to be extirpated from the Basin.
Species documentation Resources (See Bibliography).

Invasive Species

There are hundreds of thousands of non-native plants, animals, and insects thriving within the Niagara River/Lake Erie Watershed; many of which are now considered naturalized to our climate and fit well within our ecosystem, supporting their new environment. However, there are occurrences where these non-native species become nuisances, thriving beyond a natural balance and disrupting the natural food chain and ecosystem. An unchecked nuisance species can displace native and naturalized species and their supporting role in the health of the watershed. When a species begins to cause significant harm which leads to major economic impacts, it transitions from being defined as a non-indigenous nuisance to an invasive species.[24]

The descriptions of invasive species that follow include only those that are widely recognized as invasive species within New York State and also pose the greatest threat to the Niagara River/Lake Erie Watershed. Each of the species included in this list have already been found within the watershed, or pose an immediate threat to establish within the watershed in the near future and are being monitored for detection.

1. Zebra Mussels (Mollusk)

The zebra mussel (*Dreissena polymorpha*) is a small shellfish named for the striped pattern of its shell. Native to the freshwater lakes in the Caspian Sea region of Asia, zebra mussels were transported to the Great Lakes in ballast water from a transoceanic vessel. Since they were first discovered in 1988 in Lake St. Clair they have spread to all the Great Lakes and waterways in multiple states, as well as Ontario and Quebec, and to southeast and western portions of the United States.

Zebra mussels characteristically colonize hard surfaces and rocky substrates in high densities with as many as tens of thousands of individuals living in one square yard. They have been known to attach to stone, wood, concrete, iron, steel, aluminum, plastic, fiberglass, PVC, crayfish and even other mussels. Their rapid reproduction rate, negative impacts on aquatic ecology, and limited amount of predators has led NYS to designate these mussels as an Aquatic Species of Concern.

The impact of these dreissenids appears to be beneficial to many lay people because their filter feeding behavior increases water clarity. However, their negative impacts far outweigh their water clarifying benefits. These mussels are known to smother out native mussel species and their massive population in the Great Lakes reduces the amount of phytoplankton available for other organisms, thus changing the ecological structure of the lakes. Zebra mussels are also considered to contribute to harmful algae blooms. As excessive filter feeders, the mussels dramatically reduce

[24] Based on NYS Environmental Conservation Law § 9-7105 (10).

beneficial green algae and aid *Microcystis* spp. (toxic blue-green algae), as it's the only bacterium they will not eat. Their tremendous filter feeding accumulates contaminants in their tissues at greater levels than other mussels as well, further contributing to bio-accumulation in wildlife and humans. Zebra mussels also cause tremendous economic impacts beyond those to the ecosystem. By clogging intake pipes for public drinking supplies, power plants, as well as boat engine cooling systems, the mussels are extremely costly for communities, business and industry.

2. Quagga Mussels (Mollusk)

The quagga mussel (*Dreissena bugensis*) is a small freshwater bivalve mollusk native to the Ukraine. Quagga mussels took longer than zebra mussels to establish in the Great Lakes through similar transport mechanisms in ballast water, but once founded their numbers exploded. Presently, quagga mussels make up 98% of the whole mollusk population in the Great Lakes. Quagga mussels remove substantial amounts of phytoplankton and suspended particulate from the water, reducing the food supply for zooplankton and forage fishes.

Figure 5.12: Zebra Mussel vs. Quagga Mussel

Quagga mussels out compete zebra mussels in several ways. Although quagga and zebra mussels have the same biological characteristics that allow them to establish and spread to watersheds across the United States, quagga mussels have an advantage in that they can colonize soft substrates as well as hard substrates. They are also better able to flourish in the low-food conditions that zebra mussels create, allowing them to colonize less productive waters in much greater numbers. Quagga mussels can be found everywhere zebra mussels are, but because they can also settle on soft substrate they are colonizing places like the bottom of Lake Erie, where the silty bottom provides a perfect habitat. For these reasons, it is likely quagga mussels will take over areas where zebra mussels are already established to become the dominant dreissenid in the Great Lakes. This trend is already being observed in the lower Great Lakes.[25]

[25] https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=95

Similar to zebra mussels, quagga mussels clog intake pipes and cause damage to boats, power plants and harbors. As aggressive invaders, they too are destroying native mussel populations. Quagga mussels are also extremely effective in filter feeders. During their filtering process, pollutants are rejected, or spit out, leading to higher concentrations of pollutants in lake-bottom sediments. Unfortunately, quagga mussels also avoid filtering out toxic blue-green alga *Microcystis*, which provides this alga with fewer competitors for nutrients and supports their return as toxic algal blooms.

3. Round Goby (Fish)

The round goby (*Neogobius melanostomus*) is a non-native fish originating from central Eurasia. They were first detected in the St. Clair River in 1990 after being introduced via ballast water of transoceanic vessels. A rapid range expansion of the round goby has occurred throughout the Great Lakes since its initial introduction. Currently the round goby is considered established in several locations of the Niagara River/ Lake Erie Watershed.

This small fish has several traits which have allowed the populations to grow, including aggressive behavior, avid feeding behavior, and ability to feed in complete darkness. They can survive in degraded water conditions, spawn more frequently over a longer period than most native fish, reproduce rapidly, and guard their nests from predators.

Figure 5.13: Round Goby Fish (USGS)

As an aggressive competitor for food and habitat, especially spawning sites, the round goby is linked to declines in native fish populations (i.e. mottled sculpin, logperch, and darters). Round goby also feed on the eggs and fry of lake trout, posing environmental and ecological threats to these native fish populations. Although round goby usually prefer near shore habitats of rock, sand, cobble, gravel and submerged aquatic vegetation, they have been found invading offshore reefs where they are prey for sport fish like burbot, lake trout, and lake whitefish (Figure 5.5). This poses a health risk to both sport fish and humans, because gobies ingest toxic substances through the consumption of large quantities of zebra and quagga mussels. Additionally, round gobies have been identified as a potential vector for viral hemorrhagic septicemia virus (VHSV), which has decimated native fish populations of muskellunge, smallmouth bass, freshwater drum among others.

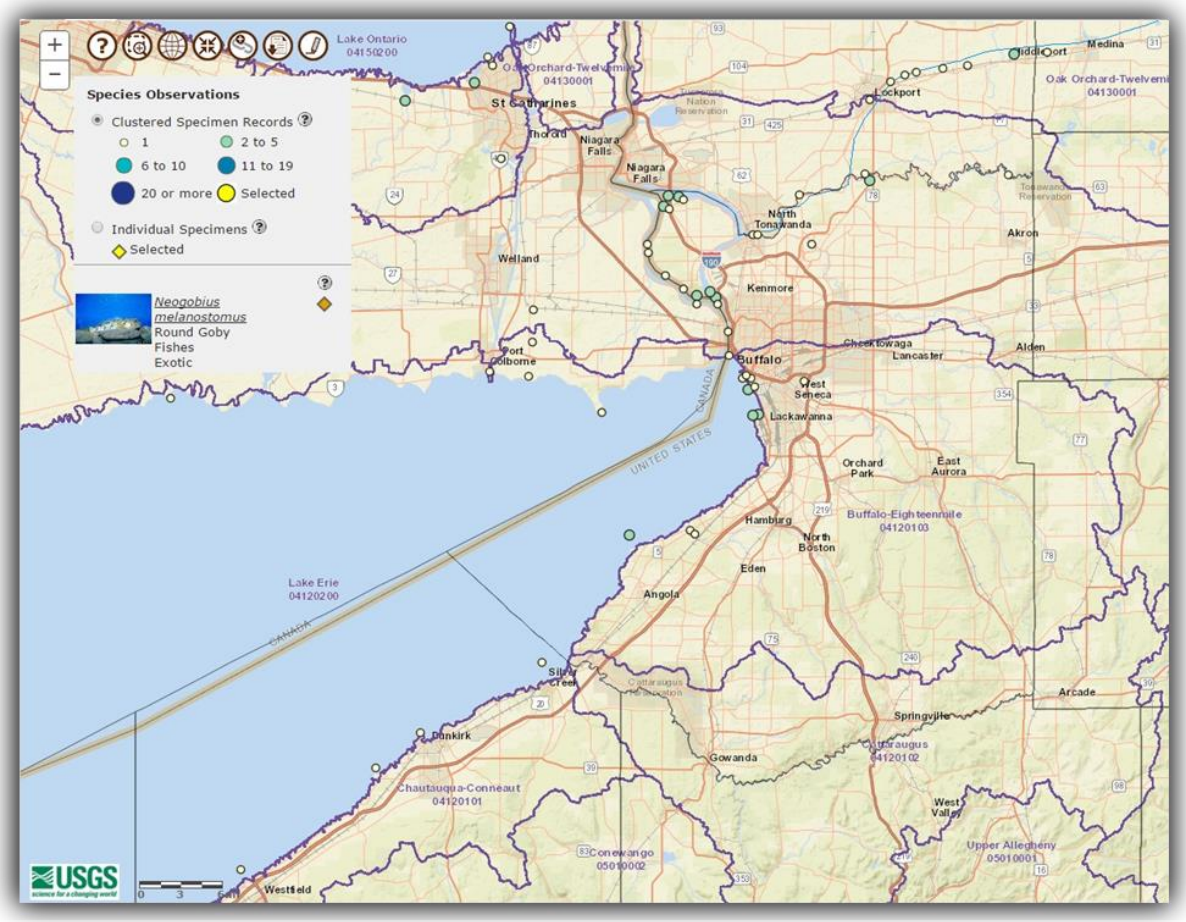


Figure 5.14: Round Goby Sightings in the Niagara River/Lake Erie Watershed
Source: (USGS Interactive Online Point Mapping)

4. Rudd (Fish)

Rudd (*Scardinius erythrophthalmus)* are an invasive fish species in the minnow family, although they reach lengths larger than what is typically considered a minnow in their adult stage, about 15 inches in length. Ruddpresence has been a combination of intentional and accidental introduction. Historically, in the late 1800s, they were likely brought to North America because they were a prized fish in Europe. More recently, in the 1980s, they were intentionally bred in bait shops and sold. Currently, their release as a bait fish is likely accidental and due to mislabeling. Rudd bears an extremely close resemblance to a native minnow species, the golden shiner. To the untrained eye, these fishes are indistinguishable, especially when they are only a few inches in length. The widespread distribution of rudd is yet another reason why the dumping of baitfish poses serious threats to watersheds. Currently they are established in the Niagara River/Lake Erie Watershed.

This invasive fish can lead to several problems in its non-native range. First, it is an omnivorous fish which consumes both insects and plants. This flexible diet makes it unlikely for the fish to become food-limited throughout the year, and gives it a competitive advantage over fish which are strictly herbivorous or carnivorous. Their preferred plant source is submerged macrophytes and they avoid nuisance plants such as algae. They are capable of depleting native vegetation, decrease water quality conditions in plant beds, both directly through uprooting and sediment disturbance, and indirectly through excretion of partially digested plant matter. Also, rudd are capable of hybridizing with the golden shiner.

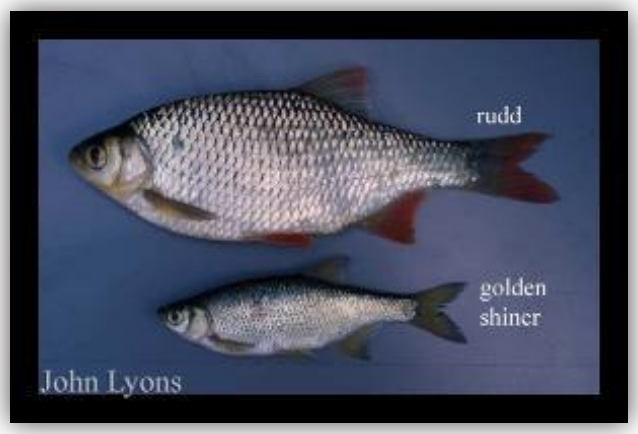


Figure 5.15: Rudd vs. Golden Shiner

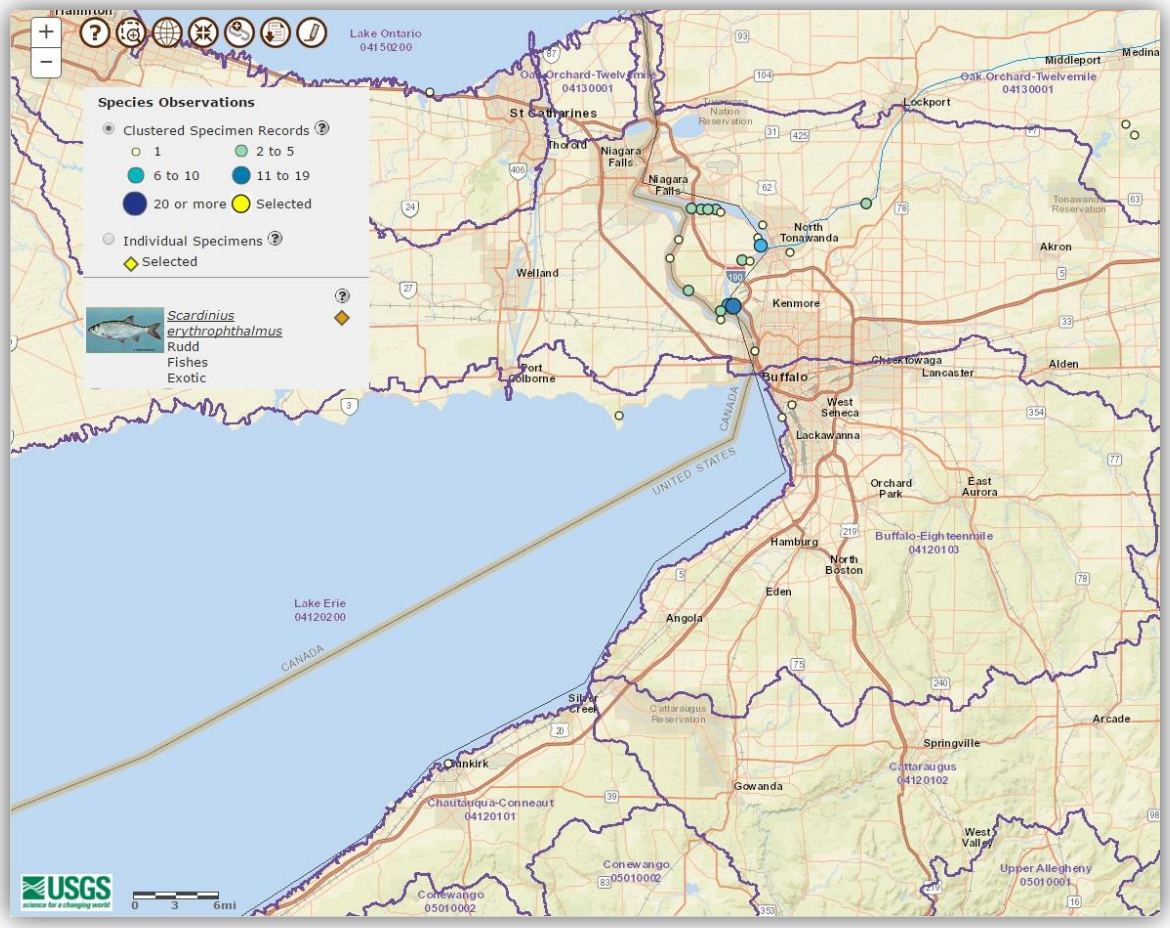


Figure 5.16: Rudd Sightings in the Niagara River/Lake Erie Watershed

This has potential to deplete the genetic integrity of golden shiners, and could disrupt the reproductive fitness and spawning behaviors.

A promising field of study is contaminant levels in rudd, which tend to be lower than other sportfish such as freshwater drum and bass, because of their herbivorous diet.[26] There is potential for a rudd fishery in the Niagara River, because they are a relatively clean source of fish protein. This would benefit both the aquatic ecosystem and humans.

5. Asian Carp (Fish)

Black, bighead, grass, and silver carp are the four species of Asian carp that were purposely introduced to ponds in Arkansas to control weeds (Figure 5.7). Since their escape, significant ecological and economic impacts have been documented in the Mississippi River system. Although they are not currently in the Great Lakes basin, these species are an imminent threat and are migrating toward Lake Michigan through the Illinois River and the Chicago Sanitary and Ship Canal. Recent discovery of the carp's environmental DNA sparked controversy regarding their status in Lake Erie. Some suspect that their populations could start growing to a notable number in the next few years.

Figure 5.17 Asian Carp Species

Source: Tip of the Mitt Watershed Council

The Asian carp diet overlaps with several native species, making them strong ecological competitors with the potential to displace and consume native populations of fishes, plants, mollusks, and other invertebrates. Rapid growth, nonselective feeding, consumption of vast quantities of food, prolific reproduction, and climate tolerance are all characteristics that will allow Asian carp to outcompete native species and potentially devastate the Great Lakes ecosystem.

[26] Kapucinsky, K.L., Farrell, J.M., Paterson, G., Wilkinson, M.A., Skinner, L.C., Richter, W., & A.J. Gudlewski. 2014. Low concentrations of contaminants in an invasive cyprinid, the rudd, in a Great Lakes Area of Concern. Bulletin of Environmental Contamination and Toxicology. 93:567–573.

Presently the Army Corp of Engineers is employing various tools to prevent Asian Carp species from entering the Great Lakes, including an electrical dispersal barrier system in the Chicago Sanitary and Ship Canal. However, in the event of a power outage, this would not be an effective barrier. There is also some preliminary research being conducted by the Corps on the efficacy of the electric barrier on juvenile fish, which are not shocked as easily as fish ≥100 mm, particularly when barges are moving through the barrier and affecting stream flow dynamics. Additionally, there are other pathways connecting the Mississippi river basin with the Great Lakes watershed. For example, in the event of a flood Asian carp could potentially make their way into the Great Lakes basin, in the same manner they escaped from Arkansas ponds.

6. Eurasian Ruffe (Fish)

Eurasian ruffe (*Gymnocephalus cernua*) are a small spiny perch capable of explosive population growth. Although they have been present in the upper Great Lakes since the 1980s, they have not yet established in Lake Erie. They were introduced to Lake Superior through the ballast water of a transoceanic vessel and have since spread throughout the southwestern and northern regions of Lake Superior, and in Lake Huron at the mouth of Thunder Bay River.

Figure 5.18: Ruffe (Wikipedia)

Ruffe are competitors with native fish for food and habitat. They outcompete other species in newly invaded areas due to their high reproductive rate (females can lay between 45,000 and 90,000 eggs per year) and feeding efficiency across a wide range of environmental conditions. Like many invasive species, they may not be recognized as prey in their newly invaded habitats, and their physical spines throughout their body may discourage potential predators. While ruffe are not currently in either the Niagara River or Lake Erie, GARP[27] modeling predicts ruffe will find suitable habitat almost everywhere in all five Great Lakes, and are considered a potential threat to Lake Erie.

[27] Genetic Algorithm for Rule-set Production (GARP) is a type of power of prediction analysis.

7. Spiny Waterflea (Crustacean)

The spiny water flea (*Bythotrephes longimanus*) is a small carnivorous crustacean with a long, barbed spiny tail native to the Caspian Sea. This zooplankton was first found in Lake Huron in 1984. Spiny water fleas have been found in all five great lakes, as well as inland rivers and creeks. They are a nuisance to anglers because gear can get tangled in large masses of *Bythotrephes,* forming a gelatinous intertwined mess that is difficult to remove.

Although they themselves are zooplankton, spiny water fleas compete directly with other native planktivorous fishes for smaller zooplankton, such as *Daphnia* spp. Spiny water fleas are capable of booming in populations under the right conditions, and their selective predation and depletion of *Daphnia* can disrupt the food web in nursery habitats for larval fish. They can also cause a change in behavior of *Daphnia* which are trying to escape predation. Many fish such as perch, shiners and walleye, consume spiny water fleas as juveniles and adults. However, most fish in their larval stage cannot eat spiny water fleas because of their large spine. *Bythotrephes* and *Daphnia* can reproduce both sexually and asexually a very complex reproductive strategy called parthenogenesis), and have an entirely female population.[28]

8. Hemlock Wooly Adelgid (Insect)

Hemlock wooly adelgid (*Adelges tsugae*), or HWA, is an invasive aphid originally from Asia. It was first found in the US in 1951, but has since spread northward, currently predicted to be dispersing at rates of 20-30 km/year. Just like *Bythotrephes* and *Daphnia*, it can reproduce both sexually and asexually, and has an entirely female population. In its introduced range, they are unable to complete the sexual reproduction phase, and produce two generations a year. Unlike most insects, they are dormant in summer months rather than winter. HWA encapsulates itself in a protective wooly substance and are generally less than one mm in length. They suck the plant tissue from the needles of hemlock, and the tree almost always dies within four to five years of infestation. Foresters are in the trial stages of using biological control methods, a beetle from HWA's native range, as a means of control. Pesticides and/or dormant oil can also be used to suppress infestations.[29]

HWA is a particularly troubling invasive species, because many of the ecoregion zones in the Niagara River/Lake Erie Watershed are comprised of Eastern hemlock forests. Once lost, it would take many decades to replace the climax forests. Furthermore, during that time period, large sections of streams would lose their shade cover; water temperatures will warm and certain streams may lose important coldwater fish such as brook trout. The loss of shaded understory will affect many other animals and plants adapted to those conditions. This widespread loss of mature

[28]. https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=162
[29] http://www.dec.ny.gov/docs/lands_forests_pdf/hwafactsheet.pdf

trees will also alter carbon cycling, because it takes many years to sequester the amount of carbon stored in climax forests, reducing regional climate resiliency.[30]

9. Emerald Ash Borer (Insect)

The emerald ash borer (*Agrilus planipennis*) is an exotic beetle native to Asia. It was first discovered in southeastern Michigan in 2002 and most likely arrived in the United States on wood packing material transported from Asia. The emerald ash borer is threatening native North American Ash trees, which currently make up around 20% of the watershed's tree population.[31] While adult beetles eat ash foliage and only cause minimal damage, the real harm comes from larvae that tunnel under bark and disrupts the tree's systems that transport food and water, eventually starving the tree and killing it.

Figure 5.19: Emerald Ash Borer (Trees Atlanta)

The NYSDEC has found emerald ash borers in all counties of the Niagara River/Lake Erie Watershed as of May 2017.[32] The entire watershed is currently quarantined.

Invasive Plant Species

The NYSDEC has identified over 60 Invasive Plant Species in the New York State Prohibited and Regulated Invasive Plants List.[33] The following are those species that pose the most significant threat to the health of the Niagara River/Lake Erie Watershed.

10. Eurasian Water-milfoil (Aquatic Plant)

Eurasian watermilfoil (*Myriophyllum spicatum*) is a submersed rooted aquatic weed native to Eurasia. It was introduced accidentally in the 1940's and has spread through the United States by boats and waterbirds. Eurasian water-milfoil forms thick, underwater strands of tangled stems and vast mats of vegetation at the water's surface which interferes with recreational activities such as boating, swimming, and fishing. The floating canopy also crowds out native plants.

[30] https://www.na.fs.fed.us/spfo/pubs/pest_al/hemlock/hwa05.htm
[31] https://www.wgrz.com/article/sports/outdoors/death-knell-for-ash-trees/71-587539056
[32] http://www.dec.ny.gov/docs/lands_forests_pdf/eabquarmaps.pdf
[33] September 10, 2014

Figure 5.20: Eurasian Milfoil Infestation

It can reproduce through stem fragmentation and underground runners, which means a single segment of stem and leaves can take root and form a new colony (i.e. fragments clinging to boats and trailers can spread from lake to lake). Clearing weed beds for beaches, docks, landings, etc. creates thousands of new stem fragments and therefore thousands of possibilities for new colonies to form. Fortunately, water-milfoil has difficulty becoming established in lakes with healthy populations of native plants. In some lakes water-milfoil appears to coexist with native flora and has little impact on fish and other aquatic animals.

Currently, water-milfoil is mostly found within the northern portions of the Niagara River/ Lake Erie Watershed, in the northern and southern locations of Attica Reservoir/Crow Creek. There have been much fewer milfoil observations (<5) in Cattaraugus, Chautauqua-Conneaut, and Buffalo-Eighteenmile sub-basins, although the adjacent Chautauqua Lake sub-basin has considerably more water-milfoil observations, which pose a threat to spreading into the Niagara River/Lake Erie Watershed.[34]

11. Curly Leaf Pondweed (Aquatic Plant)

Curly-leaf pondweed (*Potamogeton crispus*) is a submersed aquatic plant which grows in 3-10 feet of water and has a heavy presence in the Niagara River/ Lake Erie Watershed. Curly-leaf pondweed forms dense mats that interfere with water activities and displaces native plants. It is able to re-establish a colony from any remaining roots after being removed from an area. When curly-leaf dies in large numbers during mid-summer, rafts of dying plants pile up along shorelines and are often followed by an increase in phosphorus and harmful algal blooms.

Figure 5.21: Curly Leaf Pondweed

[34] http://login.imapinvasives.org/nyimi/map/#

12. Frogbit (Aquatic Plant)

Frogbit (*Hydrocharis morsus-ranae)* is a small, floating plant resembling a water lily. Native to Europe and parts of Asia, frogbit was introduced to Canada in the 1930's. They have since spread to Eastern Canada and the Northeastern US, particularly around the Great Lakes. Frogbit is fast growing, and interestingly it spreads rapidly by horizontal stems, called stolons, instead of through roots. In winter, it creates dormant buds called turionds, which rest on the bottom then rise again to the surface in the spring. Frogbit colonizes waterways and forms dense masses of vegetation on the surface, threatening biodiversity. In its native areas, this plant is rarely dominant. Once this plant establishes a population, it spreads very quickly. It first appears at boat launches and reservoirs, and should be treated as soon as it is confirmed. Currently, frogbit is absent from Buffalo-Eighteenmile, Cattaraugus, and Chautauqua-Conneaut sub-basins, although there have been a handful of isolated reports of it in the Niagara sub-basin (WNY PRISM iMap Database, accessed spring 2017). Andrea Locke (WNY PRISM: Great Lakes Center) predicts frogbit will further spread in the Niagara River/Lake Erie Watershed, because of its highly invasive nature.

13. Water Chestnut (Plant)

Water chestnut (*Trapa natans*) is an invasive plant found in freshwater lakes and ponds, and slow-moving streams and rivers. It was introduced to New York State in the 1800's and is a major nuisance for the state. In the Niagara River/Lake Erie Watershed, water chestnut has been found in Tonawanda Creek/Erie Canal where removal activities (hand pulling) take place every few years. It has also been found in Chautauqua and Cattaraugus counties in adjacent watersheds, which poses a danger to the southern portions of the Watershed.

Figure 5.22: Water Chestnut pull event in Tonawanda Creek

Water chestnut is an annual and dies back at the end of each growing season. However, its seeds, which sink down into waterway sediments can live for up to 12 years. Each plant produces approximately 20 seeds annually. Seeds are primarily distributed through moving waters and water fowl. Hand pulling, herbicides, and

mechanical harvesters are an effective tool to address water chestnut, but removal strategies need to be employed for over 10 years to ensure eradication.

Infestations of water chestnut form impenetrable floating mats of vegetation, creating hazards for boaters and other water recreation. The density of the mats can severely limit light penetration into the water and reduce or eliminate the growth of native aquatic vegetation. Upon seasonal die-off water chestnut also reduces levels of oxygen in the water, possibly contributing to fish kills. Because of its invasiveness and the severity of its impacts, the species has been listed under the federal regulations that prohibit the interstate sale and transport of noxious plants.[35]

14. Hydrilla (Plant)

Water thyme (*Hydrilla verticillata*, hereafter *Hydrilla)* is considered one of the worst aquatic invasive species in the world. To achieve such notoriety, *Hydrilla* has several features that make it difficult to eradicate. *Hydrilla* grows quickly, sometimes up to an inch a day and can regenerate new plants from broken off fragments, which makes it very easy to spread. The plant survives winter with its tubers and prefers deeper darker locations than other aquatic plants growing 20-30ft long stems. This allows it to establish and then spread along the surface waters, eventually overshadowing shallower waters with its aggressive growth. Similar to water chestnut, *Hydrilla* grows at such a density that it blocks out sunlight and outcompetes all other native plant species. The very thick mats of plant matter eventually settle to the bottom and decompose which can severely reduce dissolved oxygen and suffocate macroinvertebrates on the sediment. In some cases infrastructure has been affected, such as water intakes and power generation facilities.

First established in Florida in the 1950's the plant has spread considerably across the southern US and been found in a select few locations in New York State. The plant prefers freshwater lakes, ponds, rivers, impoundments, and canals. *Hydrilla* was first documented in 2012 in the Niagara River/ Lake Erie Watershed, specifically the Erie Canal section of Tonawanda Creek. The U.S. Army Corp of Engineers and other project partners undertook aggressive action and targeted the invasive species in a demonstration project from 2014-2018 by applying the herbicides endothall (Aquathol K™) and chelated copper (Komeen Crystal™) during the summer months. *Hydrilla* is still present in the canal and continued monitoring and maintenance treatment will be needed.[36]

[35] O'Neill, Jr., Charles R. Feb 2006. Water Chestnut (*Trapa natans*) in the Northeast, NYSG Invasive Species Factsheet Series 06-1

[36] http://hydrillacollaborative.com/Content/Files/Final%20TC%202018%20Post-Treatment%20Assessment%20Report%20(REDUCED).pdf

15. Mugwort (Plant)

Mugwort (*Artemisia vulgaris*) is an aromatic plant native to Eurasia. Like most of the other invasive plant species discussed in this section, mugwort develops into thick stands that can spread quickly, thus outcompeting native species for resources. It is also considered allelopathic, meaning it releases biochemicals that inhibit the growth, germination, or reproduction of other plants nearby. They are currently present in Monroe, Erie, and Cattaraugus counties within Western New York. Ecologist David Spiering (Buffalo Museum of Science) contests that mugwort is the most common non-grass herbaceous species found in post-industrial sites in Erie County and likely inhibiting the succession of these sites to forested communities.

16. Japanese Knotweed (Plant)

Native to eastern Asia, Japanese knotweed (*Fallopia japonica*) was introduced to the US as an ornamental plant in the late 1800's and has since been planted for erosion control and landscape screening. They can be found across the United States, but are most prevalent on the east coast.

Figure 5.23: Young Japanese Knotweed

Japanese knotweed pushes out native plant species with the formation of thick, dense colonies, reducing diversity and impacting wildlife habitat. Japanese knotweed is also considered to be allelopathic. It poses significant threat to riparian lands where it can survive flooding events and rapidly colonize scoured shores and islands. Its established populations are persistent, able to resist cutting by vigorously re-sprouting by the roots. The invasive root system and strong growth can damage concrete foundations, buildings, flood defenses, toads, paving, retaining walls and architectural sites. This plant spreads through its rhizomes, meaning fragments can be easily dispersed by moving soil or being transported downstream during storm events to form new colonies.

Unfortunately, Japanese knotweed is highly prevalent in the Niagara River/Lake Erie Watershed and efforts to remove its colonies have proven difficult for non-professionals. There are no estimates on how much land is inhabited by Japanese Knotweed at this time, though it does

appear to be extremely widespread. It mostly inhabits roadside ditches, recently disturbed soil, and riparian lands.

17. Non-Native Cattails (Plant)

There are two species of non-native cattails in North America, *Typha angustifolia* and *Typha glauca.* They were introduced with European settlers around 1920 and occur in aquatic wetland areas. Although both species can be found, *T. angustifolia* is more prevalent in the Niagara River/ Lake Erie watershed. Additionally, a hybrid of the two species has been confirmed in the watershed.[37]

T. angustifolia invades and displaces native wetland and emergent species by forming dense, monospecific stands that cause the loss of biodiversity in wetlands. They additionally clog drainageways (stormwater infrastructure). Non-native and hybrid cattail pose a potential threat to the ecosystem. Wetlands taken over by these varieties have less biodiversity and lower habitat and wildlife value.

Figure 5.24: Flowering Giant Hogweed (NYSDEC)

18. Giant Hogweed (Plant)

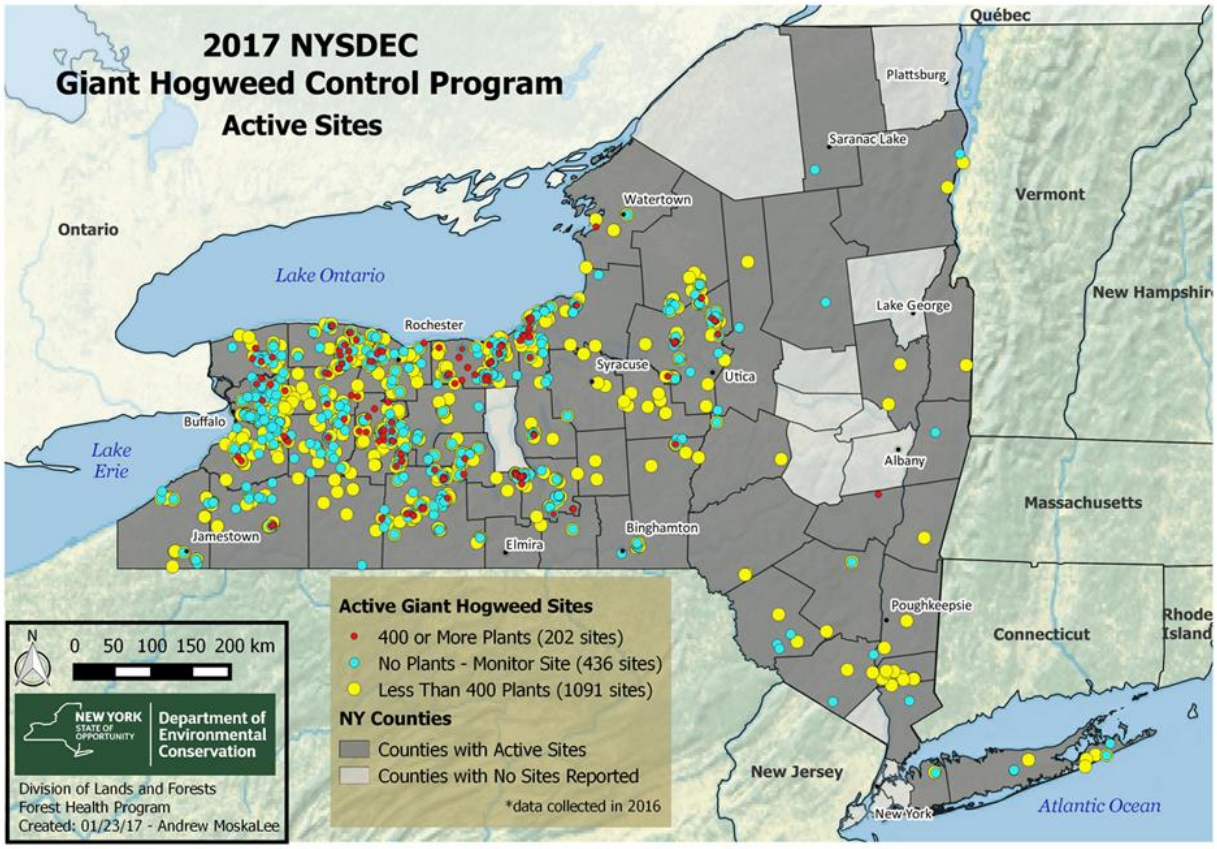
Giant hogweed (*Heracleum mantegazzianum*) is a federally listed noxious weed due to its toxic sap, which in combination with moisture and light can cause severe skin and eye irritation, painful blistering, permanent scarring and blindness.[38] Giant hogweed is native to the Caucasus Mountain region between the Black and Caspian seas and was brought to the US as an ornamental garden plant around 1917.

Tremendous, tight growth patterns, large leaf area, and prolific seed production are all characteristics which allow giant hogweed to outcompete and replace native vegetation. It prefers rich soils in disturbed areas and now grows along streams and rivers and in fields, forest, yards and roadsides. The plant's toxicity creates bare soils beneath them, contributing to shoreline soil erosion through the loss of riparian plants along slopes and stream banks.

[37] https://www.invasive.org/browse/subinfo.cfm?sub=12262
[38] http://www.dec.ny.gov/animals/39809.html

Giant hogweed is quite prolific in Western New York and the Niagara River/Lake Erie Watershed (Figure 5.25).

Figure 5.25: Giant Hogweed in New York State 2017 (NYSDEC)



19. Common Reed (Plant)

The common reed (*Phragmites australis*), also known as *Phragmites*, was introduced to North America by ballast water in the early 1800s. It has since spread to almost every state with the exception of Alaska and Hawaii. An extremely versatile plant, the common reed occurs in disturbed to pristine wet areas including tidal and non-tidal wetlands, brackish and freshwater marshes, riverbanks, shores of lakes and ponds and roadsides and ditches. Disturbances by boat or fish facilitate the spread of this invasive species.

Phragmites forms dense, monotypic stands that consume available growing space, pushing out native species. *Phragmites* is also considered to be allelopathic. Dense beds of *Phragmites* reduce and degrade wetland wildlife habitat, alter wetland hydrology, and increase the potential for fire. Common reed can be found throughout the Niagara River/ Lake Erie Watershed. Because of its

prevalence, *Phragmites* is one of the biggest threats to native communities and water quality in wetland ecosystems.

20. Purple Loostrife (Plant)

Purple loosestrife (*Lythrum salicaria*) is a wetland plant from Europe and Asia. It was introduced and distributed as an ornamental plant, and soon began growing wild along roads, canals and drainage ditches. Like most invasive plants, purple loosestrife thrives on disturbed, moist soils and often invades after some construction activity. Wetland birds carry seeds from gardens and nurseries into wetlands, lakes, and rivers. Once in aquatic systems, moving water and animals easily spread seeds. According to the Ecological Inventory of the Niagara River Gorge and Rim (2010)[39] and New York State Invasive Species Information (2015),[40] Purple loosestrife is already present in the Watershed.

Figure 5.26: Purple Loosestrife colony (Wikimedia)

Purple loosestrife forms dense, impenetrable stands that are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals, thus putting many rare and endangered animals at risk. This species is incredibly resilient to removal. A lack of effective predators has contributed to purple loosestrife's expansion across North America. As a result, several European insects that only attack purple loosestrife are being considered as a possible long-term biological control in North America.

Watershed Ecological Conditions

The *Niagara River Habitat Conservation Strategy* was completed by Buffalo Niagara Riverkeeper in the northern portion of the Niagara River/Lake Erie Watershed for 11 of the 18 sub-watersheds in 2014. The Strategy focuses on the Niagara River Watershed's biological and ecological function with the aim to reset the region's environmental health trajectory away from "poor" and towards "good". Watershed and sub-watershed level habitat-based assessments from the Strategy have been incorporated here, as well as the primary findings, while the "best-bet" conservation opportunities

[39] http://niagara.nypa.gov/RelicensingGreenwayFunds/EcologicalGreenway/NGR_AppendixB.pdf
[40] http://nyis.info/invasive_species/purple-loosestrife/

and action strategies have been incorporated into the overall sub-watershed priorities found in Chapter 8.

One component of the Strategy was to utilize a model called the Active River Area (ARA). Nature Conservancy describes the ARA as: "a conservation framework that provides a conceptual and spatially explicit basis for the assessment, protection, management, and restoration of freshwater and riparian ecosystems. The ARA framework is based upon dominant processes and disturbance regimes to identify areas within which important physical and ecological processes of the river or stream occur. The framework identifies five key subcomponents of the active river area: 1) material contribution zones, 2) meander belts, 3) riparian wetlands, 4) floodplains, and 5) terraces. These areas are defined by the major physical and ecological processes associated and explained in the context of the continuum from the upper, mid and lower watershed in the ARA framework paper. The framework provides a spatially explicit manner for accommodating the natural ranges of variability to system hydrology, sediment transport, processing and transport of organic materials, and key biotic interactions."[41]

Niagara River Watershed Assessment

The Strategy conducted a viability assessment on the Niagara River Watershed based on biodiversity features, such as open water aquatic habitat; wetlands; woodlands; grasslands; and natural areas; as well as selected indicators of these features, such as Biological Assessment Profiles; wetland classification and protections; riparian forest tracts; and contiguous natural areas in excess 150 acres.[42]The evaluations and rankings used in the report reflect The Nature Conservancy's Conservation Action Planning (CAP) model and findings from current research on watershed and ecological health. Key terms and the ranking scale of the viability assessment are provided below:

Assessing Viability of Biodiversity Features

Key Terms:

- **Size:** Abundance of a biodiversity feature or of a species population size.
- **Condition:** Measures of biological composition, structure and biotic integrity. For example, presence of representative or historic native communities or at-risk species.
- **Landscape context:** The environmental and ecological processes that maintain a biodiversity feature and keep it functional. For example, connectivity between natural areas keeps them functional as wildlife corridors.

[41] https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/ED_freshwater_ARA_NE2008.pdf

[42] This is not a comprehensive list of all of the indicators. See the Niagara River Habitat Strategy report for more detailed information. https://bnwaterkeeper.org/projects/habitat/habitat/habitatstrategy/

Ranking Scale:

- **VERY GOOD** - Ecologically desirable status; requires little intervention for maintenance.
- **GOOD** - Indicator within acceptable range of variation; some intervention required for maintenance.
- **FAIR** - Outside acceptable range of variation; requires human intervention.
- **POOR** - Restoration increasingly difficult; may result in extirpation of target.

Niagara River Watershed Baseline Data	
Total size:	903,305 acres
Total waterways:	3,193 miles
Active River Area:	413,541 acres
ARA Wetlands:	52,979 acres or 12.8%
ARA Woodlands:	115,503 acres or 28.2%
ARA Grass/Shrublands:	10,253 acres or 2.5%
ARA and continuous Natural Areas:	349,664 acres or 60% of study area (580,167 acres)
ARA and continuous tracts >150 acres:	291,622 acres or 83%

The following summary offers an overall assessment of health or viability of each biodiversity feature within the Niagara River Watershed. See Table 2.1.

Open Water Aquatic Habitat: POOR - GOOD

- Benthic community health: (2010 RIBS sampling av. plus NHP-TNC Predicted BAP scores) Map 2.2
- Percent of impervious land cover: Map 2.3
- Bed and bank assessments (by sub-watershed only)
- Barriers to migratory fish movement (by sub-watershed only, see Section 4.4)
- Presence of listed plant and animal species
- Nested features: Populations of lake sturgeon, native trout, listed mussel species are stable to increasing

Wetlands: FAIR

- Percent of NYSDEC-regulated compared to total NYSDEC and NWI mapped wetlands: Map 2.4
- Presence of Class 1 wetlands
- Population of listed marsh birds are stable to increasing

Woodlands: FAIR - GOOD

- Acreage (percent) of woodlands in the ARA: Map 2.5
- Number of core forests in unbroken blocks, >500 acres, and >100m from roads
- Amount of functional riparian forest habitat >50 acres and >100m width from stream edge
- Population of listed forest birds are stable to increasing

Grass/Shrublands: POOR

- Percent of acreages in tracts >10 acres: Map 2.6

- Population of listed grassland birds are stable to increasing

Natural Areas in and continuous with the ARA: FAIR

- Percent of ARA and continuous study area
- Number of tracts >150 acres: Map 2.7
- Amount/percent of semi-protected natural area
- Presence of listed bird species requiring large mixed natural areas are stable to increasing

Niagara River Habitat Conservation Strategy Table 2.1 Niagara River Watershed

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **5%**	5.0-7.5 **90%**	7.5-10 **5%**	
	Condition	% impervious surface	>20%	10-20%	5-10% **9%**	<5%	
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79	>80	By sub-watershed only
	Landscape Context	Known barriers to migratory fish species					By sub-watershed only
	Listed mussel species	Populations are stable to increasing	X				Of 27 species 17 are believed to be regionally extirpated
	Native trout	Populations are stable to increasing		X			Stable
	Lake sturgeon	Populations are stable to increasing			X		Increasing
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **33%**	38-50%	>50%	33%
	Condition	Number of Class 1 wetlands					59
	Listed bird species	Populations are stable to increasing	X				Of 8 listed species 5 are decreasing
Woodlands	Condition	Riparian forest tracts: >50 acres & >100m wide, spanning a waterway					354 tracts
	Condition	Core forest: unbroken blocks >500 acres and >100m from a road					110 tracts
	Listed bird species	Populations are stable to increasing		X			Of 13 listed species 3 are decreasing
Grass/ Shrubland	Condition	% of acres in tracts >10 acres	11%				11%
	Listed bird species	Populations are stable to increasing	X				Of 12 listed species 7 are decreasing

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Natural Areas	Size	% of study area (ARA and continuous) with natural cover		<60%	>60% **60%**		349,664a or 60%
	Condition	% of above that is semi-protected	<25%	<50% **27%**	>50%	>75%	27%
		# of tracts >150 acres					324
	Listed bird species	Populations are stable to increasing	X				Of 15 listed species 10 are decreasing

Threats Identification

According to the Strategy, identification of critical threats is an important step in the CAP process that helps to address the factors that most affect the future viability of biodiversity features. The CAP process generally ranks threats in terms of scope, severity, and irreversibility. Those threats that receive the highest ranks are referred to as critical threats and are factored into conservation strategy priorities.

From the Strategy process, a preliminary list of threats was developed from local, regional and Great Lakes studies, and from State assessments like the Natural Heritage Program and the Comprehensive Wildlife Conservation Strategy. The Strategy's list was fine-tuned through public workshops and meetings with local experts, resulting in the top threats for each biodiversity feature within each sub-watershed, which were then evaluated in terms of mitigation feasibility. The results of this threat-identification process are outlined below.

Critical Threats in the Niagara River Watershed

Top-ranked threats to **aquatic habitat** across all sub-watersheds are runoff, erosion and lack of riparian buffers. Runoff from farms, roads and development contribute to eroding stream banks, and increase siltation and pollutant loads—especially where natural vegetated buffers are not present to stabilize banks and filter the runoff.

For **wetlands**, invasive species are a major threat, with roadside management considered a major component, including soil disturbance, spreading of seeds and propagules, and ditching.

For **all terrestrial features**, especially woodlands and wetlands, top-ranked threats are lack of long-term protection and fragmentation from roads, utility corridors and railroad Right of Ways (ROWs).

In the major **upland sub-watersheds** where most large publicly-owned forests and parks are found, lack of ecological management plans is a top-ranked threat.

For **grasslands/shrublands**, loss of acreage and mowing regimes on farm fields and on public lands are ranked highest for their impacts on grassland breeding birds.

Climate change is a threat with widespread scope and severity that is already observable in the watershed. Climate change affects natural cycles including fish spawning and migration, increased damages to property and ecosystems related to more severe storms and temperature changes, and increasing numbers of invasive plant and animal species as their ranges shift northward. Many of the indicators chosen for habitat viability—such as the minimum size for core forests or riparian forest tracts—are directly related to climate change scenarios for the region.

Niagara River Watershed Conservation Objectives

The viability and critical threats analyses of the Niagara River Habitat Conversation Strategy led to an initial identification of conservation objectives for the eleven sub-watersheds within the Niagara River Watershed.

Conservation Objectives

Aquatic habitat:

- Increase stream buffers, especially where connectivity to active floodplains, riparian wetlands or other habitats is enhanced, or where problems with runoff and/or erosion are known to exist.
- Reduce impervious surface—especially in sub-watersheds where impervious surface is >25%.
- Protect and replicate high quality stream segments.
- Reduce stream barriers in areas of known or probable interference with aquatic life.

Wetlands:

- Protect critical wetlands (e.g., bogs, fens, mineral spring wetlands, wetlands hydraulically connected to aquifers, floodplain wetlands, wetlands supporting listed species, etc.).
- Increase the amount of state-regulated wetlands to >50% of total mapped wetlands.
- Conserve, reclaim wetlands/grasslands in quarry siting and reclamation plans.

Woodlands:

- Increase the amount of protected, functional, riparian forest, especially in headwater streams.
- Conserve & increase number and quality of core forest tracts (>500 acres >100m from roads).

Grasslands:

- Increase acreages and habitat values for grassland breeding birds.

Natural Areas:

- Increase protected coverage to >50% of existing natural areas in and continuous with ARA.

Species /communities:

- Conserve and restore habitats supporting New York State-listed fish and wildlife species.

Stewardship:

- Build partnerships with and between municipalities to connect and increase ecological values of coastal zones, stream corridors and other shared habitat features through BMPs and ecology-based planning and zoning regulations.
- Increase conservation of habitat and ecological services at the landscape level to increase habitat viability and resilience to climate change stressors.

Sub-watershed Evaluations

The same evaluation process was applied to the 11 Sub-watersheds which corresponded to the Strategy, beginning with a biodiversity assessment and then a review of the same critical threats of the full watershed. An initial set of conservation objectives for each sub-watershed was also identified by the Strategy. The full sub-watershed assessments from the Niagara River Habitat Conservation Strategy are provided on the following pages.

Since Phase 1, seven additional sub-watersheds have been incorporated into this report (Big Sister, Cattaraugus, Cattaraugus Headwaters, Walnut, Canadaway, Chautauqua and Sixmile). At this time, we do not have the same Conservation Action Planning (CAP) model ranking scores. However, a biodiversity assessment and summary is provided for the additional sub-watersheds. Updating the model to reflect all 18 sub-watersheds may be an important strategy for a more integrated watershed-wide management plan in the near future.

Eighteenmile Creek Sub-watershed

Eighteenmile Creek is a large, meandering stream whose upland forests and spring-fed headwater tributaries are part of a functional landscape providing natural overhanging cover, material contribution and good water quality to the system. Mid-reaches of both the main stream and principal tributary, South Branch, flow through steep-sided, undeveloped, wooded gorges with 70-150 foot high shale cliffs, cold springs and seeps, and talus communities of probable biodiversity significance. The lower half-mile is low gradient, 75-100 feet wide, with a broad floodplain, including potential patches of clayplain forest and/or limestone woodland with abundant swamp white oak.

The Eighteenmile Creek Active River Area has a high percentage of woodland cover (48%) and natural area cover (60%) of the described sub-watersheds. In its mid reaches Eighteenmile Creek has tributary gorges to Lake Erie. The Nature Conservancy ranked Eighteenmile Gorge highest as

a functional landscape based on natural land cover within the gorge, relative lack of dams and diversions, large roadless blocks, and good water quality.[43] The gorge has been designated a "significant fish and wildlife area" by the NYS Coastal Management Program, a "critical environmental area" by the Town of Hamburg, and a "Conservation Park" by Erie County.

Not surprisingly, given the amount and quality of riparian forest, canopy cover and the relatively low overall impervious surface, Eighteenmile Creek also has the highest amount of predicted non-impaired aquatic habitat in the Niagara River Watershed. Stream channels are mainly bedrock with cobble, gravel, sand and silt. Listed species include the northern pygmy clubtail dragonfly (in the headwaters); queen snake and freshwater drum in the lower creek near Lake Erie. From the Eighteenmile Gorge at the fork of the main and south branches downstream to the mouth, the creek has extensive public fishing access areas, known for its steelhead and smallmouth bass runs in the spring.

Conservation potential is high in this sub-watershed. Less than 20% of the riparian forest is protected. The top ranking matrix forest, Fowlerville Forest is entirely privately owned. Three upland county forests, totaling over 600 acres are not explicitly managed for ecological values. Undeveloped county parks, including Eighteenmile Gorge and the 90-acre Shale Creek natural area adjacent to Chestnut Ridge County Park contain fragile areas that will benefit from trail re-routing or other public access management strategies.

Municipalities: Towns of Hamburg, Eden, Evans, North Collins, Orchard Park, Boston, Colden, and Concord; Village of Hamburg

Total waterways: 274 miles including South Branch, Newman Creek, and Hampton Brook
Total sub-watershed: 76,843 acres

Biodiversity features by percent of ARA[44] land cover:

- ARA: 18,547 acres or 24% of sub-watershed
- Wetlands (NOAA): 1,596 acres or 9%
- Woodlands: 8,922 acres or 48%
- Grass/Shrublands: 629 acres or 3%
- Natural Areas (% of ARA and continuous land that is natural): 37,245 acres or 84% of study area

Viability assessment: (amount, condition, connectivity) Table 3.1

- Aquatic habitat: **GOOD**
- Wetlands: **FAIR**

[43] Hunt D.M., Edinger G.J., Schmid J.J., Evans D.J., Novak G., Olivero A.E., & S.M. Young 2002. Lake Erie Gorges Biodiversity Inventory and Landscape Integrity Analysis. New York Natural Heritage Program, Albany, NY.
[44] Denotes geographical Active River Area

- Woodlands: **GOOD**
- Grass/Shrublands: **POOR**
- Natural areas: FAIR – **GOOD**

Threats:

- Aquatic habitat: Erosion/sedimentation (lack of riparian buffers); runoff; fish barriers
- Wetlands: Loss of acreage; invasive species (road management practices)
- Woodlands: Lack of ecological management plans; lack of protection
- Grasslands: Management practices on agricultural and public lands
- Natural areas: Lack of protection; fragmentation (utility, roads, rail)

Conservation Strategies:

- Assess state, county, municipal and other public lands and management plans for opportunities to increase ecological function and biodiversity values
- Identify large and/or connecting headwater forest tracts for acquisition or easements
- Promote natural buffers for erosion control for high quality aquatic habitats like South Branch
- Partner with municipality, Natural Resource Conservation Service (NRCS), and/or angler groups to remove/remediate barriers to flow and fish movement

Niagara River Habitat Conservation Strategy Table 3.1 Eighteenmile Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **1%**	5.0-7.5 **89%**	7.5-10 **10%**	
	Condition	% impervious surface	>20%	10-20%	5-10%	<5% **3.5%**	
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **51**	60-69	70-79 **75,77**	>80	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y – trout spp**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **26%**	38-50%	>50%	**704a / 2,754a**
	Condition	Number of Class 1s					**1**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Woodlands	Condition	Functional riparian forest: >50 acres and >100m wide					**28 tracts (20,531a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**15 tracts (12,270a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	11.4%				**11.4%**
Natural Areas	Size	% of study area (ARA and cont.) that is natural cover		<60%	>60% **84%**		**84%**
	Condition	% semi-protected	<25% **17%**	<50%	>50%		**17%**
	Condition	Number of tracts >150 acres					**31 tracts**

Buffalo River Sub-watershed

The Buffalo River sub-watershed varies across ecoregions—from high quality upland forests and streams down to the urban-industrial corridor and AOC section approaching Lake Erie. Headwaters include the East and West Branches of Cazenovia Creek, which rise in the Towns of Sardinia and Concord respectively, and flow northwest to join in the Village of East Aurora. This sub-watershed has 31 tracts of riparian forest greater than 50 acres in size and at least 100 meters in width from water's edge, and 49 tracts of unbroken core forest greater than 500 acres. The cool, well-oxygenated Buffalo River headwaters support trout and other aquatic communities of statewide significance,[45] however they have many barriers limiting fish passage.

The industrialized lower six miles of the Buffalo River was designated a Great Lakes AOC in 1987, primarily due to contaminated sediments from the steel and chemical industries that once lined the river. Most of these sediments have been removed. However, while the shoreline transitions away from industrial uses, the lower river itself remains a federally-designated navigation channel and is subject to dredging to maintain a depth of 22 feet. Today, although 48 fish species are found in the river system, including 6 listed species, the dredged zone is likely a low oxygen barrier to walleye and other species attempting to migrate upstream to spawn. The sub-watershed as a whole is 11.9% impervious surface or "fair" for aquatic habitat with most of that occurring in the lake plain. Wetlands protection is relatively high at 41% and includes six listed marsh bird species.

[45] Hunt D.M., Edinger G.J., Schmid J.J., Evans D.J., Novak G., Olivero A.E., & S.M. Young 2002. Lake Erie Gorges Biodiversity Inventory and Landscape Integrity Analysis. New York Natural Heritage Program, Albany, NY.

This sub-watershed also includes about four miles of Lake Erie shoreline and a few semi-protected habitats inside the harbor break walls such as Times Beach, Bell Slip and Tifft Nature Preserve with its remnant of what was once one of the most extensive and productive coastal marshes on Lake Erie. These areas still play an important role in the life cycles of many resident and migratory fish and bird species, including lake sturgeon, and nesting colonies of terns and gulls. Several conservation strategies already exist for these habitats through the Buffalo and Niagara River RAPs, the Niagara River Globally Important Bird Area, and Great Lakes Fishery Commission fish community objectives.

In terms of acreage, the greatest habitat conservation opportunities in this sub-watershed lie in the publicly-owned or otherwise protected upland landscapes, including several Erie County forests, the botanically-rich Protection Bog, eight NYSDEC Class 1 wetlands, and recreational lands such as parks and ski resorts which have potential to enhance ecological values while still accommodating recreational uses. Two large grassland areas—the state-owned Knox Farm and Erie County owned Sprague Brook Park—are good candidates for management plans and practices in support of grassland breeding birds.

Municipalities: City of Buffalo; Villages of East Aurora and Sloan; Towns of West Seneca, Elma, Aurora, Colden, Holland, Concord, Cheektowaga, Boston, Wales and Sardinia

Total waterways including Buffalo River, Cazenovia Creek: 312 miles
Total sub-watershed: 105,392 acres

Biodiversity features by percent of ARA land cover:

- ARA: 23,838 acres or 23% of sub-watershed
- Wetlands (NOAA): 2,036 acres or 8.61%
- Woodlands: 9,130 acres or 39%
- Grass/Shrublands: 770 acres or 3%
- Natural Areas
  (% of ARA and continuous natural tracts):
  52,468 acres or 82% of study area

Viability assessment: (amount, condition, connectivity) Table 3.2

- Aquatic habitat: FAIR – **GOOD**
- Wetlands: FAIR – **GOOD**
- Woodlands: **GOOD**
- Grasslands: **POOR**
- Natural Areas: **FAIR** – **GOOD**

Threats:

- Aquatic: Lack of riparian buffers; barriers to fish movement; channelization (lower river)
- Wetlands: Loss of acreage; highway department practices (spreading invasives/ditching)
- Woodlands: Lack of ecological management plans; lack of protection (land clearing)
- Grasslands: Mowing (agricultural practices); management practices on public lands
- Natural areas: Lack of protection; Fragmentation/Loss of connectivity

Conservation strategies:

- Assess public lands and management plans for opportunities to increase ecological values
- Partner with municipalities, Trout Unlimited (TU), NRCS to remove/remediate barriers to flow and fish movement
- Grasslands/wetlands: Assess large tracts for habitat values and opportunities for conservation of at-risk species
- Lower river and lakeshore: support ongoing shoreline, channel and floodplain conservation efforts

Niagara River Habitat Conservation Strategy Table 3.2 Buffalo River

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0	5.0-7.5	7.5-10	
	Condition	% impervious surface	>25%	10-20% **11.9%**	5-10%	<5%	**11.9%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **56, 57**	60-69	70-79	>80 **85**	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **41%**	>50%	**1,443a /3,524a**
	Condition	Number of Class 1s					**8**
Woodlands	Condition	Functional riparian forest: >50 acres and >100m wide					**31 tracts 38,622 acres**
	Condition	Core forest: unbroken blocks >250 acres, >100m from road					**24 >250a (8,468a) 25 >500a (22,662a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**8.12%**	<50%	>50%		**8.12%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60%	>60% **82%**	82%	**82%**
	Condition	% semi-protected	**<25%**	<50%	>50%		**10%**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Condition	Number of tracts >150 acres					**20 tracts**

Buffalo Creek Sub-watershed

Buffalo Creek has many miles of high quality trout streams within the headwaters. Six NYSDEC Class 1 wetlands occur in the source areas; several are hydraulically connected to the underlying aquifer and support heritage strains of brook trout. Queen snake and two listed species of freshwater mussel, fragile papershell and slippershell, are found in mid-reaches, plus several pocketbook mussel were observed there in 2013, although they are listed as locally extirpated.[46]

Upland and mid-reaches have significant tracts of natural land, including three county forests plus the 384-acre Beaver Meadow Audubon Center and the 789-acre Hunter's Creek County Park. Almost 80% of the ARA and adjacent land is capable of supporting at least eight listed bird species, which require large, mixed-cover natural areas to survive and breed. However, only 16% of this land is semi-protected, therefore the natural area may potentially decline without additional protection status

The sub-watershed includes 44 tracts of riparian forest, 39 tracts of core forest larger than 500 acres, and six reported species of listed woodland birds, plus several others observed but not yet documented in the state records. Wetlands are also an important feature in this sub-watershed which includes three rare wetland communities as well as the kettle pond wetlands of Beaver Meadow and the County-owned Protection Bog, subject of several botanical studies.

Given the sprawl that has taken place in the lower Buffalo Creek basin, and the growing awareness of the municipalities and local groups of the value in their natural assets, this sub-watershed offers good opportunity for partnerships in stream corridor, floodplain and farmland conservation.

Municipalities: Towns of West Seneca, Elma, Marilla, Bennington, Aurora, Wales, Sheldon, Holland, Java, Sardinia, and Arcade

Total waterways: Hunters Creek and Pond Brook tributaries: 354 stream miles
Total sub-watershed: 93,165 acres

Biodiversity features by percent of ARA land cover:

- ARA: 22,944 acres or 5.5% of sub-watershed
- Wetlands (NOAA): 2,329 acres or 10%
- Woodlands: 9,168 acres or 40%

[46] http://www.dec.ny.gov/animals/30483.html

- Grass/Shrublands: 868 acres or 4%
- Natural Areas (% of ARA and continuous tracts in natural cover): 38,894 acres or 79% of study area

Viability assessment: (amount, condition, connectivity) Table 3.3

- Aquatic habitat: **GOOD**
- Wetlands: **GOOD**
- Woodlands: **GOOD**
- Grass/Shrublands: **POOR**
- Natural areas: FAIR – **GOOD**

Threats:

- Aquatic: Lack of riparian buffers/erosion; barriers to fish movement; loss of headwater spring connectivity and quality
- Wetlands: Loss of acreage; highway department practices (spreading/ditching)
- Woodlands: Lack of ecological management plans; lack of protection
- Grasslands: Mowing (agricultural practices); management practices on public lands
- Natural Areas: Lack of protection; fragmentation (utility, roads, rail)

Conservation strategies

- Aquatic: Identify opportunities to build on mid and upper watershed town partnerships for stream corridor, floodplain and farmland conservation (Elma, W. Seneca, Marilla, etc.)
- Aquatic: This is a priority sub-watershed for work with NYSDEC, TU and other partners on improving trout habitat including barrier remediation (upper tributaries)
- Wetlands: Identify areas where headwater spring and wetlands protection is most critical and feasible (e.g. Beaver Meadow, Protection Bog)
- Forests: Identify conservation opportunities on county forest and park land
- Parks: Identify practices to conserve ecological values in county and town parks

Niagara River Habitat Conservation Strategy Table 3.3 Buffalo Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **5%**	5.0-7.5 **92%**	7.5-10 **3%**	
	Condition	% impervious surface	>20%	10-20%	5-10% **3.8%**	<5%	**3.8%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **47**	60-69 **67, 6.13**	70-79 **74, 70**	>80	

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Landscape Context	Known barriers to native migratory fish species					**Y – trout**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**# & status**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **34%**	38-50%	>50%	**1,240a / 3,683a**
	Condition	Number of Class 1s					**7**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**44 tracts (24,373 a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**12 tracts (10,455a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**8.63%**	<50%	>50%		**8.63%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60%	>60% **79%**		**79%**
	Condition	% semi-protected	<25% **16%**	<50%	>50%		**16%**
	Condition	Number of tracts >150 acres					**39 tracts**

Cayuga Creek Sub-watershed

Cayuga Creek has just under half of its land area in the Cattaraugus Hills ecoregion (48%). The remaining Erie/Ontario Lake Plain and Lowlands are comparatively developed. Predicted BAP scores are correspondingly lower, with 17% of the stream miles considered "moderately impacted." Silt, sedimentation and high water temperatures related to stream bank erosion, storm runoff and lack of canopy are suspected of stressing fisheries in segments of Cayuga Creek in Cheektowaga.

The 1993 Buffalo River RAP baseline habitat study recommended using the creek upstream from its confluence with Buffalo Creek to the county-owned Overflow Retention Facility (ORF) as an AOC reference area for aquatic habitat restoration, as this stretch appears to be the least manipulated of the three lower tributaries. Stream bank cover, natural shoreline, boulders, pools, riffles and snags provide conditions suitable for many native fish. Four listed fish species: northern brook lamprey, Iowa darter, bigeye chub, longear sunfish; and four listed mussel species are reported.

Little Buffalo Creek, Cayuga Creek's main tributary, contains many reaches of adequate aquatic habitat, which would be improved if homeowners maintained or restored vegetated buffers along the banks. Dams, including one at Como Lake and another a mile upstream on Little Buffalo Creek, may impede movement and reproduction of native aquatic species as well as steelhead stocked in Cayuga Creek below the dam and brown trout stocked in Little Buffalo Creek above the dam.

Invasive species like Japanese knotweed are pervasive along lower Cayuga Creek. Of the 4,779 acres of mapped wetlands, only 1,082 or 23% are regulated by the NYSDEC. One listed marsh bird species, one listed wetland plant, and three listed grassland bird species are recorded. The 280-acre Reinstein Woods State Nature Preserve contains a unique 80-acre forest of old growth cherry, sugar maple and beech.

The Town of Cheektowaga has designated its freshwater wetlands, Cayuga Creek and its 100-year floodplain, Reinstein Woods Preserve and its surrounding 400-foot buffer, and Stiglemeier Town Park as Critical Environmental Areas (CEAs), providing greater protection against development incursions. Aside from these CEAs and Como Lake County Park, natural areas in the Cayuga Creek ARA are mainly privately owned, with only 12% semi-protected. A conservation overlay district along Cayuga and Little Buffalo Creek could help set up a review process to encourage best management practices designed to reverse degradation trends and benefit habitat and stream function over time.

Municipalities: Towns of Cheektowaga, Lancaster, Alden, Elma, Marilla, Bennington, Darien, Sheldon; Villages of Lancaster and Depew
Total waterways including Little Buffalo, Slate Bottom, Plum Bottom Creeks: 356 stream miles
Total sub-watershed: 81,385 acres

Biodiversity features by percent of ARA land cover:

- ARA: 33,037 acres or 41% of sub-watershed
- Wetlands (NOAA): 2,545 acres or 8%
- Woodlands: 12,247 acres or 37%
- Grass/Shrublands: 1,128 acres or 3%
- Natural Areas (% of ARA and continuous with natural land cover): 32,758 acres or 66% of study area

Viability assessment: (amount, condition, connectivity) Table 3.4

- Aquatic habitat: **FAIR** – **GOOD**
- Wetlands: **FAIR**
- Woodlands: **FAIR** - **GOOD**
- Grass/Shrublands: **POOR**
- Natural areas: **POOR** – **FAIR**

Threats:

- Aquatic: Lack of buffers; runoff: agricultural and residential; barriers to fish movement

- Wetlands: Loss of acreage; invasive species (road management practices)
- Woodlands: Lack of protection; lack of ecological management plans
- Grass/Shrublands: Management practices on agricultural and public lands
- Natural areas: Lack of protection; fragmentation

Conservation strategies:

- Policy: Pursue stream corridor conservation planning with neighboring municipalities
- Remove or modify known barriers to fish spawning
- Use "Very Good" micro-scale reference sites for restoration, including: Cayuga upstream from confluence w/ Buffalo Creek to ORF, Little Buffalo Creek segments, and Reinstein Woods.

Niagara River Habitat Conservation Strategy Table 3.4: Cayuga Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **17%**	5.0-7.5 **73%**	7.5-10 **11%**	
	Condition	% impervious surface	>20%	10-20%	5-10% **6.4%**	<5%	**6.4%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60 **42**	60-69	70-79 **76**	>80 **85**	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y (but not listed)**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25% **23%**	25-37%	38-50%	>50%	**1,082a / 4,779a**
	Condition	Number of Class 1s					**6**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**42 (20,756 a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**10 tracts (6,570a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**11.2%**	<50%	>50%		**11.2%**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Natural Areas	Size	% study area in natural cover		<60%	>60% **65.8%**		**65.8%**
	Condition	% semi-protected	**<25%**	<50%	>50%		**12%**
	Condition	Number of tracts >150 acres					**35 tracts**

Upper Tonawanda Creek Sub-watershed

The Upper Tonawanda sub-watershed is almost equally divided between the Cattaraugus Hills and Ontario Lowlands ecoregions (57% and 42%, respectively). From its source in the Towns of Wethersfield and Java, the creek flows north through the Towns of Alexander and Batavia where the terrain levels out and the active floodplain broadens. The main branch, Little Tonawanda Creek, joins Tonawanda in the Town of Batavia. At the City of Batavia, the Onondaga Escarpment blocks further flow north and the creek turns west towards the Niagara River. The confluence with another tributary, Bowen Creek, marks the northwestern boundary of the Upper Tonawanda Creek sub-watershed.

Aquatic habitat, based on the actual and predicted health of the benthic macroinvertebrate community, is slightly impacted to non-impacted in the upland reaches of Tonawanda Creek and its tributaries. Two listed species of freshwater mussels are recorded, including one in Little Tonawanda. Naturalized trout species are found in the cool waters upstream from Route 20A, although barriers like stranded culverts interfere with some trout movement. Overall, good quality aquatic habitat is supported by the fact that only about 3.3% of the basin has impervious land cover. Most of that occurs around the City of Batavia, where the benthic community is moderately impacted. Downstream from Batavia, Tonawanda Creek and its tributaries are mainly warm water streams due to urban runoff and lack of buffering.

The 4,442 acres (110 tracts) of NYSDEC-regulated wetlands represent about half the potential for wetland conservation. Wetlands are at the source of many small tributary headwaters, and are a major land cover in the Towns of Alexander and Batavia. NHP identifies three significant wetland communities including red maple-tamarack and hemlock-hardwood peat swamps and a rich sloping fen. Nine of the NYSDEC wetlands are Class 1s, including one on the highest hill in Wyoming County connected to a glacial aquifer that is the source of Tonawanda, Cayuga, and Buffalo Creeks.

Almost 30,000 acres of riparian and continuous woodlands larger than 50 acres indicate good potential for conserving stream buffers and habitat. The Natural Heritage Program (NHP) notes a functional floodplain forest at the headwaters of Little Tonawanda. Carlton Hill is a good example of a large natural upland area that provides critical cover, filtration and material

contribution to first and second order streams. The Faun Lake area, official source of Tonawanda Creek, is another. Implementation of headwater stream stewardship principles (Meyer, 2003) could improve ecological values at these sites and throughout the watershed.

Municipalities: Towns of Batavia, Stafford, Alexander, Bethany, Bennington, Attica, Middlebury, Sheldon, Orangeville, Java, Warsaw, Darien, and Wethersfield; City of Batavia; Villages of Attica and Alexander

Total waterways including Tannery, Stony Brooks; Little Tonawanda, Crow, Bowen Creeks: 589 miles
Total sub-watershed: 127,308 acres

Biodiversity features by percent of ARA cover:

- Active River Area: 41,994 acres or 33% of sub-watershed
- Wetlands (NOAA): 4,813 acres or 12%
- Woodlands: 12,820 acres or 31%
- ARA Grass/Shrublands: 2,141 acres or 5%
- ARA and continuous Natural areas: 50, 723 acres or 70% of study area

Viability assessment: (amount, condition, connectivity) Table 3.6

- Aquatic habitat: **GOOD**
- Wetlands: **GOOD**
- Woodlands: **GOOD**
- Grass/Shrublands: **POOR**
- Natural Areas: **FAIR**-**GOOD**

Threats:

- Aquatic: Lack of riparian buffers; agricultural runoff; barriers to fish movement
- Wetlands: Loss of acreage; road management practices
- Woodlands: Lack of protection; lack of ecological management plans (invasives; overbrowsing)
- Grasslands: Management practices on agricultural and public lands
- Natural areas: Lack of protection; fragmentation (roads, utility corridors)

Conservation strategies:

- Assess opportunities for headwater stewardship within and across sub-watersheds
- Aquatic: Analyze highest BAP score sites for reference conditions to conserve/replicate
- Remediate culverts impeding trout movement
- Wetlands: Assess potential impacts and reclamation strategies for stone, sand and gravel quarries
- Woodlands: Identify opportunities to conserve/restore riparian buffers based on critical areas of need
- Natural Areas: Identify best bet opportunities (size, ownership) to acquire easements on active floodplains (Alexander)

Niagara River Habitat Conservation Strategy Table 3.5: Upper Tonawanda

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **4%**	5.0-7.5 **92%**	7.5-10 **4%**	
	Condition	% impervious surface	>20%	10-20%	5-10%	<5% **3.3%**	**3.3%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79 **79**	>80	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y – trout spp.**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **47%**	>50%	**4,742a / 10,094a**
	Condition	Number of Class 1s					**9**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**66 tracts (29,763a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**13 tracts (9,061a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**16.9%**	<50%	>50%		**16.9%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60%	>60% **70%**		**70%**
	Condition	% semi-protected	<25%	**<50%**	>50%		**27%**
	Condition	Number of tracts >150 acres					**57 tracts**

Middle Tonawanda Creek Sub-watershed

From the City of Batavia to the Village of Pendleton, Middle Tonawanda Creek includes parts of seven towns and the Tonawanda Seneca territory. Its northern border is formed by the Niagara

Escarpment and its southern, in part, by the Onondaga Escarpment which the creek crosses at Indian Falls. In the 20-mile stretch from Indian Falls downstream to the Village of Pendleton, where the creek meets the Barge Canal, Tonawanda Creek's broad floodplain and many wetlands are a remnant of glacial Lake Tonawanda. New York's Freshwater Blueprint program recognizes this wetland-floodplain complex as "a critical area for floodplain protection and restoration" based on the presence of a large active floodplain adjacent to core patches of wetland, grassland and forest. These patches include parts of the 20,000-acre Alabama Swamp including the State Tonawanda Wildlife Management Area.

The Middle Tonawanda sub-watershed has approximately twice as much wetland (20% of the ARA land cover) as all the other sub-watersheds in the watershed except Murder Creek. Of the federally mapped and state regulated wetland acreage, 56% is State regulated, including 24 large (>100 acre) tracts and four Class 1 wetlands.

According to a 1998 survey, Middle Tonawanda's freshwater mussel population is regionally significant with 19 species recorded below Indian Falls,[47] including several NYS-listed species. Other protected aquatic species here include redfin shiner, black redhorse, and longear sunfish. However, in terms of aquatic habitat, Middle Tonawanda Creek is nearing the threshold of impaired uses. These impairments are caused by a variety of threats including increasing pollution from agricultural and residential runoff and lack of buffering.[48] The amount of stream predicted to be moderately impaired is about the same as the amount slightly impaired, based on these NYSDEC RIBS benthic macroinvertebrate profiles. Freshwater mussels such as those in the Unionidae family may be most affected of macroinvertebrates due to their very specific dispersal strategy. They attach onto fish in a larval parasitic life stage (glochidium stage), then detach from the fish, attach to substrate and enter the juvenile life stage. Certain mussels have high host-specificity, and can live up to 40 years. However, dams and flow alterations may prevent movement of the host fish and consequently, native mussel dispersion. Therefore, the presence of an adult mussel does not necessarily indicate reproducing populations; particularly if fish passageways have been blocked in recent years.

At least five listed grassland bird species breed in the area, though grassland cover is less than 1%. Large natural areas of mixed native vegetation support species like Northern Harrier, Short-eared Owl and Henslow's Sparrow. Patches of lupine support three state-protected butterfly species in this area.

Conservation opportunities in this sub-watershed include in-filling, connecting and protecting unique riparian natural feature complexes such as the thousand-acre Tonawanda wetland-

[47] Marangelo, P.J. and D.L. Strayer. 2000. The freshwater mussels of the Tonawanda Creek basin in western New York. Walkerana, 11(25): 97-106.

[48] New York State Department of Environmental Conservation (NYSDEC), New York State's Waterbody Inventory and Priority Waterbodies List (WI/PWL) Basin Report, 2010

floodplain complex and unique features like the Onondaga Escarpment, with its rare limestone-loving plants.

Municipalities/Governments: Tonawanda Seneca Nation, Towns of Lockport, Royalton, Alabama, Clarence, Newstead, Pembroke, Shelby and Batavia

Total waterways including principal tributaries Mud and Beeman Creek: 331 miles
Total sub-watershed: 79,116 acres

Biodiversity features by percent of ARA cover:

- ARA: 60,859 acres or 80% of sub-watershed
- Wetlands (NOAA): 11,978 acres or 20%
- Woodlands: 14,781 acres or 24%
- Grass/Shrublands: 762 acres or 1%
- Natural areas (ARA and continuous): 30,609 acres or 49% of study area

Viability assessment

- Aquatic habitat: **FAIR-GOOD**
- Wetlands: **GOOD**
- Grass/Shrublands: **POOR**
- Woodlands: **FAIR**
- Natural Areas: **GOOD**

Threats

- Aquatic: Lack of riparian buffer, runoff
- Wetlands: Loss of acreage; highway department practices (spreading invasives, ditching)
- Woodlands: Fragmentation, lack of protection (invasive species, overbrowsing)
- Grasslands: Management practices on agricultural and public lands
- Natural areas: Fragmentation, loss of acreage

Conservation Strategies

- Aquatic: Identify good reference areas for benthic/mussel habitat conservation and restoration
- Identify acquisition, easement, and/or best management opportunities for stream buffering
- Grasslands: Identify priority tracts for conservation within Tonawanda Creek floodplain complex
- Woodlands: Identify opportunities to conserve and connect Onondaga Escarpment parcels

Niagara River Habitat Conservation Strategy Table 3.6: Middle Tonawanda

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **51%**	5.0-7.5 **49%**	7.5-10	
	"	% impervious surface	>20%	10-20%	5-10%	<5% **3.4%**	**3.4%**
	"	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69 **63**	70-79	>80 **80**	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50%	>50% 56%	**8,455a / 15,595a**
	"	Number of Class 1s					**4**
Woodlands	Condition	Riparian forest tracts: >50a and >100m wide, spanning a waterway					**31 tracts (14,490a)**
	"	Core forest: unbroken blocks >500 acres, >100m from road					**9 tracts (6,170a)**
Grass/Shrublands	Condition	% of acreage in tracts >10a	**1.4%**	<50%	>50%		**1.4%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **49%**	>60%		**49%**
	Condition	% semi-protected	<25%	<50%	**>50%**		**59%**
		Number of tracts >150a					**26 tracts**

Lower Tonawanda Creek Sub-watershed

From the Village of Pendleton to its mouth on the Niagara River, the last 11.6 miles of Tonawanda Creek is channelized and dredged to a width of 75 feet and a depth of 12 feet to accommodate the Erie Canal. From April through November, a lock diverts Lower Tonawanda Creek to flow backward approximately 19 miles northeast through the canal to Lockport. The Erie Canal channelization and flow reversal regime limits habitat connectivity between the Niagara River and Tonawanda Creek, its main tributary, and has likely impaired aquatic biodiversity in both systems. Flow reversals also affect water temperatures and may be responsible for periodic fish die-offs in the creek.

Biological and channel assessments show Lower Tonawanda tributaries to be moderately impaired, with lack of stream cover, lack of water clarity, and lack of aquatic vegetation affecting many segments of Ransom, Bull, and Gott Creeks. The lack of mussel species below Pendleton is likely an impact of the Erie Canal. Upstream from Pendleton, Lower Tonawanda Creek is similar to Middle Tonawanda Creek in that both receive high (non-impacted) BAP scores, and include many listed aquatic species including redfin shiner, black redhorse, and eight species of native mussels. Most notably, however, this is the only waterway in New York that hosts self-sustaining populations of the NYS threatened longear sunfish, in the stretch just before the Erie Canal.[49]

The NYSDEC regulates about 5,000 acres of wetlands or 37% of the state regulated and federally mapped wetlands in the Lower Tonawanda ARA. These 51 tracts include eight Class 1 wetlands including three near the source of Ransom Creek that are hydraulically connected to the Onondaga Aquifer, a high quality limestone aquifer whose northern border is the Onondaga Escarpment. Several crushed stone quarries along the escarpment have historically influenced water well yields as have surface water channelizations that rerouted streams away from aquifer recharge areas.[50] Listed species associated with this escarpment-aquifer-wetland habitat include Pied-billed Grebe, Sedge Wren, Upland Sandpiper and Swamp Lousewort.

Conservation opportunities include outreach and education on mitigating the habitat impacts of the Erie Canal including native buffers and shallow water habitat improvements; working with willing quarry owners on habitat-enhancing design and implementation for quarry reclamations; and working with towns and land conservancies to target high quality riparian parcels for protection or acquisition.

Municipalities: Towns of Cambria, Lockport, Wheatfield, Pendleton, Clarence, Amherst, Lancaster, and Newstead, City of North Tonawanda and Lockport.

Total waterways including Bull and Sawyer Creeks, Erie Canal, Black, Gott, and Ransom Creeks: 217 miles
Total sub-watershed: 78,802 acres

Biodiversity features by percent of ARA land cover:

- Active River Area: 62,938 acres or 79% of sub-watershed
- Wetlands (NOAA): 7,698 acres or 12%

Woodlands: 15,092a or 23.9%

- Grass/Shrublands: 1,142 acres or 2%
- Natural areas (% of ARA and continuous that has natural cover): 23,932 acres or 41% of study area

[49] NYSDEC Fish Atlas Maps of New York
[50] Staubitz, W.W. and Miller, T.S., 1987, Geology and hydrology of the Onondaga aquifer in eastern Erie County, New York, with emphasis on ground-water-level declines since 1982: U.S. Geological Survey Water-Resources Investigations Report 86-4317, p.44

Viability assessment: (amount, condition, connectivity) Table 3.7

- Aquatic habitat: **FAIR**
- Wetlands: **FAIR-GOOD**
- Grass/Shrublands: **POOR**
- Woodlands: **FAIR**
- Natural Areas: **FAIR**

Threats:

- Aquatic: Lack of riparian buffers; runoff; channelization (invasives)
- Wetlands: Loss of acreage; Highway department practices; hydrologic alterations
- Woodland: Lack of protection; fragmentation
- Grasslands: Management on public lands; invasive species (loss of native vegetation)
- Natural areas: Fragmentation; invasive species

Conservation strategies:

- Aquatic: Identify best public land opportunities (Canal Corps; T's of Amherst & Pendleton) for naturalizing/buffering shoreline or increasing wetland values between Veterans Park & Pendleton.
- Wetlands/grasslands/groundwater: Assess Tillman Swamp as a reference area for wetland habitat
- Natural Areas: Assess conservation easement opportunities with interested private owners.

Niagara River Habitat Conservation Strategy Table 3.7: Lower Tonawanda

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **77%**	5.0-7.5 **23%**	7.5-10	
	Condition	% impervious surface	>20%	10-20%	5-10% **8.4%**	<5%	**8.4%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79	>80	**N/A**
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **37%**	>50%	**4,688a / 12,683 a**
	Condition	Number of Class 1s					**8**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**24 tracts (8,274a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**2 tracts (1,134a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	<25% **20%**	<50%	>50%		**20%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **41%**	>60%		**41%**
	Condition	% semi-protected	<25%	<50% **44%**	>50%		**44%**
	Condition	Number of tracts >150 acres					**36 tracts**

Murder Creek Sub-watershed

Murder Creek is the major tributary to Middle Tonawanda Creek, with its mouth about two miles downstream from the western boundary of Tonawanda Seneca territory. The two sub-watersheds share many characteristics. In both, over half of the Active River Area has natural land cover evenly divided between forest and wetland. A major difference is in the amount of natural area that is protected. Only 29% of the Murder Creek ARA and continuous natural area is protected, compared with 63% of the Middle Tonawanda ARA. Murder Creek has fewer state-protected wetlands, no wildlife management areas, and only one major habitat preserve, Counterfeiter's Ledge on the Onondaga Escarpment.

NYSDEC RIBS assessments find Murder Creek's aquatic habitat to be moderately impacted, with urban and industrial contaminants found in the reach between Corfu and Akron. However, predicted BAP scores for most of the creek and its main tributary, Ledge Creek, are good, or slightly impacted. As a C(t) classified stream with a Class 1 wetland at its source, Ledge Creek may be a priority for aquatic habitat conservation. Only three recent records of living native mussel species occur in the sub-watershed, including one at Ledge Creek.[51]

[51] Marangelo, P. J. and D. L. Strayer, *The Freshwater Mussels of the Tonawanda Creek Basin in Western New York*, Walkerana, 2000, 11(25): 97-106.

Of the federally mapped and state-regulated wetland acreage, 50% is state-protected, with three tracts greater than 500 acres. The NHP lists no protected wetlands species. The Spring Marsh created wetlands complex along Ledge Creek at Koepsel Road was field assessed and rejected as a possible reference area for wetlands habitat restoration. A Class 1 wetland (AT-4) at the headwaters of Murder Creek in the Town of Bennington partially supplies the Attica Reservoir, a public drinking water supply.

Historic (NHP) woodland communities and plants are associated with the Onondaga Escarpment and provide some good connectivity along the Pembroke Creek tributary, with opportunity to link core forest areas. Non-native invasive species, illegal dumping and ATV use negatively impact the potential habitat value of these corridors.

Municipalities: Tonawanda Seneca Nation; Towns of Newstead, Pembroke, Darien, Alexander, Batavia, Bennington; Villages of Akron and Corfu.

Total waterways: including principal tributaries Ledge Creek, Pembroke, Darien: 222 miles
Total sub-watershed: 46,686 acres

Biodiversity features by percent of ARA land cover:

- ARA: 27,533 acres or 59% of sub-watershed
- Wetlands (NOAA): 6,794 acres or 25%
- Woodlands: 7,190 acres or 26%
- Grass/Shrublands: 446 acres or 2%
- Natural areas: 14,431 acres or 53% of ARA
- ARA and continuous Natural areas: 19,586 acres or 60% of study area

Viability assessment: (amount, condition, connectivity) Table 3.8

- Aquatic habitat: **GOOD**
- Wetlands: **GOOD**
- Woodlands: **FAIR** – **GOOD**
- Grass/Shrublands: **POOR**
- Natural Areas: FAIR - **GOOD**

Threats:

- Aquatic: Lack of riparian buffers; runoff (from agriculture, urban, roads); failing septic systems
- Wetlands: Loss of acreage; highway department practices (spreading invasive species)
- Woodlands: Fragmentation; land clearing
- Grasslands: Agricultural practices; unprotected status
- Natural areas: Fragmentation; loss of acreage/ lack of protection

Conservation Strategies:

- Protect and connect wooded uplands and wetlands along Onondaga Escarpment
- Assess created Spring Marsh as a gravel pit reclamation reference area, as recommended in the Akron/Newstead Comprehensive Plan

- Aquatic: Assess tributary along Dodgeson Rd for confined animal feelot operation (CAFO) impacts and remediation opportunities
- Work with highway departments to reduce invasives spreading
- Woodlands: Identify opportunities to connect large riparian woodland tracts in Pembroke and Newstead

Niagara River Habitat Conservation Strategy Table 3.8: Murder Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **19%**	5.0-7.5 **81%**	7.5-10	
	Condition	% impervious surface	>20%	10-20%	5-10%	<5% **3.3%**	**3.3%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79 **73**	>80	
	Landscape Context	Known barriers to migratory fish species					**N**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37%	38-50% **50%**	>50%	**4,671a / 9,413a**
	Condition	Number of Class 1s					**2**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**25 tracts (11,631a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**6 tracts (4,758a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	<25% **5.2%**	<50%	>50%		
Natural Areas	Size	% of study area that is natural		<60%	>60%		**60%**
	Condition	% of natural areas that is semi-protected	<25%	<50% **29%**	>50%		**29%**
	Condition	Number of tracts >150 acres					**19 tracts**

Ellicott Creek Sub-watershed

Ellicott Creek flows northwest from headwater wetlands in the Town of Darien (southwest corner of Genesee County) to the City of Tonawanda where it joins Tonawanda Creek about a half mile above its mouth at the Niagara River. While the upper reaches (upstream of Transit Rd.) are less developed; the lower reaches flow through the residentially and commercially developed Towns of Lancaster, Amherst and Tonawanda. Overall the sub-watershed is 14.7% impervious. Aquatic biological assessment profiles follow this pattern: slightly impacted in the upper watershed; moderately impacted downstream in Lancaster and Amherst. Variables like agricultural activity upstream, and groundwater discharge downstream affect these conditions.

In the 1930s lower Ellicott was widened and a dam was built at Island Park 2.4 miles upstream of the United States Geological Survey gage near the Village of Williamsville to control flooding. Regulation occurs today by the seasonal manipulation of that dam and also by intermittent pumping from stone quarries into the stream. In 1965, Erie County completed construction of a 1.5 mile long diversion channel between Rt. 990 and Niagara Falls Blvd. to control flooding in the Town of Amherst. This also affects stream and riparian habitat quality.

The Onondaga Escarpment and Aquifer are major features across the sub-watershed (as in the Lower Tonawanda and Murder Creek sub-watersheds), along with many associated active and abandoned stone quarries. The Onondaga Aquifer discharges to and is recharged by many of the wetlands along this northern edge, including five Class 1 wetlands in the Towns of Clarence, Lancaster, Newstead and Alden (LA-14 is in the Ellicott sub-watershed). Springs, swallets and sinks are important connecting features that should be protected by setbacks and buffers.

Grasslands associated with the 1,800-acre Darien Lakes State Park and its grassland breeding bird species are another feature with potential opportunities for conservation. Working with the Darien Lake Park rangers to incorporate mowing regimes that are less harmful to nesting grassland birds would be an important first step.

Municipalities: Towns of Tonawanda, Amherst, Lancaster, Newstead, Alden, Bennington, Cheektowaga, Clarence, and Darien; Cities of Tonawanda and Buffalo; Villages of Williamsville and Alden

Total waterways: 244 miles including Elevenmile, Crooked, Spring/Peck and Dorsch Creeks
Total sub-watershed: 76,843 acres

Biodiversity features by percent of ARA land cover

- ARA: 44,699 acres or 58% of sub-watershed
- Wetlands (NOAA): 6,729 acres or 15%
- Woodlands: 10,146 acres or 23%
- Grass/Shrublands: 769 acres or 2%

- Natural areas: 17,645 acres or 40%
- ARA and continuous Natural areas: 25,679 acres or 49% of study area

Viability assessment: (amount, condition, connectivity) Table 3.9

- Aquatic habitat: **FAIR**
- Wetlands: **GOOD**
- Woodlands: **FAIR**
- Grass/Shrublands: **FAIR**
- Natural Areas: **FAIR**

Threats:

- Aquatic: Channelization; lack of riparian vegetation; runoff
- Wetlands: Loss of acreage; invasives
- Woodlands: Lack of protection; fragmentation
- Grasslands: Lack of protection; mowing-planting regimes on public lands (e.g. Darien Lakes SP)
- Natural areas: Lack of protection; invasive species; fragmentation

Conservation Strategies:

- Aquatic: Assess the Doersch Creek area of the Onondaga Escarpment and Aquifer for threats to significant areas of surface and groundwater recharge (sinks, swallets, springs) and conservation options (Recommend to include in the Town of Alden Proposed Aquifer Overlay District)
- Grassland: Darien Lakes State Park. Assess for grassland breeding bird habitat opportunities
- Assess the Town of Amherst's Nature View Park for habitat and functional values including stormwater retention benefits provided to neighboring property owners

Niagara River Habitat Conservation Strategy Table 3.9: Ellicott Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **30%**	5.0-7.5 **69%**	7.5-10	
	Condition	% impervious surface	>20%	10-20% **14.7%**	5-10%	<5%	**14.7%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69 **66**	70-79	>80	

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Landscape Context	Known barriers to migratory fish species					**N**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**N**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **35%**	38-50%	>50%	**3,714a / 10,774a**
	Condition	Number of Class 1s					**4**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide,spanning a waterway					**26 tracts (14,363a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**6 tracts (4,758a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**15%**	<50%	>50%		**15%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **49%**	>60%		**49%**
	Condition	% semi-protected	<25%	<50% **41%**	>50%	>75%	**41%**
	Condition	Number of tracts >150 acres					**29 tracts**

Smokes Creek Sub-watershed

Smokes Creek rises in the Town of Orchard Park and flows northwest for 15 miles to its mouth on Lake Erie. Its one principal tributary, South Branch, is 12 miles long. The creek is named after "Old Smoke," a Seneca leader whose son traditionally carried the fire—the "smoking brand"—from the Haudenosaunee or Iroquois Confederacy Council fire at Onondaga to the Seneca Nation council fire in Western New York. Old Smoke lived near this creek in his later years and was buried here.

Smokes Creek is a tributary to a NYS DOS "significant coastal habitat"—the 500-acre shallow water Smokes Creek Shoals—a spawning grounds for important Lake Erie fish species like walleye and smallmouth bass. However, over the past decades, Smokes Creek itself was severely degraded by cyanide and other toxic waste from the Bethlehem Steel plant and inadequately treated sewage effluent. The creek's habitat value was further impaired by complete buffer removal and channelization of the last mile of the creek. The NYSDEC 2010 RIBS data at three of four sites sampled shows aquatic life to be moderately impacted by elevated nutrient and silt/sediment loads, sludge banks, and other pollutants associated with urban runoff and other

nonpoint source inputs. Hydrologic modification for flood control and a high density of roads and culverts are also a concern. The US Army Corp of Engineers is considering a plan to restore ecology and natural flows to areas along the main stem and South Branch (2014).

This sub-watershed includes several small direct tributaries to Lake Erie, all unnamed except for Rush Creek, within a mile of Smokes Creek on the south. The coastal area here includes an NHP-listed remnant Great Lakes dune system, with a wide sand beach and a strip of wooded dunes partially protected by Woodlawn Beach State Park and used by colonial nesting gulls and terns. Another of the unnamed Lake Erie tributaries supports a high predicted number (5-7) of native mussel species.[52] With the major industrial use gone, this once significant Lake Erie coastal area—associated with three state-listed mussel species and three listed fish species, including lake sturgeon—needs to be assessed for any opportunity to improve its viability and connectivity for these important remaining Great Lakes species.

Two Hamburg municipal parks are part of larger (200-500 acre) woodland communities, including a high quality hardwood swamp in the headwater areas. These parks and adjacent natural areas offer many potential opportunities to improve ecological function and habitat in and along Smokes Creek.

Municipalities: Towns of Hamburg, Orchard Park, Aurora, and West Seneca. City of Lackawanna. Villages of Blasdell and Orchard Park

Total waterways: 109 miles including principal tributaries Rush Creek, South Branch
Total sub-watershed: 39,527 acres

Biodiversity Features by percent of ARA cover

- ARA: 15,680 acres or 40% of sub-watershed
- Wetlands (NOAA): 1,306 acres or 8%
- ARA Woodlands: 4,563 acres or 29%
- ARA Grass/Shrublands: 462 acres or 3%
- ARA and continuous Natural areas: 11,654 acres or 56% of study area

Viability assessment: (amount, condition, connectivity) Table 3.10

- Aquatic habitat: **FAIR**
- Wetlands: **FAIR**
- Woodlands: **FAIR**
- Grasslands: **POOR**
- Natural Areas: **POOR**

Threats:

[52] White, E.L., J.J. Schmid, T.G. Howard, M.D. Schlesinger, and A.L. Feldmann. *New York State freshwater conservation blueprint project, phases I and II: Freshwater systems, species, and viability metrics. New York Natural Heritage Program*, The Nature Conservancy. Albany, NY. 85 pp. plus appendix, 2011.

- Aquatic habitat: Lack of riparian buffer; channelization (culverts)
- Wetlands: Loss of acreage; road management practices
- Woodlands: Lack of protection; lack of ecological management plans
- Grasslands: Invasive species; management on public lands
- Natural Areas: Lack of protection; fragmentation

Conservation strategies:

- Identify forest, wetland and/or aquatic habitat values and needs in county owned parcels around California Rd. Recreation Area (Brush Mountain Park) and Lakeview Rd. Recreation Area
- Identify any opportunities to mitigate flood control channelization with shoreline softening
- Investigate lakeshore/tributary restoration opportunities including mussel habitat protection

Niagara River Habitat Conservation Strategy Table 3.10: Smokes Creek

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **23%**	5.0-7.5 **77%**	7.5-10	
	Condition	% impervious surface	>20%	10-20% **18.3%**	5-10%	<5%	**18.3%**
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69 **60**	70-79	>80	
	Landscape Context	Known barriers to migratory fish species					**Y**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Unknown**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25%	25-37% **30%**	38-50%	>50%	**724a / 2,452a**
	Condition	Number of Class 1s					**1**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning a waterway					**22 tracts (3,912a)**
	Condition	Core forest: unbroken blocks >500 acres, >100m from road					**1 tract (543a)**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	**8%**	<50%	>50%		**8%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **56%**	>60%		11,654a or **56%**
	Condition	% semi-protected	<25% **21%**	<50%	>50%		**21%**
	Condition	Number of tracts >150 acres					**15 tracts**

Niagara River Sub-watershed

Biodiversity features and conservation opportunities in the Niagara River sub-watershed vary according to three major geographies: the Upper River including the stream drainages above Niagara Falls; the Lower River, including the Niagara Gorge; and the natural (unpopulated) islands. Niagara Falls was the historic natural barrier between the four Upper Great Lakes and the Lower Lake Ontario-St. Lawrence River system. Fish species like Atlantic salmon and American eel migrated to and from the Atlantic Ocean as far as the lower river, but no further. Canals like the Erie Canal changed all of that, and yet even today the assemblages and even genotypes of some Upper River-Lake Erie aquatic species differ from those in the Lower River-Lake Ontario system.

Direct drainage to the Upper River includes the lower Buffalo River, Scajaquada Creek, Twomile Creek, Tonawanda Creek, Cayuga Creek, and Gill Creek tributaries. Shoreline and riparian areas have been highly modified by navigational dredging, diversions (Ontario and New York power plants and the Erie Canal), industrialization, landfills, and waste discharges. The land disturbance and contamination caused by this history led to significant loss and degradation of habitat. Based on existing and predicted BAP scores, 88% of the stream miles are moderately impacted for aquatic life, and lower Scajaquada Creek is “precluded” for aquatic life. In the lower Niagara River, below the falls, the one major tributary, Fish Creek, was channelized to accommodate the NYPA power reservoir, and much of the Greenway area is highly modified by power plant infrastructure.

Island habitat has been decreased by quarrying (Strawberry), infilling of channels (Rattlesnake), removal (Bird) and park development (Three Sisters). Restoration efforts are underway to restore components of these historic island complexes but much work is needed to ensure long-term protection and management practices are in place and practical.

Despite this history, the Niagara River sub-watershed is the most biodiverse of all the tributary sub-watersheds in its watershed, in part because of its key role in the migratory cycles of so many Great Lakes and global species. Globally significant numbers of Bonaparte’s Gull, Common

Tern and Lesser Scaup overwinter here. The islands and shoreline areas support breeding colonies of black-crowned night heron, great egret and great blue heron, as well as nesting osprey, bald eagle and peregrine falcon. Lake sturgeon are found in increasing numbers in both the upper and lower river, likely representing two different genetic variants from Lake Erie and Lake Ontario. Keystone species like the emerald shiner support many of these resident and migratory species. The Niagara Gorge, once considered one of the most botanically diverse places in North America, still supports many rare plants and communities.

There are several major existing proposals to protect these features, including designation of the Niagara Gorge as a bi-national park or biosphere reserve; removal of redundant roads like the Robert Moses Parkway to restore a natural condition to the gorge rim; and protection of the islands and shallow water habitats with no or low-wake zones and other measures limiting human disturbance. The eight state parks and many municipal parks along the river, along with the Niagara River Greenway initiative offer opportunities to coordinate restoration work.

Scajaquada Creek is one of the greatest restoration priorities within the urbanized Greenway corridor of this sub-watershed. Listed as either “impaired” or “precluded” for aquatic life and buried for much of its journey to the Niagara River, the creek’s water quality is degraded due to point and non-point source pollution. Most notably, urban storm and waste water inputs from both the upper and lower portions of the sub-watershed result in frequent sewage overflows, intense sediment loads and decreased aquatic habitat availability. Both human and wildlife are threatened by exposure to these impaired conditions. Yet, springs and seeps within the entirety of the creek provide a portion of the stream’s baseflow with high-quality water inputs and offer opportunities for restoration where documented problems can be addressed.

Other strategies involve reconnecting the river with its tributaries through strategic barrier removal (where barriers limit the capacity of fish or mussels to reproduce), restoring (or mimicking) natural flows, and compensating for the loss of wetland and shallow water habitat. These will be further explored in the Niagara River Greenway Habitat Conservation Strategy, a companion planning effort currently underway.

Municipalities: Towns of Porter, Lewiston, Niagara, Grand Island, Wheatfield, Tonawanda, Cheektowaga, Lancaster; Cities of Buffalo, Niagara Falls, North Tonawanda, Cambria, and Tonawanda; Villages of Youngstown, Kenmore, Depew, and Lewiston. Tuscarora Indian Reservation

Total waterways: Including Fish Creek, Gill Creek, Cayuga Creek, Bergholtz Creek, Black Creek, Two Mile Creek, Scajaquada Creek, and Grand Island creeks: 185 miles
Total sub-watershed: 98,211 acres

Biodiversity features by percent of ARA land cover:

- ARA: 62,452 acres or 64% of sub-watershed

- Wetlands (NOAA): 5,149 acres or 8%
- Woodlands: 12,442 acres or 20%
- Grass/Shrublands: 1,136 acres or 2%
- ARA and Continuous Natural areas: 22,179 acres or 34% of study area

Viability assessment: (amount, condition, connectivity) Table 3.11

- Aquatic habitat: **POOR**-**FAIR**
- Wetlands: **FAIR**
- Woodlands: **FAIR**
- Grass/Shrublands: **POOR**
- Natural areas: **FAIR**

Threats:

- Aquatic: Channelization; flow alterations/water level fluctuations; hazardous waste (sediments, landfills, discharges); fish barriers; invasives
- Wetlands: Loss of acreage; invasive species; water level fluctuations
- Woodlands: Lack of ecological management plans; lack of protection
- Grasslands: Management practices on public lands; invasive species
- Natural areas: Lack of protection; fragmentation

Conservation strategies:

- Assess shorelines for softening and buffering opportunities
- Include living shoreline Best Management Practices in waterfront regulations and policies
- Prioritize and remediate barriers to migratory fish use of tributaries
- Investigate water level fluctuation influence on reproduction of fish, mussel and shore birds
- Assess identified high quality woodland parcels for conservation easements or acquisition
- Develop and implement ecology-based management plans for public lands including NY State parks, WMAs, Class 1 wetlands, and Niagara River islands

Niagara River Habitat Conservation Strategy Table 3.11: Niagara River

- **Bold** = Current condition
- Listed plant and animal species are identified in technical report
- For unranked indicators, see sub-watershed descriptions

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
Open Water Aquatic Habitat	Condition	Actual & predicted BAP scores (by % of stream)	0-2.5	2.5-5.0 **88%**	5.0-7.5 **12%**	7.5-10	
	Condition	% impervious surface	>20% **23.3%**	10-20%	5-10%	<5%	**23.3%**

FEATURE	ATTRIBUTE	INDICATOR	POOR	FAIR	GOOD	V. GOOD	OTHER
	Condition	Bed/ bank assessments (HMA/SVAP scores)	<60	60-69	70-79	>80	**See Greenway**
	Landscape Context	Known barriers to migratory fish species					**Y**
	Species	Presence of listed fish or mussel species					**9 birds; 2 bird communities; 6 fish; 10 mussels**
Nested Feature	Migratory Fish	Reproducing trout or sturgeon populations					**Y**
Wetlands	Condition	NYSDEC compared to total mapped (NYSDEC, NWI)	<25% **24.7%**	25-37%	38-50%	>50%	**3,166a / 12,722a**
	Condition	Number of Class 1s					**10**
Woodlands	Condition	Riparian forest tracts: >50 acres and >100m wide, spanning waterways					**15 tracts (9,249a)**
	Condition	Core forest: unbroken blocks >250 acres, >100m from road					**7 tracts (5,342a)**
Grass/Shrublands	Condition	% of acreage in tracts >10 acres	<25% **14%**	<50%	>50%		**14%**
Natural Areas	Size	% of study area in & cont. w/ ARA that is natural		<60% **34%**	>60%		**34%**
	Condition	% semi-protected	<25%	<50% **35%**	>50%		**35%**
	Condition	Number of tracts >150 acres					**17 tracts**

Big Sister Creek Sub-Watershed

The headwaters of the Big Sister sub-watershed begin in Collins, North Collins, Cattaraugus Indian Reservation and Eden, and then drain into Lake Erie. This is the southwestern most sub-watershed within the Buffalo-Eighteenmile sub-basin. Notable recreational areas along Lake Erie's coast are Evangola State Park, Bennett Beach, and Sturgeon Point. There are two largely intact forests: Franklin Gulf County Park (North Collins) and also in Cattaraugus Indian Reservation. The remainder of the land is dominated by a mix of suburban municipalities, agricultural farms, with evenly distributed wetland patches of sized 50-150 acres.

The Big Sister Creek sub-watershed is within the Erie/Ontario Lake Plain and Cattaraugus Hills ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The Cattaraugus Hills region has broad, low hills with deeply cut streams in shale bedrock. The region is described by the NYSDEC as moderately covered by forest, which is mostly comprised of beech-maple mesic (and American chestnuts historically), shale cliffs, and a talus

community. However these forests are fragmented by both agricultural and suburban areas; headwaters have marshland with inadequate forest buffer zones.[53] Many of the municipalities in this sub-watershed are on septic systems, some of which are known, suspected, or considered possible to be failing, and contributing to poor water quality.[54]

The Lake Erie waterfront in this sub-watershed is impaired due to PCBs and pathogens. Lower stems of Little Sister Creek and Muddy Creek are both listed as impaired for pathogens, and Little Sister is also impaired due to nutrients and dissolved oxygen. Big Sister Creek, Delaware Creek, and upper Muddy Creek have minor impacts, while only Rythus Creek has no known impacts.[55] NYSDEC RIBS assessments in this sub-watershed are consistent with poor aquatic habitat and water quality. In lower Little Sister Creek, the macroinvertebrate community was dominated by midges and scuds which are tolerant for low dissolved oxygen and poor water quality. Big Sister and Delaware Creeks macroinvertebrate communities were more diverse, however many nutrient tolerant species were present.[56]

Historically, Big Sister Creek has been highly impacted by sewage input. A stream survey conducted in 1973 (Puleo et al. 1974) found low dissolved oxygen, pollution tolerant macroinvertebrate communities, and noted that the area noticeably smelled of sewage. Currently, this is still observed in most tributaries in this sub-watershed as indicated through macroinvertebrate community distribution.[57] In 2010, sewage and nutrient input were still cited a major impairment of Big Sister Creek despite SPDES compliance.[58]

A key area for conservation is Evangola State Park, which provides critical habitat for many migratory species including monarch butterflies, bats, and numerous bird species. In 2011, a survey conducted by US Fish and Wildlife Service found Evangola State Park to have the highest bird count, and second highest bat count of all the coastal sites surveyed spanning each of the Great Lakes (USFWS 2012). This park is also known to host Bald Eagles, and protection of this stopover point is essential for the migratory biotic community. The Lake Erie portion of this sub-watershed also hosts important fishes including lake sturgeon, lake trout, walleye, yellow perch, channel catfish and smallmouth bass. Established non-native species that are of recreational importance are steelhead, brown trout and Chinook salmon.

Municipalities: Villages of North Collins, Angola, and Farnham. Towns of Brant, Eden, Evans, Collins, and North Collins. Cattaraugus Indian Reservation.

[53] New York State Department of Environmental Conservation (NYSDEC*), Species of Greatest Conservation Need*, *Comprehensive Wildlife Conservation Strategy for New York*, Lake Erie Table 11, pp. 233 – 279, 2005.
[54] https://www.dec.ny.gov/docs/water_pdf/winiagbigsister.pdf
[55] Ibid
[56] New York State Department of Environmental Conservation (NYSDEC*), Rotating Integrated Basin Studies Water Quality Assessment Program New York Statewide Waters Monitoring Program. Niagara River Lake Erie Drainage Basin: Sampling years 2005 – 2006*. 2011
[57] Ibid
[58] https://www.dec.ny.gov/docs/water_pdf/winiagbigsister.pdf

Total waterways: 186.65 miles including principal tributaries Big Sister Creek, Little Sister Creek, Delaware Creek, Muddy Creek.
Total sub-watershed: 62,363 acres

Threats:

- Aquatic: nonpoint nutrient runoff (agricultural), storm runoff, sewage input, pathogens,
- Wetlands: Inadequate buffers and/or fragmentation, suburban development
- Woodlands: Inadequate forest buffers, the largest intact forest (Franklin Gulf) is surrounded by agriculture
- Grasslands: Invasive species in grassy dunes along Lake Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Fragmentation of natural areas

Conservation Strategies:

- Increase stream buffers to reduce pathogen and nutrient inputs.
- Protection of Rhythus, Big Sister, Delaware and upper Muddy Creek, which have no known or minor impacts.
- Conserve, protect and regulate the well-distributed wetlands. Prevent degradation of largest wetland areas.
- Protect intact forests and increase forest acreage where possible.
- Partnerships with Seneca Nation of Indians and NYSDEC to enhance key conservation areas, such as natural areas within Cattaraugus Indian Reservation and Evangola State Park.
- Work with landowners to improve septic systems, increase riparian zones between cropland and streams, and implement mowing regimes that reduce harm to grassland dependent species (block mowing method outwards from the center as opposed to strip mowing).

Cattaraugus Creek Sub-Watershed

The Cattaraugus Creek sub-watershed, along with the Headwaters Cattaraugus Creek sub-watershed make up their own sub-basin, which drains into Lake Erie. The far reaches of this sub-watershed begin in Concord, Springville, Ashford, East Otto, and Mansfield. The midreaches flow through several towns in Erie and Cattaraugus Counties—mostly agricultural villages. In the lowest reaches it passes through Cattaraugus Indian Reservation and Hanover before draining into Lake Erie. There is adequate forest coverage in this sub-watershed, including parks and multiple use areas such as Zoar Valley, Cattaraugus State Forest, Deer Lick Nature Sanctuary, East Otto State Forest, and Dobbins Memorial State Forest. The Nature Conservancy, North Collins, Cattaraugus Indian Reservation and NYSDEC are all stakeholders in the forested areas with high conservation potential. There are also three designated wildlife preserves in this watershed operated by Nature Sanctuary Society of Western New York, which does not permit public access. These preserves host many unique plants ranging from sphagnum moss and orchids in a bog preserve, to protected floodplains with native wildflowers.

This sub-watershed encompasses six ecoregions before draining into Lake Erie: the Unglaciated High Allegheny Plateau, Glaciated Allegheny Hills, Low Allegheny Plateau, Cattaraugus Hills, Low Lime Drift Plain, and Erie/Ontario Lake Plain. As such, there is a variety of soil types, forest communities and climate patterns throughout this sub-watershed. Some parts of this sub-watershed are covered with

broad sloping hills, open lands with rich soils, while other sections have steep shale cliffs and stony, nutrient-poor soils with hemlock-beech forests.

The main stem of Cattaraugus Creek is relatively long, about 50 miles. Most of the wetlands are in the northern extent of this sub-watershed with a large cluster in Otto and East Otto south of Cattaraugus Creek. The poorest water quality occurs at the end of the watershed, due to agricultural runoff accumulation (NYSDEC 2005). The lower stem of Cattaraugus Creek, Rainbow, Timber, and Clear Lakes are known to have minor impacts. One of greatest concern in this region is siltation, excess nutrients and low dissolved oxygen caused by agricultural runoff and erosion. Stream bank erosion naturally occurs in this region, but can be exacerbated by additional erosion as a consequence of poor agricultural practices. The remaining tributaries in this watershed have no known impacts affecting biological communities, as observed through macroinvertebrate testing. However, nutrient loading is evident from agricultural nonpoint sources and should be monitored, so that it does not continue to increase. Failed septic systems in the region are an identified cause for increased nutrients and decreased dissolved oxygen.[59]

Cattaraugus Creek is an important migratory body of water for salmonids and protection of this cold water fishery should be a priority. However, dating to at least 1970 there have been concerns about adequate dissolved oxygen from sewage input negatively affecting native brook trout (Barry and Kaczaja 1970). The NYSDEC RIBS assessments suggest that although healthy, pollution-sensitive macroinvertebrate communities are supported in all sampled streams, siltation and excess nutrients are present in most, if not all streams.[60]

Notable wildlife found in Zoar Valley forest includes Bald Eagles, red-spotted newt, and ruffed grouse, among others. NYSDEC is working with partners to re-establish American chestnuts in this forest, a tree which was nearly wiped out from blight.[61] Many other rare and/or slow-growing woodland plants thrive in the forests of Zoar Valley. Important cold water fisheries in the tributaries and Lake Erie are lake sturgeon, lake trout, brook trout, naturalized steelhead, brown trout, and Chinook salmon (NYSDEC 2006). However, Cattaraugus Creek also provides habitat for very large populations of sea lamprey in Lake Erie, with costly lampricide treatments necessary every three to five years. Important warm water fisheries in the Lake Erie waters and lower stem of Cattaraugus Creek are smallmouth bass, walleye and yellow perch.

This watershed is in fairly good condition; however, it should be protected from any further degradation. The most imminent threat is agricultural runoff in the watershed. Also, it is adjacent to the West Valley Demonstration Project, located in the Cattaraugus Headwaters sub-watershed, which is a storage area for hazardous radioactive waste. Although the hazardous waste is currently being stored in

[59] https://www.dec.ny.gov/docs/water_pdf/winiagcattrgslow.pdf

[60] New York State Department of Environmental Conservation (NYSDEC*), Rotating Integrated Basin Studies Water Quality Assessment Program New York Statewide Waters Monitoring Program. Niagara River Lake Erie Drainage Basin: Sampling years 2005 – 2006*. 2011

[61] New York State Department of Environmental Conservation (NYSDEC), *Zoar Valley Multiple Use Area.* 2017. http://www.dec.ny.gov/lands/36931.html

solid form, it cannot be disregarded as a potential threat to the biotic community should the storage facility be compromised.

Municipalities: Villages of Springville, Cattaraugus and Gowanda. Towns of Ashford, Concord, Ellicottville, Mansfield, East Otto, Otto, New Albion, Persia, Dayton, Collins, North Collins, Perrysburg, Brant, and Hanover. Cattaraugus Indian Reservation.

Total waterways: 837 miles including principal tributaries Cattaraugus Creek, Connoisarauley Creek, Clear Creek.
Total sub-watershed: 197,539 acres

Threats:

- Aquatic: Siltation due to stream bank erosion, nonpoint sources of agricultural runoff and septic system failure, inadequate dissolved oxygen which is necessary for trout and salmons.
- Wetlands: Loss of acreage, invasive species.
- Woodlands: Invasive species, fragmentation.
- Grasslands: Invasive species in meadows and floodplains (Zoar Valley).
- Natural areas: Fragmentation of contiguous natural areas.

Conservation Strategies:

- Reduce agricultural runoff into waterways through increasing riparian forest buffers.
- Protect the several high quality stream segments in this watershed from further degradation.
- Maintain strong riparian forest buffers.
- Continued protection and conservation of critical wetlands, bogs and floodplains by Nature Sanctuary Society of WNY.
- Partnerships with the several agencies that are active stakeholders in the region.
- Working with homeowners to improve and maintain septic systems. Work with farmers to implement best land use practices and cattle guards to prevent livestock from eroding and degrading streams.

Headwaters Cattaraugus Creek Sub-Watershed

The Cattaraugus Headwaters sub-watershed, along with the lower Cattaraugus Creek sub-watershed, make up their own sub-basin which drains into Lake Erie. The headwaters begin in the rural towns of Java, Arcade, Wethersfield, Farmersville and Freedom. The midreaches pass through Sardinia, Delevan, Yorkshire, and Machias which contain both forests and farms. Finally this sub-watershed feeds into the Cattaraugus Creek sub-watershed near Springville and Ashford.

This sub-watershed encompasses three ecoregions: Cattaraugus Hills, Glaciated Low Allegheny Plateau, and Glaciated Allegheny Hills. Cattaraugus Hills, in the northern portion host the only wetlands in the sub-watershed. The steep shale banks of the Glaciated Allegheny Hills and Plateau regions do not support wetland systems; however, the Cattaraugus Hills ecoregion can potentially support wetland

systems (in the northern extent of this sub-watershed). Two state forests, Farmersville and Bush Hill, as well as Erie County forests are within this sub-watershed.

This sub-watershed has some of the best intact forest coverage of all those described in this report. It has multiple community types, both climax and successional communities: beech-mesic, hemlock-northern hardwoods, maple-basswood and northern- southern hardwoods (NYSDEC 2005). However, in the furthest upland extent of this sub-watershed, near Freedom and Delevan, agricultural areas begin to dominate and fragment the forests. Work with landowners to restore riparian buffers in these key locations would mitigate agricultural runoff to the lower reaches.

Both perennial and intermittent streams feed the main stem of Cattaraugus Creek. The streams in this sub-watershed sustain many fishes indicative of adequate water quality, such as darters, sculpins, shiners, suckers and daces (NYSDEC 2006). Non-native rainbow and brown trout have been established since the early 1900s due to early stocking (NYSDEC 2006). Fourteen tributaries in this sub-watershed support brook trout. Of these, Spring Brook has the greatest ability to sustain wild populations of brook trout, although lack of shade canopy as the stream meanders through a golf course is warming the stream and threatens the coldwater fishery. Scoby Dam, a 40 foot former hydroelectric dam near Springville, separates the headwaters from lower reaches of Cattaraugus Creek and prevents migration and movement of native trout along this tributary. The dam is currently being assessed with plans to be lowered in the near future. Although this will help to restore connectivity, it will likely increase sedimentation in the initial stages, then be a potential pathway for invasive and non-natives species such as sea lamprey and steelhead. These impacts could strain wild native brook trout populations thriving upstream of the dam (NYSDEC 2006). Preventative weirs and fish ladders are planned to be installed to exclude sea lamprey, while allowing other fish to pass through. There will also be lamprey traps installed during their spawning migrations for individuals to be euthanized.

Although this is a healthy sub-watershed, certain risks have been identified which could compromise these headwaters. Any degradation experienced in the headwaters has the potential to further exacerbate the stressors and impacts apparent in the lower Cattaraugus Creek watershed. Within the Cattaraugus headwaters is the West Valley Demonstration Project, a 3,000 acre storage area of hazardous radioactive waste and facilities from a fuel rod reprocessing facility near the town of Ashford. The liquid high-level radioactive waste was solidified in the early 2000s and is currently stored in 275 stainless steel canisters, each of which contains an average of 36,640 curies. Also on site are two radioactive waste burial grounds made up of 20 acres of unlined, unengineered trenches containing an estimated 340,000 curies. The facility is within the Buttermilk Creek and Cattaraugus Creek floodplains, and should not be dismissed as a potential threat to this watershed and Lake Erie. Decision making for the future of this site (clean-up or long term stewardship) is still in the process of studying options and will not be made until 2020. Any decision will take decades, if not centuries to implement and maintain.

Municipalities: Villages of Arcade, Delevan, and Springville. Towns of Java, Wethersfield, Eagle, Arcade, Centerville, Freedom, Rushford, Farmersville, Machias, Yorkshire, Sardinia, Concord, Ashford, and Ellicottville.

Total waterways: 615.27 miles including principal tributaries Cattaraugus Creek, Clear Creek, Elton Creek, Stony Creek, Spring Brook.
Total sub-watershed: 160,667 acres

Threats:

- Aquatic: Invasive sea lamprey movement to headwaters, stream bank erosion
- Wetlands: Loss of acreage, invasive species
- Woodlands: Natural forests are surrounded by farmland.
- Grasslands: Invasive species in meadows and floodplains, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Nuclear and hazardous waste storage facility near floodplains and streams.

Conservation Strategies:

- Protection of wild brook trout populations in key tributaries.
- Early detection monitoring for invasive sea lamprey post-dam removal.
- Continued protection of forested areas, particularly stream riparian buffers.
- Work with NYSDEC and Erie County to increase acreage or quality of the state and county forests.
- Work with homeowners and farmers to implement BMPs, including strip barriers between croplands and forests, maintenance on septic systems, mowing strategies to protect grassland dependent species and excluding livestock from natural areas.
- Work with NYSERDA to ensure that West Valley Demonstration project hazardous waste storage tanks are adequately maintained.

Walnut Creek Sub-Watershed

The Walnut Creek sub-watershed is the northernmost of the Chautauqua/Erie sub-basin, and encompasses portions of the Erie/Ontario Plain and Low Lime Drift Plain ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and nutrient rich soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The lower reaches of Walnut Creek have shale cliff and talus communities, with a narrow band of forest buffer surrounded by agricultural land. The headwaters, in the Low Lime Drift Plain are rockier and more protected with forest coverage (NYSDEC 2005), however the forests are fragmented by agricultural land throughout the entire area. These soils are poorly-drained and better suited for livestock than farming.

The headwaters of this sub-watershed begin in Villenova, Arkwright, and Perrysburg. Most of the sub-watershed is located in the town of Hanover, with some portions in Sheridan and Forestville as well. It eventually drains directly into Lake Erie at Silver Creek and Hanover. Most of the sub-watershed is within Chautauqua County, but there is a small portion in Cattaraugus County as well. Some segments of Wheeler Brook and Silver Creek tributaries have farmland right up to the stream, without any riparian buffer whatsoever. Suburban development from the village of Silver Creek expands right up to the Lake

Erie coastline. Working with landowners to address these issues would significantly improve water conditions in this watershed. There are no major county or state parks within this sub-watershed and the only notable wetlands are on the southernmost edge near Villenova.

Upper Silver Creek and Silver Creek Reservoir have no known impacts, as described by the NYSDEC to date. Halfway Brook, Walnut Creek and Lower Silver Creek have minor impacts to water quality.[62] Halfway Brook has shifted to a pollution tolerant community of macroinvertebrates, most likely as a response to lowered dissolved oxygen and increased organic loads from sewage input. Walnut Creek is reported to have poor dissolved oxygen, increased phosphorous and siltation, and possible thermal pollution. Logging activities have increased turbidity, sedimentation and siltation loads in lower Silver Creek. In 2012, NYSDEC initiated legal action against the Silver Creek wastewater treatment plant for violation of SPDES regulations. The plant was reportedly using clarifiers intended for secondary wastewater treatment and bypassing primary treatment steps, and releasing improperly treated waste.[63]

Silver Creek (CT) and Halfway Brook (CTS) are designated for fishing (C), and as important streams for trout habitat (T) and potentially trout spawning (S). These streams can support various species of trout, including naturalized ones such as steelhead and brown trout. Future protection and stocking may eventually support self-sustaining brook trout, a native species of interest. As with other sub-watersheds encompassing eastern Lake Erie, lake trout and lake sturgeon are important native species warranting protection and conservation. Lake trout cannot inhabit the shallower western and central basins of Lake Erie, thus their habitat in this lake is limited. Other notable warm water fishes in eastern Lake Erie are walleye, yellow perch, channel catfish and large and smallmouth bass. Important avian species such as Bald Eagles, waterfowl, gulls, and many other migratory birds utilize the Lake Erie coastline.

Municipalities: Villages of Forestville and Silver Creek. Towns of Arkwright, Sheridan, Perrysburg, Villenova, and Hanover.

Total waterways: 129.44 miles including principal tributaries Walnut Creek, Tupper Creek, Silver Creek and Wheeler Brook.
Total sub-watershed: 36,014 acres

Threats:

- Aquatic: Improper wastewater treatment methods and release of sewage (leading to pathogen loads and inadequate dissolved oxygen), siltation caused by logging practices, nutrient loading from agricultural runoff, potential thermal pollution sources.
- Wetlands: Lack of connectivity, lack of formal protection, invasive species.
- Woodlands: Loss of riparian woodlands, forests are extremely fragmented by suburban development and agriculture on all sides, lack of formal protection.

[62] https://www.dec.ny.gov/docs/water_pdf/winiagwalnutcr.pdf
[63] Ibid

- Grasslands: Invasive species in grass dunes along Erie coasts and houses replacing dune areas, mowing regimes on farmland impact grassland-dependent bird nests.
- Natural areas: No natural areas with formal protection or designation on state, county or municipality level.

Conservation Strategies:

- Restoration and reclamation of forested riparian buffers, particularly along Wheeler Brook, Silver Creek and Walnut Creek, where agriculture fields dominate.
- Development of formal protection status of natural areas, or watershed plan in this sub-watershed is essential.
- Protection of wetlands.
- Protection of streams described as having minor impacts and prevention of further degradation cause by agricultural runoff.
- Increase the acreage and quality of natural forests, reduce fragmentation.
- Consider partnering with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote the Agricultural Environmental Management Program to promote best management practices with farmers (in partnership with the Soil and Water Conservation District).

Canadaway Creek Sub-Watershed

The Canadaway Creek sub-watershed is located within the Chautauqua/Erie sub-basin and is entirely in Chautauqua County. It begins in the towns of Charlotte and Arkwright, then flows through Pomfret Fredonia, Sheridan and Dunkirk. Erie/Ontario Lake Plain and Low Lime Drift Plain are the two ecoregions of this area. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and nutrient rich soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The Low Lime ecoregion is comprised of beech-maple forests and numerous depositional glacial landforms. Those soils are poorly-drained and better suited for livestock than farming. This sub-watershed has intact forest coverage in the furthest reaches; however the land closest to Lake Erie shores is almost entirely altered by the city of Dunkirk and/or agricultural lands.

Lake Erie waters and two tributaries (Crooked Brook and Scott Creek) are listed as impaired by the NYSDEC. Lake Erie is impaired due to the presence of PCBs in the sediments, fish consumption advisories, and pathogen and storm runoff in the waters. Hyde Creek, which flows through the city of Dunkirk, has been identified as a source of storm runoff transport into Lake Erie. The impaired streams have excessive nutrient inputs, although the source has not been confirmed. In Crooked Brook and Scott Creek, macroinvertebrate communities were moderately impacted, though Scott was nearly categorized as severely impacted. Pollution tolerant species are missing, with an overrepresentation of tolerant species. Dissolved oxygen levels were poor and nutrients were elevated. However, both of these tributaries are suspected to have other pollution sources, which are to date unidentified. Upper and lower Canadaway Creek are not impaired. Many other tributaries are listed as threatened, with

unverified sources of pollution input. Siltation from logging and stream bank erosion, thermal pollution, inadequate sewage treatment from Dunkirk's WWTP, industrial and urban runoff from Dunkirk, and livestock runoff from agriculture are all suspected causes.[64]

Sheridan has the most emergent wetland and woodlands of all the municipalities, but they are fragmented by roads and development. In the southern reaches of this sub-watershed, in Arkwright, is the Canadaway Wildlife Management Area (owned by the NYSDEC) with a few small county forest parcels adjacent to it. Just south of this, in Charlotte is the Boutwell Hill State Forest, also owned by NYSDEC. These two areas are the largest core forest areas and likely have the highest conservation impact in the sub-watershed. The NYSDEC has recently prepared an in-depth management plan for these forests, which aims to increase habitat for species in decline, while also utilize the land for logging.[65]

Notable wildlife in the state forests include black bear, deer, Wild Turkey, Ruffed Grouse, American Woodcock[66], and multiple species of frogs, snakes and turtles. Multiple threatened, high priority, and species of concern are found in these woods as well, including many types of grassland and young forest dependent birds. For this reason, the NYSDEC currently manages abandoned pastures as grassland habitat, and is working to convert softwood plantations back to young forests in early succession stages to support several of these species. As with other sub-watersheds that encompass the eastern basin of Lake Erie, there are important warm and cold water fishes to protect including lake sturgeon, lake trout, walleye, channel catfish, large and smallmouth bass, and yellow perch. Recreational species that are not native, but have naturalized include brown trout, Chinook salmon, and steelhead.

Municipalities: Villages of Silver Creek and Fredonia. Towns of Sheridan, Hanover, Arkwright, Charlotte, Stockton, Pomfret, Dunkirk, and Portland. City of Dunkirk.

Total waterways: 187.33 miles including principal tributaries Canadaway Creek, Little Canadaway Creek, Scott Creek, Beaver Creek
Total sub-watershed: 64,521 acres

Threats:

- Aquatic: Urban runoff from city of Dunkirk,
- Wetlands: Fragmentation, invasive species
- Woodlands: Fragmentation from agriculture and urban sprawl
- Grasslands: Invasive species in grass dunes along Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Lack of protection, increasing urbanization and suburban sprawl

Conservation Strategies:

[64] https://www.dec.ny.gov/docs/water_pdf/winiagcanadaway.pdf
[65] New York State Department of Environmental Conservation (NYSDEC*), Habitat Management Plan for Canadaway Creek Wildlife Management Area*. 2017
[66] Audubon title case capitalization is used for bird species only

- Reduce impervious surface in the city of Dunkirk. Install green infrastructure, particularly along Hyde Creek where urban runoff is polluting Lake Erie.
- Increase forest areas and riparian zones where agricultural lands begin to dominate in lower reaches.
- Identify sources of pollution and degradation to threatened stream segments.
- Reduce siltation from poor logging practices by increasing buffer distance between logging fields and waterways. Install living shorelines along streams where riparian zones have been logged.
- Protection of wetlands in Sheridan from further fragmentation and/or invasive species.
- Partnerships with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote BMPs among regional farmers (see Walnut Creek sub-watershed for further detail).

Chautauqua Creek Sub-Watershed

Chautauqua Creek is in the Chautauqua/Erie sub-basin, divided between the Erie/Ontario Plain and Low Lime Drift Plain ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect conditions. The Low Lime ecoregion is comprised of beech-maple forests and numerous depositional glacial landforms. Those soils are poorly-drained and better suited for livestock than farming. Compared to the other sub-watersheds in the same ecoregion, Chautauqua Creek has better forest coverage, approximately 70%, with most of the agriculture occurring closest to Lake Erie (NYSDEC 2005). There are many small wetland patches interspersed throughout the watershed, but there are not any large connected wetland regions.

The headwaters of this sub-watershed begin in Westfield and Chautauqua and the lower reaches pass through Brocton and Portland, which drain to Lake Erie. It contains Chautauqua Gorge State Forest, which has steep shale banks on either side of Chautauqua Creek and bedrock creek bottom. This 538-acre forest has a popular swimming spot for tourists and day hikers. It borders private property, but the portion that belongs to the state is protected and fairly rustic. On the far southeastern edge of this sub-watershed is Mount Pleasant State Forest. Mount Pleasant State Forest is just over 1,500 acres in size and hosts many mammals and birds such as bear, deer, rabbit, Turkey and Ruffed Grouse. This forest is managed by the NYSDEC for logging and forestry practices.

Lake Erie State Park in Brocton is a large campground and park in this sub-watershed. As with other Lake Erie coastal areas, it is an important stopover point for many migratory birds, and species of interest such as the Bald Eagle. Important cold and warm water fishes to protect include lake sturgeon, lake trout, walleye, large and smallmouth bass, channel catfish and yellow perch. Recreational species throughout the watershed include naturalized populations of brown trout, Chinook salmon, and steelhead. Lake Erie State Park has some wetland habitat intact, which hosts herpetiles such as salamanders and frogs.

Currently, this sub-watershed is in good condition; all the stream segments in this watershed are listed as having no known impact, though some are considered threatened by the NYSDEC.[67] Several streams host healthy communities of macroinvertebrates, and Chautauqua Creek is listed as a suitable trout habitat stream. However, agricultural and non-point sources are suspected to be in the early stages of affecting waters, and protection is necessary to prevent degradation of this relatively healthy sub-watershed. Westfield WWTP has been required to address water treatment and overflow issues, and has rectified most of them to date. This watershed is adjacent to the Chautauqua Lake watershed, which has a very thorough water management plan in place by various watershed partners in that region. Collaboration with these conservation groups may play a future role in ensuring the protection of the Chautauqua Creek sub-watershed.

Municipalities: Villages of Brocton and Westfield. Towns of Pomfret, Portland, Chautauqua, Westfield, and Ripley.

Total waterways: 180.43 miles including principal tributaries Chautauqua Creek, Little Chautauqua Creek, Doty Creek, Spring Creek, Bournes Creek, Walker Creek, Corell Creek, and Slipper Rock Creek.
Total sub-watershed: 51,243 acres

Threats:

- Aquatic: Agricultural non-point sources of nutrients and water pollution. Inadequate sewage treatment by Westfield WWTP.
- Wetlands: Fragmentation, invasive species.
- Woodlands: Loss of forests in lower reaches of watershed.
- Grasslands: Invasive species in grass dunes along Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: Overuse or misuse in recreational areas (Chautauqua Gorge State Forest)

Conservation Strategies:

- Identification and resolution of non-point pollution threats to tributaries. Working with homeowners to encourage septic system routine maintenance.
- Protection of wetlands.
- Increase stream buffers in lower reaches of watershed.
- Partnerships with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote BMPs among regional farmers (see Walnut Creek sub-watershed for further detail).
- Partnerships with the NYSDEC in state forests, which have high conservation value.

Six Mile Sub-Watershed

For the purpose of this report, only the portion of this sub-watershed within New York State boundaries is described. Pennsylvania municipalities and streams are not surveyed; however they are an integral

[67] https://www.dec.ny.gov/docs/water_pdf/winiagchautauqua.pdf

component of the sub-watershed health as well. On the New York side, this sub-watershed begins in the towns of Mina and Sherman. The bulk of the watershed is within the towns of Ripley and Westfield before the tributaries drain into Lake Erie.

The Six Mile sub-watershed is within the Chautauqua/Erie sub-basin and encompasses the Erie/Ontario Lake Plain and Low Lime Drift Plain ecoregions. The Erie Lake Plain ecoregion consists of beach dunes with various grass species, and soils containing limestone and shale that allow for agricultural success. This ecoregion is susceptible to lake effect weather conditions. The Low Lime ecoregion is comprised of beech-maple forests and numerous depositional glacial landforms. Those soils are poorly-drained and better suited for livestock than farming. The Lake Erie coastline, lower reaches and headwaters of this sub-watershed are dominated by agriculture. Twentymile Creek is well forested along its corridor; however it is surrounded by agriculture on either side. The nearest 2-3 miles to Lake Erie coasts in this watershed are nearly all agriculture.

There are no major parks in this sub-watershed on the NY side. However, there are five small parcels owned by the county, reserved for reforestation with minimal conservation value (NYPAD GIS Data Layer). There is one large (~100 acres) shrub wetland community intact; however it is bounded by the I-90 to the north and the 20 to the south. The remaining wetlands are patchy, interspersed and fragmented by farmland and roads (USFWS, National Wetland Inventory).

Lake Erie waters near Barcelona Harbor are impacted due PCB contaminated sediments and fish advisories. Twentymile Creek has very healthy macroinvertebrate communities (as of 2005 NYSDEC RIBS sampling efforts). Upper Belson Creek, Gage Gulf, and minor tributaries leading to Lake Erie, however are threatened and/or need continued monitoring to properly assess the health of the aquatic ecosystems. Pathogen inputs from poor agricultural practices are suspected impairments that may impact aquatic communities if these waterways are not protected from degradation.

As with other sub-watersheds that encompass the eastern basin of Lake Erie, there are important cold and warm water fishes to protect including lake sturgeon, lake trout, walleye, small and largemouth bass, channel catfish, and yellow perch. Recreational species of importance include naturalized populations of brown trout, Chinook salmon, and steelhead. Many migratory and resident avian species utilize the Erie coastlines, such as raptors including Bald Eagles, gulls, and various waterfowl.

Municipalities: Village of Westfield. Towns of Westfield, Sherman, Mina, and Ripley. This report does not include municipalities in the state of Pennsylvania.

Total waterways: 573.63 miles including principal tributaries Norge Creek, Freelings Creek, Twentymile Creek, Belson Creek, and Gage Gulf. This report does not include waterways in the state of Pennsylvania.

Total sub-watershed: 68 acres

Threats:

- Aquatic: agricultural runoff, pathogen input
- Wetlands: Lack of protection, invasive species, fragmentation

- Woodlands: Lack of protection, no significant core forests, all forests are bound by agriculture and suburban sprawl.
- Grasslands: Invasive species in grass dunes along Erie coasts, mowing regimes on farmland impact grassland-dependent bird nests
- Natural areas: There are no large protected natural areas or notable parks within this sub-watershed, fragmentation and suburban sprawl.

Conservation Strategies:

- Close monitoring and protection of streams with no known impact.
- Increase forest coverage and riparian zones to reduce pathogen and nutrient input. Forest riparian zones in the headwaters would be ideal.
- Working with the county to improve protected forest areas, and increase woodland acreage.
- Protection of wetlands.
- Partnerships with the Chautauqua Lake & Watershed Management Alliance (and their affiliated members) to promote BMPs among regional farmers (see Walnut Creek sub-watershed for further detail).
- The Jillson Road Farm (>100 acres) within this sub-watershed is under conservation easement with WNY Land Conservancy. Partnership with this farmer may lead to increased BMP and conservation implementation, as this farm is immediately adjacent to Freelings Creek, which feeds Lake Erie.

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