APPENDICES

APPENDIX 1: BACKGROUND

1.1 INTRODUCTION

Since 1973, the International Joint Commission (IJC) Water Quality Board has identified specific areas throughout the Great Lakes basin as having serious water quality problems. These water quality "problem areas", vary in scope, complexity and severity. In 1981, the Water Quality Board in an attempt to assess the "problem areas" in a consistent manner, they were renamed "Areas of Concern (AOCs)". This new approach shifted the emphasis from limited "water quality issues" to broader environmental quality issues such as water, sediment and biota. The identification of an area as an AOC incorporated an ecosystem approach, recognizing the need to consider all components of the system, as they relate to water quality.

An AOC is defined as "an area where there is a known impairment of a beneficial water use". A "beneficial water use" is defined as the environmental, economical and recreational benefits that are derived from a particular water use. For example, fish and wildlife habitat and fish and wildlife consumption are two examples of beneficial water uses. When fish and wildlife habitats are disrupted and/or destroyed, populations can not survive in adequate numbers and this ultimately leads to local extinctions, water quality problems and reduced hunting/recreational opportunities. This is an example of a water use that has become impaired. Fourteen potentially impaired beneficial uses have been named as critical in designating an area as an AOC.

St. Clair River was identified as an AOC due to the following problems: conventional pollutants (e.g. bacteria), heavy metals, toxic organics, contaminated sediments, fish consumption advisories, impacted biota, and beech closings. The sources of the problems included municipal and industrial point sources, urban and rural non-point sources, combined sewer overflows and contaminated sediments.

In 1983, the St. Clair River was identified as a "Class A" AOC representing one of the most degraded areas around the Great Lakes. In 1985, a new approach for categorizing the AOCs was presented. This approach was based on status of the data base, programs underway to fill data gaps, and remedial actions taken to address the identified problems. No efforts were made to classify AOCs on the severity of the problems.

In order to resolve the problems, Remedial Action Plans (RAPs) were developed in 1985 through the Great Lakes Water Quality Agreement, for each AOC within their jurisdictional boundaries. Because the St. Clair River is within the boundaries of both Canada and the U.S., one RAP is developed jointly between Ontario and Michigan.

The RAP process is a long-term, 3 stage endeavor to restore environmental problems. Stage one identifies the environmental problems, stage two develops an action plan to address the problems and stage three will be completed when the area is no longer listed as an AOC. When beneficial uses have been restored, and the RAP processes have ended, designated agencies will continue efforts to restore, protect and enhance environmental quality indefinitely.

One of the impaired beneficial uses identified for the St. Clair River, was "loss of habitat". Habitat loss is one of the most serious of the use impairments because it is the most difficult to reverse (MOEE and MDNR 1995). Habitat loss and wetland degradation and loss, also affects four other use impairments that include:

- Degradation of fish and wildlife populations
- Restrictions on fish and wildlife consumption
- Bird or animal deformities or reproductive problems; and
- Degradation of benthos

1.2 LOCATION OF THE ST. CLAIR RIVER AOC

The St. Clair River and Lake St. Clair together with the Detroit River, form the connecting channel between Lake Huron and Lake Erie. The St. Clair River is the direct outlet of Lake Huron and it flows approximately 64 km (38 mi) in a southerly direction to Lake St. Clair where it creates an extensive delta containing numerous distribution channels and wetlands.

Figure 6

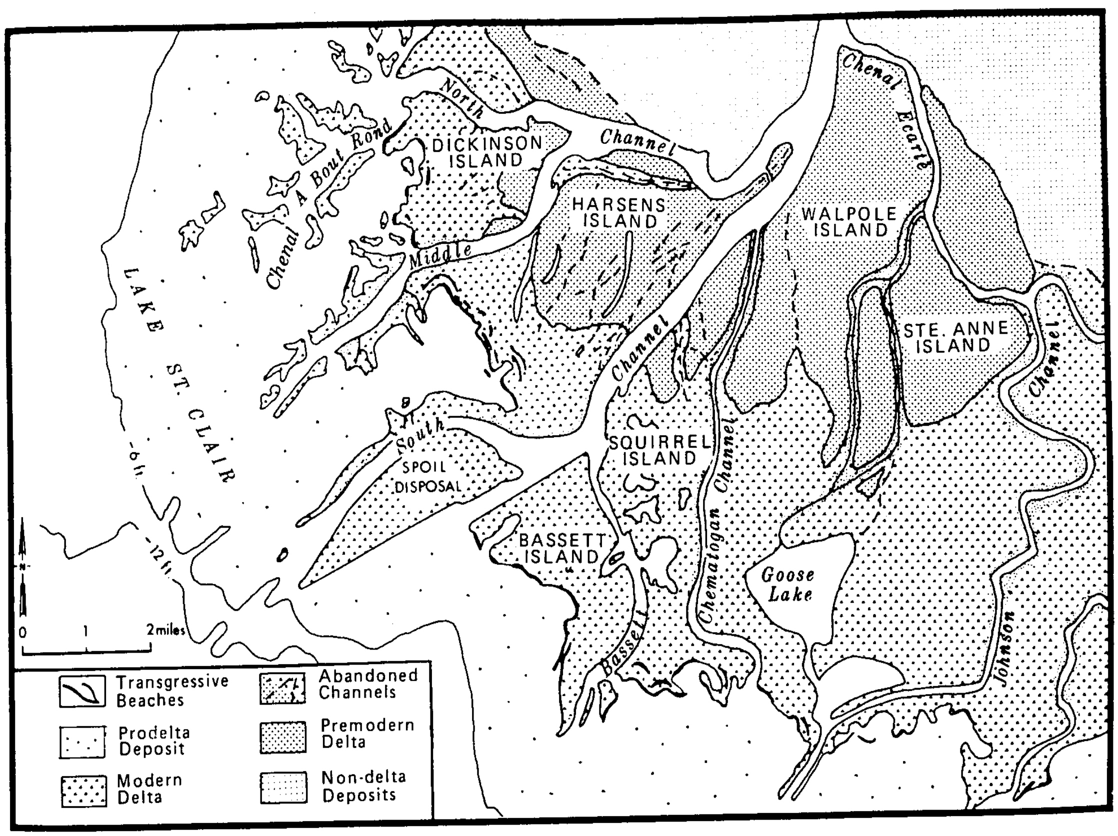

Figure 26. The St. Clair Delta (Raphael and Jaworski 1982).

The St. Clair River is located along the international boundary between Canada and the United States. It borders Lambton, Kent and Essex counties in Ontario, Canada, and St. Clair County in Michigan. Two islands are found in the main channel - Stag Island and Fawn Island. In the delta, Walpole Island consists of six separate channels. Seaway Island lies between the South Channel and the St. Clair cutoff, and Basset Island lies between the cutoff and Basset Channel. Squirrel Island, Walpole Island and Pottawatamie Island make up the largest Island complex. St. Anne's Island lies between the Johnston Channel and Chenal Ecarte. On the American side, Dickinson Island lies between the North Channel and the Middle Channel, and Harsens Island lies between the Middle Channel and the South Channel.

The St. Clair River watershed covers 315,900 ha (780,589 acres) in Michigan, and 20,976 ha (51,832 acres) in Ontario. The watershed encompasses several tributaries including the Black, Belle and Pine Rivers in Michigan, and Talfourd Creek, Baby Creek, Bowens Creek, Clay Creek, Marshy Creek and the North Sydenham River in Ontario.

1.3 GEOLOGY, GEOMORPHOLOGY AND SOILS

The rocks beneath the St. Clair system are sedimentary in origin and Paleozoic in age. They are 4,200 m (13,780 ft) thick and rest upon a floor or "basement" of very ancient Precambrian igneous and metamorphic rocks. During the Paleozoic Era (405 million years ago), the Appalachian Mountains to the east began to rise, exposing the area to weathering and erosion. Silts and muds were deposited to the west and hardened to form extensive beds of Antrim Shale beneath the St. Clair system. Sediments from source areas to the east were deposited in Michigan throughout most of the Paleozoic Era. Over time these sediments hardened into the sedimentary rocks, which dominated the Lower Peninsula of Michigan (Edsell et al, 1988).

Much of the development of the St. Clair region was dependent on the Devonian rocks in the area, which provided fossil fuels (gas and oil). The first oil field in North America was developed at Oil Springs, northeast of Lake St. Clair in southeastern Ontario in 1858. Salt has also been extensively mined and together these products have contributed to the chemical and petroleum industries of nearby areas.

Two million years ago during the Pleistocene era, glaciers covered the region and left deposits in the form of elongated ridges or moraines, composed of sand and gravel paralleling the present shoreline of the Great Lakes. Glacial melt waters ponded in the basins between the moraines and the glacier. Finer sediments accumulated in the ancestral basins to form Lake Plains. The St. Clair River and lake St. Clair are today located between the Port Huron moraine to the north and the Detroit moraine to the south.

Lake St. Clair is the youngest of the Great Lakes. Until about 11,000 years ago, the upper Great Lakes drained southward through the Mississippi River or through the Trent River in Ontario. Some 9,500 years ago, the St. Clair River and Lake St. Clair came into existence along with the Detroit River and their formation was not completed until 3,200 years ago.

1.4 HISTORICAL SETTLEMENT

Pre-historically, the St. Clair River became important for Native and European settlers because of its transportation opportunities and the abundance of fish and wildlife for food and clothing. Wetlands produced wild rice (*Zizania aquatica*) and sweet grass (*Hierochloe odorata*), as well, baskets were woven from the grass as a source of income for tribes in the area (Jones, 1935; and Edsell et al, ibid). Today, much of the Canadian portion of the delta is a reservation for the Walpole Island Ojibway, Chippewa and Potawatomi tribes.

The French are believed to have been the first European settlers in the late 1600's and trading, trapping and agriculture were the main exploitation. From the 1800's until the turn of the century, agriculture dominated the landscape, and industries began. In the late 1800's, two significant developments occurred which stimulated rapid development in the region: the Swamp Acts of 1850 and improved transportation. The Swamp Acts allowed the diking and draining of what was considered "worthless swamp and wetlands". These areas were then converted to agriculture. Transportation was then greatly improved by the first dredging of the river to allow for better passage of ships and the creation of railroads along the shorelines.

With the improvement of transportation to the area, private and public recreational use boomed, and the area became well known for hunting opportunities and vacationers from all over. In 1897, Imperial Oil Company constructed a refinery in Sarnia, Ontario, which initiated the development of southern Ontario's chemical valley. Within a short time several oil and chemical companies were established from Corunna north to Sarnia. In Michigan, most industry was sited from the town of St. Clair north to Port Huron. Industries and electric power generating stations are now the foremost users of water for their operations, and have been catalysts for navigation improvements in the region (Edsell et al, ibid).

During the period from 1900 to 1940, urban development increased and the importance of agriculture began to decline. Summer cottages also began to prevail at this time. Urban sprawl began to intensify by the 1950's, particularly on the Michigan shoreline, and Interstate 94 was constructed. Several marinas were also constructed along the shoreline, navigation channels were dredged and widened, and bulkheads and seawalls were constructed. By the mid 1970's, much of the lower Michigan shoreline was in residential use while the upper was in agriculture/natural use. In Ontario, the upper portions were industrialized, and the lower river shoreline was in agriculture. This landscape has changed little since the mid-1970's (Edsell et al, ibid).

1.5 PRESENT SHORELINE USE

Permanent residential homes occupy about 42 km (25 mi) of the river shoreline in Michigan, while industrial and commercial uses occupy 10 km (6 mi). Most of the shoreline is in private ownership, but 8.1 km (6.1mi) is publicly owned and 5.5 km (3.3 mi) is dedicated to recreation and wildlife preserves. Water of the river is heavily use for industry as well as to receive municipal effluents from the surrounding area. Landuse statistics are not available for the Ontario shoreline.

1.6 CLIMATE AND WEATHER

Mild summers and cold winters generally characterize the climate of the region. Average annual air temperatures range from a high of 23.6^{o}C (77.2^{o}F) in July at Detroit, to a low of 4.4^{o} C 38.8^{o}F) in January at Port Huron. Monthly precipitation ranges from a high of 8.1cm (3.2 in) at Detroit to a low of 3.6 cm (1.4 in) at Port Huron. Water temperatures in the St. Clair system reach about 0.5^{o} C (33^{o}F) in January and February and the annual maximum of about 21-22^{o} C (72^{o}C-74^{o}F)in August. Ice does not occur to a large degree on the river.

The frost-free season or growing season, which is the interval between the last occurrence of frost in spring and the first occurrence in fall, is 160 days. With the exception of the south shores of Lake Ontario, Erie and Michigan, which experience 180 frost-free days, the St. Clair System has the longest growing season in the Great Lakes Basin.

1.7 HYDROLOGY AND WATER LEVELS

The water velocities of the St. Clair River range from 6.0 km/hr (3.6 mi/hr) at the Blue Water Bridge in Sarnia, to 1.1 km/hr (0.7 mi/hr) at Lake St. Clair. The highest velocity generally occurs north of the town of St. Clair, and decreases downstream. The lowest velocities occur in the delta and lake where gradients are significantly decreased. The flow time from Lake Huron to Lake St. Clair is 21.1 hours, and the average fall is 1.5 m (4.5 ft) (Korigian 1963 in Edsell et al, ibid).

The St. Clair River is morphologically unusual in that it is a strait with no large network of tributaries. Sand and gravel are the principle sediments transported by the river, and water clarity is exceptionally high. The river is essentially flowing through glacial moraine and lake plain topography and has cut its channel in lake clays, which are more difficult to erode than sand. This may be why the river runs straighter instead of having meanders and oxbow lakes, typical in many alluvial valleys.

Deltaic landforms occur where substantial quantities of clastic sediment are introduced and deposited into a receiving basin. Sediment is normally eroded from a drainage basin and transported down an alluvial valley by a stream and its tributaries, therefore the rate of delta development is dependent upon the flow regime and the availability of sediments. The principal source of sediment to the St. Clair Delta appears to be the shorelines of Lake Huron and is composed of sand-sized sediments.

The Delta, which is commonly referred to as the St. Clair flats, is the most significant landform in the system. It contains three main distributaries or channels, known as the North, Middle and South Channels. They average 500 m (1,641 ft) wide and 11 m (36.1 ft) deep.

1.8 BIOLOGICAL CHARACTERISTICS

1.8.1 Macrophytes and Macroalgae

At least 21 submersed plant taxa occur in the St. Clair system (see table 4). The most common native taxa are *Chara sp* (macroalga), *Vallisneria americana, Potamogeton richardsonii*, and *Elodea canadensis.* The importance of each species to fish and waterfowl follows table 4.

Three exotic macrophytes have been found in the system to date. Curly pondweed (*Potamogeton crispus*), *Nitellopsis obtusa* and *Eurasion water-milfoil.* Curly pondweed was assumed to have been first introduced from Europe. It may grow 2 m (6.6 ft) long and can spread by re-rooting small fragments. This plant is one of the first aquatic plants to appear in the spring and is very important because it is colonized by insects, which are in turn consumed by waterfowl on their northward migration. It is one of the most abundant macrophytes and serves as important spawning substrate for fish. Eurasion watermilfoil may spread from lake to lake when small fragments are transported via recreational boaters. It is capable of crowding out other aquatic plants used by fish and waterfowl, however it also provides an overwintering mat of decaying vegetation on which many aquatic invertebrates can feed. No detailed studies of emergent macrophytes have bee completed. Over 95% of emergent beds in the river occur in the lower section.

Table 4. Distribution and abundance of submersed plants in the St. Clair system (Schloesser and Manny 1982 in Edsell et al, ibid). Tabular values are the percent frequency of occurrence among stations sampled in each water body segment of the system.

Scientific Name	Common Name	St. Clair River	Lake St. Clair	Anchor Lake Bay
Vallisneria americana	Wild celery	28	42	11
Chara sp.	Muskgrass	68	62	7
Potamogeton richardsii	Redhead grass	49	13	4
Myriophyllum spicatum	Eurasian watermilfoil	28	30	5
Elodea canadense	Waterweed	36	20	4
Heteranthera dubia	Water stargrass	<1	2	4
Potamogeton spp.	Narrow-leaf forms	24	12	0
Najas flexilis	Naiad	<1	43	2
Potamogeton gramineus	Variable pondweed	11	3	0
Ceratophyllum demersum	Coontail	0	3	0
Myriophyllum exalbescens	Watermilfoil	<1	2	0
Nymphaea sp.	Water lily	0	0	0
Potamogeton spp.	Broad-leaf forms	2	0	0
Potamogeton crispus	Curly pondweed	2	0	0
Potamogeton illinoensis	Illinois pondweed	0	0	0
Potamogeton natans	Floating-leaf pondweed	<1	0	0
Potamogeton nodosus	Long-leaf pondweed	2	0	0
Potamogeton zosteriformis	Flatstem pondweed	<1	0	0
Ranunculus sp.	Buttercup	2	2	0

Collectively, submersed and emergent aquatic plants are the dominant primary producers supporting animal populations in some areas of the St. Clair system. They provide substrate for periphyton and for invertebrates, cover for fish, and food for macrobenthos as detritus.

Submersed plants that provide cover and food for fish and waterfowl in Great Lakes connecting channels include: Musk-grass; Coon-tail; Eurasian water- milfoil; Naiad; Water star-grass; Water-weed; Wild celery; Clasping leaf pond-weed; and Narrow leaf pond-weed. These plants provide cover and food for such species as Alewife, Black crappie, Bluegill, Bluntnose minnow, Brown bullhead, Largemouth bass, Muskellunge, Northern pike, Rockbass, Yellow perch, American coot, Black duck, Bufflehead, Canvasback, Common scooter, Goldeneye, Greater scaup, Lesser scaup, Mallard, Redhead, and Ringneck (Edsell et al, ibid).

1.8.2 Vegetation

Appendix 1 provides lists of vegetation found in the St. Clair River watershed. Major upland forest species include beech, sugar maple, basswood, red maple, red oak, white oak and bur oak. Other species that occur sporadically include black walnut, sycamore, swamp white oak, shagbark, hickory, butternut, bitternut hickory, rock elm, silver maple, blue beech, sassafras, tulip-tree, black cherry, mockernut and pignut hickories, chinqapin oak, pin oak, black oak, black hum, blue ash, cucumber-tree, paw paw, kentucky coffee-tree and red mulberry. Conifers are not well represented, but common species include eastern hemlock, white pine, eastern red cedar and eastern white cedar. See Appendix 2 for a complete list of vegetation species found in the area.

1.8.3 Macrozoobenthos

Invertebrates collected between 1976 and 1985 produced 179 different taxa. The most common are the Nematoda (round worms), Oligochaeta (aquatic worms), Amphipoda (crustaceans), Diptera (true flies), Emphemeroptera (Mayflies), Trichoptera (caddisflies), Gastropoda (snails), and Pelecypoda (clams and mussels).

1.8.4 Fish

Historically, Lake Trout, Lake Herring and Lake Whitefish were major seasonal components of the native coldwater fish and fauna in the St. Clair System. All three are northern species with ranges extended to the Arctic drainage, east and west of Hudsons Bay. Lake Trout and Lake Whitefish are among the largest native species in the Great Lakes. All three typically occupy colder, deeper waters in summer. Herring is pelagic, Whitefish is bottom associated, and Trout exist in both habitats.

Lake Sturgeon, Northern Pike, Muskellunge, Walleye, yellow perch are the most important members of the cool water fish community. These species remain in the system all year long, unlike the coldwater species above. The Muskellunge is the second largest fish species and Lake St. Clair is one of the two major centers for abundance in the Great Lakes.

Yellow Perch and Walleye are very important for anglers. Both species are well adapted to large rivers and lakes with habitats similar to rivers. Yellow perch use a wide variety of habitats and feed mainly on fish and invertebrates, and are preyed upon by walleye, pike, bass and sunfish. They reach a maximum size of 1.8 kg (4 lbs), and occupy shallower waters. Walleyes prefer deeper channels, feed on fish and invertebrates and weigh up to 10.0 kg (22 lbs).

Warmwater fish include suckers, catfish, bass, sunfish and the drum families. These species also exist year round. A complete list of fish species found in the St. Clair River is provided in Appendix 2.

<u>Spawning and Nursery Habitat</u>

The St. Clair system provides valuable spawning and nursery habitat for at least 46 species of fish that are a permanent resident of the system or which enter the system from Lakes Huron and Erie to spawn.

Shoals, shallow littoral areas around islands, and river shoulders are the main nursery and spawning areas. These areas have lower water velocities than the main channel. The substrate ranges from rock, gravel and sand to mixtures of sand, silt and organic matter. Submersed and emergent aquatic plants colonize some of the areas. Spawning also occurs in the deeper areas of the main channel where substrate is hard, the cannel edge is a bulkhead, water velocities are high, and rooted aquatic plants are absent.

Historically, large numbers of whitefish and herring migrated from Lake Erie to Lake St. Clair. The Lake Herring were believed to have spawned along the Chara beds along the western side of the lake, while whitefish went farther up stream to spawn in St. Clair River.

Yellow perch spawn along the western shoreline of Lake St. Clair, in Anchor Bay, in the St. Clair Delta and at several locations in the littoral zone of the St. Clair River, and in the Black River. This species also uses this system as a nursery area. Northern pike spawn along the shoreline of Lake St. Clair from the mouth of the Clinton River, around the north side of the lake into the delta, and along the eastern side of the lake to about the mouth of the Thames River. Marshes of the St. Clair Delta are the only recorded muskellunge nursery areas.

Native warmwater species also spawn extensively in the St. Clair system. Longnose gar, bowfin and several species of minnows and sunfishes spawn in embayments, marshes and canals in the Delta. These are also nursery areas. Smallmouth bass spawn in tributaries, near Stag Island, along shore of Lake St. Clair. All of the delta and the shoreline of Anchor Bay are nursery areas. Largemouth bass spawn along the shore of the lake, throughout the delta, embayments and marshes are nursery areas. Channel catfish spawn in the lake, nearshore waters of Anchor Bay and in the Delta and Thames River. St. John’s Marsh on Anchor Bay is an important nursery area. Channel catfish may also spawn in the Belle River, a tributary of the St. Clair River.

Alewives, rainbow smelt and common carp are among the most abundant introduced species in the system. All spawn in the River and its tributaries as will as the delta and near Sand Island at the mouth of the North Channel. White perch are also know to spawn in the system.

<u>Movements</u>

Coldwater fish exhibit the most obvious migrations, historically migrating from the big lakes in the fall to spawn. Lake, Brown and Rainbow Trout and Coho and Chinook salmon are now frequently found in the St. Clair River and Lake St. Clair during the cooler months of the year (Hass et al 1985 in Edsell et al, ibid). Most of the warm and cool water fish that frequent the system however are not strongly migratory. Permanent residents are the small mouth bass, brown bullhead, black crappies, Northern pike, white suckers, and redhorse. White bass and channel catfish move to the River and tributaries in spring and summer to spawn. Rock bass after spawning in the Lake in spring and summer, mover to the River then return to the lake to overwinter in the fall.

1.8.5 Waterfowl

The St. Clair Delta is located at the intersection of the Atlantic and Mississippi flyways and is therefore a vital stopover for migrating waterfowl. In September, local nesting waterfowl gather in large wetlands in the Lake where they are joined by waterfowl from more northerly breeding grounds. Major concentration areas extend from the lower St. Clair River to the middle of the Lake. In October or the beginning of the cold weather, resident and migrating waterfowl begin to funnel southward. The coastal wetlands and shallow waters of the Lake are critical resting and feeding habitat for these fall migrants. Spring migration from southern overwintering grounds begins in Mid-march and usually lasts until mid-April or May. Waterfowl surveys have been carried our consistently since 1987. Prior to 1987, surveys were done but on a very ad hoc basis. Data collected from 1987 to 1998 is found in Appendix 2. For a list of waterfowl known to use the St. Clair system, see Appendix 2.

1.8.6 Other Biota

Few studies have been conducted on the populations of amphibians, reptiles and mammals in the St. Clair system. Thirty-nine species of amphibians and reptiles, including salamanders, frogs, toads, snakes, lizards, and turtles, occur in aquatic, wetland, and adjacent terrestrial habitats in the system. Only the Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), American coot (*Fulica americana*), American woodcock *(Scolopax minor*), and common snipe (*Gallinago gallinago*) are game birds in the Great Lakes area, and do not support a significant hunting industry.

More than a dozen species of medium to large mammals occur in the system including the Virginia opossum (*Didelphis virginiana*), eastern cottontail rabbit (*Sylvilagus floridanus*), muskrat (*Ondatra zibethicus*), striped skunk (*Mephitis mephitis*) and white-tailed deer (*Odocoileus virginianus*) are abundant or common. All are game species or are harvested as furbearers. Muskrats are also valuable because manipulations of their populations can be an effective management technique for maintaining optimum marsh conditions. Muskrats utilize cattails and bulrush as food and shelter, which creates open water areas in the marsh system. When muskrats get too abundant, harvesting is required to allow regrowth of the vegetation.

For a complete list of wildlife found in the St. Clair system, see Appendix 2.

1.8.7 Wetlands

The St. Clair system contains one of the largest coastal wetlands in the Great Lakes - 550 ha (1,359 ac) in the River and 13,230 ha (32,678 ac) in the lake and delta. These figures may be conservative, as wetlands composed of submersed macrophyte stands are common in the system but not well documented on maps and charts. Thirty-two wetlands exist altogether, and can be divided into eight major types of wetlands based on physical settings, which influence soil drainage, type, exposure to currents, waves and composition of plant communities.

Open Water Wetlands - These wetlands have a water depth that does not exceed 2 m (6.6 ft) and contain both submersed and emergent plants and occur in shallow waters along the perimeter of the Lake and in the interdistributary bays. These wetlands are found at Anchor Bay, Fishery Bay, Goose Bay, Muskamoot Bay.

River-Channel Wetlands - largely submersed species, with emergent macrophytes occurring occasionally on point bars. They occur along the River shoulders which are shallow, submerged shoals along the River and the distributary channels. They also occur on the lake shelf, which borders most of the Lake’s shoreline. The shoulder and shelf are approximately 35 m (114.8 ft) wide and water depth does not exceed 2 m (6.6 ft). The River and its main channels in the delta are sites with river-channel wetlands.

Beach and Shoreline Wetlands - these contain a mix of species including trees and shrubs, other terrestrial non-woody plants and emergent species. These plants grow on beach deposits which are often erosional in origin and generally stand 30 cm (12 in) above the lake surface. They are discontinuous, sinuous features and are most common on the Delta. Lower Harsens and Dickinsons Islands contain this wetland type.

Cattail Wetlands - these occur in broad zones in the lower delta and the Clinton River. Stands of hybrid cattails are associated with the more clayey and organic sediments. Shallow openings are colonized by floating and submersed species. These wetlands are typically found in shallowest waters on interdistributary bays and behind dykes. Clinton River and Harsens Island contain these.

Sedge Wetlands - these are found in the shallowest waters of the interdistributary bays on Harsens and Dickinson Islands.

Abandoned River Channel Wetlands - support submerged and emergent aquatics, and occasionally buttonbush is present. The abandoned channels provide the physical setting for these wetlands and can be found on Harsens and Dickinsons Islands.

Wet Meadow Wetlands - contain low, woody plants interspersed with grasses. These wetlands are distinctly above lake level are characteristic of drier settings found along the lower margins of the pre-modern delta. These usually occur landward of cattail and sedge wetlands and can be found on Harsens and Dickinsons Islands.

Shrub Wetlands - dominated by mixed shrubs, water-tolerant trees, and under-story plants. They are usually found landward of the wet meadow wetlands on the drier, lower, pre-modern delta. Dickinson and Harsens Islands also contain these.

Overall, more of the eight types of wetlands occur on the delta than along the River or Lake shorelines.

1.9 ENVIRONMENTAL CONDITIONS RELATED TO HABITAT LOSS

Between 1873 and 1973, the Michigan side of the AOC has suffered a 72% decrease in wetlands while in Ontario, 1,064.4 ha (2,630 ac) were lost between 1965 and 1984 from the mouth of the Thames River to Chenal Ecarte, including channels of the Walpole Island First Nation Unceded Land. Industrialization, urban development and agriculture have caused significant altering of the shoreline, and dykes, which block wetlands from the Lake. This has resulted in the loss of the hydrological functions of wetlands and has minimized spawning, rearing and feeding sites for many fish species.

Losses of other habitat types have not been well documented, however, in reviewing present day conditions of forest and wetland cover (see Section 3) it is clear that significant destruction of wildlife habitat has occurred since pre-settlement time.

Population trends for waterfowl have been studied extensively. Overall, peak use of the St. Clair wetlands by waterfowl has not changed significantly, but the species composition of waterfowl use has. Use of the wetlands between 1968 and 1982 by dabbling ducks such as the American wigeon, Green-winged teal, Blue-winged teal, and Wood duck has shown a 78% decrease in spring use, and a 41% decrease in fall use. Decreases of species such as these, has been offset by increases in use by mallards and Canadian Geese.

APPENDIX 2: VEGETATION AND WILDLIFE SPECIES OF THE AOC

2.1 TREE SPECIES FOUND IN UPLAND SITES IN THE ST. CLAIR RIVER AOC.

Community Type	**Common Name**	**Scientific Name**
Deciduous Hardwoods	red ash	*Fraxinus pennsylvanica*
	white ash	*Fraxinus americana*
	blue ash	*Fraxinus quadrangulata*
	swamp white oak	*Quercus bicolor*
	pin oak	*Quercus palustris*
	burr oak	*Quercus macrocarpa*
	red oak	*Quercus rubra*
	white oak	*Quercus alba*
	chestnut oak	*Quercus prinus*
	silver maple	*Acer saccharinum*
	sugar maple	*Acer saccharum*
	red maple	*Acer rubrum*
	American elm	*Ulmus americana*
	shagbark hickory	*Carya ovata*
	bitternut hickory	*Carya cordiformis*
	eastern cottonwood	*Populus deltoides*
	beech	*Fagus grandifolia*
	basswood	*Tilia americana*
	ironwood	*Ostrya virginiana*
	black cherry	*Prunus serotina*
	red mulberry	*Morus rubra*
	pawpaw	*Asimina triloba*
	black gum	*Nysaa sylvatica*
	honey locust	*Gleditsia triacanthos*
	sassafras	*Sassafras albidum*

Community Type	Common Name	Scientific Name
	tulip tree	*Liriodendron tulipfera*
	sweet chestnut	*Castanea dentata*
<u>Boreal Species</u>	black spruce	*Picea mariana*
	tamarack	*Larix larcinia*
<u>Broad-ranging Conifers</u>	white pine	*Pinus strobus*
	white cedar	*Thuja occidentalist*
	eastern hemlock	*Thuja canadensis*
<u>Shrub Ecotones</u>	eastern cottonwood	*Populus deltoides*
	quaking aspen	*Populus tremuloides*
	red ash	*Fraxomis pennylvanica*
	red osier dogwood	*Cornus stolonifera*
	gray dogwood	*Cornus racemosa*
	wild grape	*Vitus palmata*
	hawthorn	*Cruataequs sp.*

2.2 RARE VASCULAR PLANTS OF THE WALPOLE ISLAND UNCEDED LAND. (from Woodliffe 1988).

Scientific Name	Common Name	Habitat
Eragrostis capillaris (L.) Nees[2]	Lace grass	sandpit
Koeleria cristata (Ledeb.) Schultes	June grass	prairie/savannah
Leptoloma cognatum (Shultes)	Chase Fall witch grass	prairie
Dichanthelium clandestinum (L.) Gould & Clark	Broadleaf panic grass	woods
Dichanthelium leibergii (Vasey) Freckmann	Leiberg's panic grass	prairie
Dichanthelium praecocius Hitchcock & Chase	Early-branching panic grass	prairie
Dichanthelium meridionale Ashe[2]	Panic Grass	prairie
Dichanthelium sphaerocarpon (Ell.) Gould	Panic Grass	prairie/savannah
Sphenopholis obtusata (Michx.) Scribn.	Early bunchgrass	prairie/savannah
Stipa spartea Trin.	Needle grass	prairie/savannah
Bulbostylis capillaris (L.) Clarke	Hair-like bulbostylis	disturbed area
Carex bicknellii Britton	Sedge	prairie
Carex conoidea Willd.	Sedge	prairie/savannah
Carex emoryi	Dewey Sedge	prairie
Carex formosa	Dewey Sedge	prairie/woods
Carex gracilescens Steudel	Sedge	prairie
Carex meadii Dew.	Sedge	prairie
Carex muskingumensis Schw.	Sedge	wet woods
Carex suberecta (Olney) Britt.	Sedge	prairie
Carex swanii (Fern.) Mack.	Sedge	savannah

Carex tetanica Schkuhr	Sedge	prairie
Cyperus erythrorhizos Muhl.	Red-rooted cyperus	savannah
Fimbristylis spadicea (L.) Vahl[2]	Fimbristylis	prairie
Scripus clintonii	Gray Clinton's club-rush	prairie
Scleria triglomerata Michx.	Tall nut-rush	prairie
Scleria verticillata Muhl ex Willd.	Low nut-rush	prairie
Tradescantia ohiensis Raf.	Ohio spiderwort	prairie/savannah
Juncus acuminatus Michx.	Sharp-fruited rush	prairie/disturbed
Juncus greenei Oakes & Tuckerm.	Rush	prairie/savannah
Aletris farinosa L.	Colic-root	prairie/savannah
Hypoxis hirsuta (L.) Cov.	Yellow star-grass	prairie
Sisyrinchium albidum Raf.	Blue-eyed grass	prairie
Aplectrum hyemale (Muhl. ex Willd.) Nutt	Putty-root	woods
Cypripedium candidum Muhl. ex Willd.	Small white lady's-slipper	prairie
Platanthera blephariglottis (Willd.) Hooker	White-fringed orchid	roadside ditch
Platanthera leucophaea (Nutt.) Lindl.	Prairie white-fringed orchid	prairie
Spiranthes lacera Raf. var. gracilis (Bigel.) Luer	Southern slender lady's-tresses	prairie
Spiranthes magnicamporum Sheriak	Great Plains ladies'-tresses	prairie/savannah
Spiranthes ochroleuca (Rydb. ex Britt.) Rydb.	Yellow ladies'-tresses	savannah
Spiranthes ovalis Lindley[2]	Oval ladies'-tresses	prairie
Carya laciniosa (Michx. f.)	Loud Big shellbark hickory	woods/savannah
Quercus palustris Muenchh.	Pin oak	woods/savannah
Polygonum tenue Michx.	Knotweed	roadside/savannah
Cerastium velutinum Raf.	Chickweed	savannah
Hydrastis canadensis L.	Golden-seal	woods
Thalictrum revolutum D.C.	Waxy meadow-rue	savannah
Liriodendron tulipifera L.	Tulip-tree	woods
Agrimonia parviflora Ait.	Agrimony	prairie
Geum vernum (Raf.)	Torr & Gray Spring avens	prairie
Rosa setigera Michx.	Prairie rose	prairie/savannah
Baptisia tinctoria (L.) R. Br.	Wild indigo	prairie/savannah
Desmodium rotundifolium (Michx.) D.C.	Prostrate tick-trefoil	woods
Gymnocladus dioica (L.) K. Koch	Kentucky Coffee-tree	wood edge
Lupinus perennis L.	Wild lupine	savannah
Vicia caroliniana	Walt Carolina vetch	prairie/savannah
Ptelea trifoliata L.	Hop-tree	shorelines
Polygala incarnata L.[2]	Pink milkwort	prairie
Aesculus glabra Willd.[2]	Ohio buckeye	woods
Lechea pulchella Raf.	Pinweed	savannah
Lechea villosa Ell.	Hairy pinweed	savannah
Hibiscus moscheutos L.	Swamp rose mallow	marshes
Lythrum alatum Pursh	Wing-angled loosestrife	prairie
Nyssa sylvatica Marsh.	Black gum	roadsides
Ludwigia polycarpa Short & Peters	Many-seeded ludwigia	woods/disturbed
Bartonia virginica (L.) BSP.	Virginia bartonia	woods/disturbed
Gentiana alba Muhl.	White gentian	savannah
Gentiana puberulenta Pringle	Downy gentian	N/A
Gentianella quinquefolia (L.) Small	Stiff gentian	prairie/savannah
Asclepias purpurascens L.	Purple milkweed	prairie/savannah
Asclepias sullivantii Engelm.	Sullivant's milkweed	prairie
Cuscuta cephalanthi Engelm.	Dodder	prairie
Cuscuta coryli Engelm.	Dodder	prairie/savannah

Phyla lanceolata Michx.	Fog fruit	
Blephilia ciliata (L.) Benth.	Downy wood-mint	prairie
Lycopus rubellus Moench	Stalked water-horehound	woods
Agalinis gattingeri (Small)	Small Gattinger's agalinis	prairie
Agalinis skinneriana (Wood) Britt.	Skinner's agalinis	prairie
Aureolaria pedicularia (L.) Raf.	Fern-leaved false foxglove	savannah
Veronicastrum verginicum (L.) Farw.	Culver's-root	prairie/savannah
Aster dumosus L. var. strictior T. & G.	Bushy aster	prairie/savannah
Aster praealtus Poir. var. praealtus	Willow aster	prairie/savannah
Bidens coronata (L.) Britt	Southern tickseed	wetlands
Cirsium hillii (Canby)	Fern Hill's Thistle	prairie
Coreopsis tripteris L.	Tall coreopsis	prairie/savannah
Eupatorium purpureum L.	Purple-jointed joe-pye weed	woods
Hieracium longipilum Torr.	Long-bearded hawkweed	N/A
Krigia biflora (Walt.) Blake	Two-flowered cynthia	prairie/savannah
Liatris aspera Michx.	Rough blazing star	savannah
Liatris spicata (L.) Willd.	Dense blazing star	prairie/savannah
Ratibida pinnata (Vent.) Barnh.	Gray-headed coneflower	prairie
Silphium terebinthinaceum Jacq.	Prairie dock	prairie
Solidago riddellii Frank	Riddell's goldenrod	prairie
Solidago rigida L.	Stiff-leaved goldenrod	prairie/savannah
Solidago speciosa Nutt.	Showy goldenrod	prairie/savannah
Vernonia gigantea (Walt.) Trel. ex Banner & Coville	Tall ironweed	prairie/savannah

[2]Only known Canadian location.

2.3 TRANSITIONAL PLANT SPECIES COMMON TO THE ST. CLAIR RIVER AOC.

Community Type	Common Name	Scientific Name
Wet Meadows	quaking aspen	*Populus tremuloides*
	red ash	*Fraxinus pennsylvanica*
	red osier dogwood	*Cornus stolonifera*
	swamp rose	*Rosa palustris*
	golden rods	*Solidago sp.*
	bluejoint grass	*Calamagrostis canadensis*
	fowl meadow grass	*Poa palustris*
	rice cutgrass	*Leersia oryzoides*
	panic grass	*Panicum sp.*
	tussock sedge	*Carex stricta*
	swamp milkweed	*Asclepias incarnata*
	soft rush	*Juncus effusus*
	marsh fern	*Dryopteris thelypteris*
	silverweed	*Potentilla anserina*
Sedge Marshes	bluejoint grass	*Calamagrostis canadensis*
	tussock sedges	*Carex stricta*
	duckweed	*Carex lacustris*
	pickerel weed	*Pontederia cordata*
	waterweed	*Elodea canadensis*
	water smartweed	*Polygonum amphibium*
	curly pondweed	*Potamogeton crispus*
	pondweeds	*Potamogeton spp.*

buttonbush	*Cephalanthus occidentali*
muskgrass or stonewart	*Chara sp.*
filamentous green algae	*Cladophora sp.*

Island Shorelines and Transgressive Beaches

eastern cottonwood	*Populus deltoides*
staghorn sumac	*Rhus typhina*
willows	*Salix spp.*
reed canary grass	*Phalaris arundinacea*
bluejoint grass	*Calamagrostis canadensis*
tussock sedge	*Carex stricta*
touch-me-not, jewel weed	*Impatiens capensis*
reed grass	*Phragmites australis*
swamp thistle	*Cirsium muticum*
stinging nettle	*Urtica dioica*
morning glory	*Convoluvulus sepium*
black bindweed	*Polyogonum convolvulus*

2.4 BIRDS SPECIES OCCURRING IN THE VICINITY OF LAKE ST. CLAIR AND ST. CLAIR RIVER COASTAL WETLANDS

Species Residence Status* Class Aves (birds)

Waterfowl

Order Anseriformes
Family Anatidae (swans, geese, and ducks)
Subfamily Anserinae (swans and geese)
Tribe Cygnini
Cygnus columbianus (tundra swan)
Cygnus olor (mute swan)
Tribe Anserini
Anser albifrons (white-fronted goose)
Branta canadensis (Canada goose)
Chen caerulescens (snow goose)
Subfamily Anatinae (ducks)
Tribe Cairinini
Aix sponsa (wood duck)
Tribe Anatini (dabbling ducks)
Anas crecca (green-winged teal)
Anas rubripes (American black duck)
Anas platrrhynchos (mallard)
Anas acuta (northern pintail)
Anas discors (blue-winged teal)
Anas clypeata (northern shoveler)
Anas strepera (gadwall)
Anas americana (American wigeon)
Tribe Aythyini (diving ducks)
Aythya valisineria (canvasback)
Aythya americana (redhead)

Aythya collaris (ring-necked duck)
Aythya marila (greater scaup)
Aythya affinis (lesser scaup)
Tribe Mergini
Clangula hyemalis (oldsquaw)
Bucephala clangula (common goldeneye)
Bucephala albeola (bufflehead)
Lophodytes cucullatus (hooded merganser)
Mergus merganser (common merganser)
Mergus serrator (red-breasted merganser)
Tribe Oxyurini
Oxyura jamaicensis (ruddy duck)

<u>Waterbirds</u>

Order Podicipediformes
Family Podicipedidae (grebes)
Podiceps auritus (horned grebes)
Podilymbus podiceps (pied-billed grebe)
Order Pelecaniformes
Family Pelecanidae (pelicans)
Pelecanus erythrorhynchos (white pelican)
Order Gruiformes
Family Rallidae (rails, moorhens, and coots)
Rallus elegans (King rail)
Rallus limicola (Virginia rail)
Porzana carolina (Sora)
Gallinula chloropus (Common moorehen)
Fulica americana (American coot)

<u>Wading Birds</u>

Order Ciconiiformes
Family Ardeidae (herons)
Botaurus lentiginosus (American bittern)
Ixobrychus exilis (Least bittern)
Ardea herodias (Great blue heron)
Casmerodius albus (Great egret)
Bubulcus ibis (Cattle egret)
Butorides striatus (Green-backed heron)
Nyticorax nyticorax (Black-crowned night-heron)

<u>Shorebirds</u>

Order Charadriiformes
Family Charadriidae (plovers)
Charadrius semipalmatus (Semipalmated plover)
Charadrius vociferous (Killdeer)
Pluvialis squatarola (Black-bellied plover)
Family Scolopacidae (sandpipers)
Tringa melanocleuca (Greater yellowlegs)

Tringa flyipes (Lesser yellowlegs)
Actitus macularia (Spotted sandpiper)
Bartramia longicauda (Solitary sandpiper)
Calidris alba (Sanderling)
Calidris minutilla (Least sandpiper)
Calidris melanotos (Pectoral sandpiper)
Calidris alpina (Dunlin)
Limnodromus scolopaceus (Long-billed dowitcher)
Arenaria interpres (Ruddy turnstone)
Scolopax minor (American woodcock)
Gallinago gallinago (Common snipe)

Gulls and Terns

Order Charadriiformes
Family Laridae (gulls and terns)
Subfamily Larinae (gulls)
Larus philadelphia (Bonaparte's gull)
Larus delawarensis (Ring-billed gull)
Larus hyperboreus (Glaucous gull)
Larus argentatus (Herring gull)
Larus minutus (Little gull)
Larus marinus (great black-backed gull)
Larus glaucoides (Iceland gull)
Subfamily Sterinae (terns)
Sterna caspia (Caspian tern)
Sterna hirundo (Common tern)
Sterna forsteri (Forster's tern)

Raptors

Order Falconiformes
Family Accipitridae (ospreys)
Pandion haliaetus (Osprey)
Family Accipitridea (hawks, eagles)
Subfamily Accipitrinae
Haliaeetus leucocephalus (Bald eagle)
Circus cyaneus (Northern harrier)
Accipiter striatus (Sharp-shinned hawk)
Accipiter cooperii (Cooper's hawk)
Aquila chrysaetos (Golden eagle)
Buteo jamaicensis (Red-tailed hawk)
Buteo lagopus (Rough-legged hawk)
Buteo platypterus (Broad-winged hawk)
Family Falconidea (falcons)
Falco sparverius (American kestrel)
Order Strigiformes
Family Strigidea (owls)
Asio flammeus (Short-eared owl)

Perching and Other Birds

Order Coraciiformes
Family Alcedinidae (kingfishers)
Ceryle alcyon (Belted kingfisher)
Order Passeriformes
Family Troglodytidae (wrens)
Cistothorus palustris (Marsh wren)
Cistothorus platensis (Sedge wren)
Family Musicapidae (thrushes)
Catharus fuscescens (Veery)
Family Emberizidae
Subfamily Parulinae (wood warblers)
Dendroica petechia (Yellow warbler)
Geothlypis trichas (Common yellowthroat)
Subfamily Icterinae
Sturnella magna (Eastern meadowlark)
Xanthocephalus santhocephalus (Yellow-headed blackbird)
Agelaius phoeniceus (Red-winged blackbird)
Quiscalus quiscula (Common grackle)
Subfamily Emberizinae (sparrows)
Melospiza georgiana (Swamp sparrow)
Passerculus sandwichensis (Savannah sparrow)

Data sources: Peterson (1980), Herdendorf et al (1981c), Scott (1983)

2.5 AMPHIBIANS AND REPTILES OCCURRING IN THE COASTAL WETLANDS OF LAKE ST. CLAIR AND THE ST. CLAIR FLATS

Species Abundance Status
Class Amphibia (amphibians)

Order Caudata (salamanders)
Necturus maculosus (Mudpuppy)
Notophthalmus viridescens (Red-spotted newt)
Ambystoma tigrinum (Eastern tiger salamander)
Ambystoma laterale (Blue-spotted salamander)
Ambystoma maculatum (Spotted salamander)
Plethodon cinereus (Red-backed salamander)
Midactylium scutatum (Four-toed salamander)
Order Salientia (frogs and toads)
Bufo americanus (American toad)
Hyla crucifer (Northern spring peeper)
Hyla versicolor (Gray treefrog)
Pseudacris triseriata (Western chorus frog)
Acris crepitans blanchardi (Blanchard’s cricket frog)
Rana clamitans melanota (Green frog)
Rana catesbeiana (Bullfrog)
Rana pipiens (Northern leopard frog)
Rana palustris (Pickerel frog)
Rana sylvatica (Wood frog)

Order Squamata (snakes and Lizards)
Natrix s. spiedon (Northern water snake)
Thamnophis s. sirtalis (Eastern garter snake)
Thamnophis butleri (Butler's garter snake)
Hamnophis sauritus septentrionalis (Northern ribbon snake)
Storeria o. occipitomaculata (Northern red-bellied snake)
Storeria d. dekayi (Northern brown snake)
Storeria dekayi wrightorum (Midland brown snake)
Heterodon platyrhinos (Eastern hognose snake)
Diadophis punctatus edwardsi (Northern ringneck snake)
Opheodrys v. vernalis (Eastern smooth green snake)
Coluber constrictor foxi (Blue racer)
Elaphe vulpina gloydi (Eastern fox snake)
Elaphe o. obsoleta (Black rat snake)
Lampropeltis t. triangulum (Eastern milk snake)
Sistrurus c. catenatus (Eastern massasauga)

Order Testudines (turtles)
Chelydra s. serpentina (Snapping turtle)
Clemmys guttata (Spotted turtle)
Sternothaerus odoratus (Stinkpot)
Graptemys geographica (Map turtle)
Chrysemys picta marginata (Midland painted turtle)
Emydoidea blandingi (Blanding's turtle)
Trionyx s. spiniferus (Eastern spiny softshell)
Data sources: Ruthven et al., (1928), Conant (1975), Behler and King (1979), Herdendorf et al., (1981c)

2.6 MAMMALS OF THE WALPOLE ISLAND UNCEDED LAND (Woodliffe 1988).

Scientific Name	Common Name
Sorex cinereus	masked shrew
Blarina brevicauda	short-tailed shrew
Eptesicus fuscus	big brown bat
Lasiurus borealis	red bat
Lepus europaeus	European hare
Sylvilagus floridanus	eastern cottontail
Tamias striatus	eastern chipmunk
Marmota monax	woodchuck
Sciurus carolinensis	grey squirrel
Tamiasciurus hudsonicus	American squirrel
Glaucomys volans	southern flying squirrel
Castor canadensis	Canadian beaver
Peromyscus maniculatus	deer mouse
Peromyscus leucopus	white-footed mouse
Microtus pennsylvanicus	meadow vole
Ondatra zibethica	muskrat
Anis latrans	coyote
Vulpes bulpes	red fox
Procyon loto	raccoon
Mustela erminea	short-tailed weasel
Mustela vison	mink

Taxidea taxu	badger
Mephitis mephitis	striped skunk
Odocoileus virginianus	white-tailed deer

2.7 SIGNIFICANT BREEDING BIRDS OF WALPOLE ISLAND UNCEDED LAND.

Horned grebe
Least bittern
Great egret
Cattle egret
Cooper’s hawk
Bald eagle
Northern bobwhite
Canvasback
Redhead
Northern shoveler
Ruddy duck
Sandhill crane
King rail
Little gull
Forster’s tern
Caspian tern
Black tern
Acadian Flycatcher
Tufted titmouse
Eastern bluebird
White-eyed vireo
Prothonotary warbler
Louisiana waterthrush
Hooded warbler
Yellow-breasted chat
Yellow-headed blackbird
Orchard oriole
Henslow’s sparrow

APPENDIX 3: LITERATURE REVIEW

3.1 A FRAMEWORK FOR GUIDING HABITAT REHABILITATION IN GREAT LAKES AREAS OF CONCERN (Environment Canada et al, 1998)

Environment Canada et al (1998), has developed a framework to assist RAP teams and PAC teams in establishing targets for habitat rehabilitation in AOCs. Guidelines have been developed based on literature reviews that if achieved will eventually lead to the delisting of habitat in the AOC. The guidelines provided represent a "best case scenario" for ecosystem health in a watershed. As each AOC differs in its sociologic and economic makeup these guidelines must be adjusted to individual targets that fit the needs of each AOC.

The following is a summary of the guidelines presented in the framework for wetland, forest and riparian habitat.

Table 5: A Summary of Habitat Restoration Guidelines for AOCs.

PARAMETER	FRAMEWORK TARGET
% forest cover	>30%
size of largest forest patch	minimum 100 ha
% watershed with forest cover 100 m from edge	>10%
% watershed with forest cover 200 m from edge	>5%
% wetlands in watershed	>10% or restore to original
% wetlands in subwatersheds	6%
amount of vegetation adjacent to wetland	240 m
% natural vegetation	- 75% natural vegetation - 75% buffers > 30 m
% baseflow of average annual flow	>25%
total suspended solids concentrations	<25 mg/L
stream sinuosity	meander every 5-7 channel widths

Parameter Guideline:

- Percent Wetlands in Watershed Greater than 10% of each major watershed in wetland habitat, greater than 6% of each sub-watershed in wetland habitat, or restore to original percentage of wetlands in the watershed.

- Amount of Natural Vegetation Adjacent to the Wetland: greater than 240 m (790 ft) of adjacent habitat that may be herbaceous or woody vegetation.

- Wetland Type: The only two wetland types suitable for widespread rehabilitation are marshes and swamps.

- Wetland Location: Headwater areas for groundwater recharge; floodplains for flood attenuation; and coastal wetlands for fish production.

- Wetland Size: Swamps should be as large as possible to maximize interior forest habitat. Marshes of various sizes attract different species and a range of sizes is beneficial across a landscape (Environment Canada et al,1998).

The framework suggests that a minimum buffer of 240 m (790 ft) is essential for filtering excessive nutrients and providing wildlife cover and nesting sites. Ultimately, a 3:1 ratio of upland habitat to marsh habitat is preferred. This guideline may be obtainable for small marshes, but is likely impractical for larger sized wetlands. Less than a 30 m (98 ft) buffer results in extremely low reproductive success and reduced species diversity. A 240 m (790 ft) buffer however, may not be sufficient by itself, in many cases. Adjacent land practices such as road construction and forest removal even up to 2 km (1.2 mi) away will pose risks to wetland biodiversity by impeding migrations, modifying wetland hydrology and road kills.

The framework suggests that marsh and swamp are the most feasible types of wetlands to restore as little is known about recreating bogs and fens. Marshes are even more feasible than swamps to restore, as a marsh can become functional within one to two years, while a swamp may take several years or even decades to become fully functional.

Wetlands will be beneficial anywhere in a watershed, however, the framework has suggested some optimal choices. Headwater swamps are critical in controlling temperature regime, protecting ground water discharge areas, and providing nutrients to the stream system. On-stream or floodplain marshes should be restored on second and third order streams to asynchronize flood peaks and to preserve water quality.

Coastal wetlands are critically imperilled habitats and should be rehabilitated and recreated wherever possible (based on historical landscape). The mouth of an inlet stream is suggested as a first priority so as to benefit fish spawning. A second priority would be the expansion of existing coastal marshes.

Different wildlife species have shown differing preferences for wetland size. Therefore, a mosaic of wetland sizes within the watershed is optimal. Marshes function best with irregular shapes, and a high interspersion of open water, submergent and emergent vegetation. Generally, a 1:1 ratio of open water to vegetation is optimal.

<u>Guidelines for Riparian Habitat in AOCs</u>

Parameter Guidelines:

- Percent of natural vegetation along streams 75% of stream length should be naturally vegetated

- Amount of natural vegetation adjacent to streams: streams should have a 30 m (98 ft) natural vegetated buffer on both sides

- Total Suspended Solids: Suspended Solids concentrations should remain below 25 mg/L for the majority of the year

- Percent of an urbanized watershed that is impervious: less than 15% imperviousness in an urbanized watershed should maintain stream water quality and quantity; and leave biodiversity relatively unimpaired.

- Fish Communities Targets are set based on knowledge of underlying characteristics of watershed (drainage area, surficial geology, flow regime), historically and naturally occurring fish communities, and factors presently impacting the system and their relative magnitudes (Environment Canada et al, 1998).

The suggested buffer width is based on literature reviews that describe functions for different buffer sizes. The framework reports that buffers of 3 to 100 m (10 to 328 ft) to maintain species diversity, 3 to 200 m (10 to 656 ft) for wildlife movement, 10 to 60 m (35 to 196 ft) for sediment removal, 3 to 90 m (10 to 295 ft) for nutrient removal, and 15 to 30 m (50 to 98 ft) is necessary for water temperature moderation. A 30 m (98 ft) buffer strip may not be feasible in many areas within the AOC as a great deal of the land is in private ownership.

<u>Guidelines for Forest Habitat in AOCs</u>

Parameter Guidelines:

- Percent of forest cover: 30 % of watershed should be in forest cover

- Size of largest forest patch: at least one 200 ha (490 ac) forest patch which is a minimum of 500 m (1,640 ft) wide

- Percent of watershed that is forest cover 100 m (328 ft) and 200 m (656 ft) from forest edge: greater than 10% forest cover 100 m (328 ft) from the edge and greater than 5% forest cover 200 m (656 ft) from the edge

- Forest shape and proximity to other forest patches: forest patches should be circular or square in shape and in close proximity (i.e., 2 km/1.2 miles) to adjacent patches.

- Fragmented landscapes and the role of corridors: Corridors designed to facilitate species movement should be a minimum of 100 m (328 ft) wide and corridors designed for specialist species should be a minimum of 500 m (1,640 ft) wide

- Forest quality, species composition, age and structure: watershed forest cover should be representative of the full diversity of forest types found in that ecoregion (Environment Canada et al,1998).

The framework sets guidelines for several forest parameters including overall percent forest cover, size of the largest forest patch and interior forest habitat. Table 5 provides a summary of the forest habitat guidelines presented in the framework.

The framework has produced a chart documenting the presence of forest bird species breeding in southern Ontario in relation to habitat size (interior forest). Findings show that as the amount of forest declines, so does the number of breeding bird species. Table 6 shows targets and thresholds for the protection of bird species.

Table 6: The Relationship Between Forest Cover and the Protection of Forest Bird Species.

Parameter	**Target**	**Threshold and Level of Protection Provided**
percent forest cover in watershed	>30%	20-30% 90% of bird species 15-20% 80% of bird species 10-15% 60-70% of bird species <10% 50-60% of bird species, but only approximately 20% of forest interior species
size of largest forest patch	100 ha minimum	none provided
% of watershed that is interior forest > 100 m from edge	>10%	5-10% 80-90% of interior bird species 2-5% 60-80% of interior bird species, but restricted distribution <2% Maximum 50% of interior bird species, 1 or 2 locations
% of watershed that is interior forest >200 m from edge	>5%	3-5% 70-80% of bird species 1-3% 40-70% of bird species, restricted distribution <1% Fewer interior species

A forest patch size of 100 ha (2,470 ac) is considered to be an absolute minimum guideline as many of the true forest interior species are rare in forests this small. Studies have shown that a single 100 ha (247 ac) forest tract in a watershed is too small to support any viable populations of breeding forest interior birds, a 200 ha (494 ac) tract would serve 80% of breeding bird species, while several large tracts would support 90% to 100%.

The framework also provides a table showing wildlife use (i.e. mammals, amphibians, reptiles etc.) of various size and types of habitats (i.e. 1 ha/2.5 ac forest, 1 ha/2.5 ac marsh, and 1ha/2.5 ac grassland and savannah etc.). It shows that even a patch as large as 1,000 ha (2,470 ac) will be not be sufficient for many forest-dependent mammals and some grassland species. It is clear that the larger the habitat the better, for all communities and wildlife species. The framework suggests that each AOC should have at least one forest patch that is 200 ha (494ac) in size.

PARAMETER	FRAMEWORK TARGET	ST. CLAIR TARGET	ST. CLAIR STUDY AREA
% forest cover	>30%	20%	13.2%
size of largest forest patch	minimum 100 ha	75 ha	3,039 ha (55 forest patches greater than 100 ha)
% watershed with forest cover 100 m from edge	>10%	5%	2.6% (1,741 forest patches covering 9980 ha)
% watershed with forest cover 200 m from edge	>5%	3%	0.7% (334 forest patches covering 2,437 ha)
% wetlands in watershed	>10% or restore to original	10%	not currently available
% wetlands in subwatersheds	6%	6%	not currently available
amount of vegetation adjacent to wetland	240 m	120 m	not currently available
% natural vegetation	- 75% natural vegetation - 75% buffers > 30 m	- 50% - 15 m	- 13.4% (stream lengths through forests) - not currently available

3.2 ST. CLAIR/SYDENHAM RIVER REGIONAL HABITAT MANAGEMENT PLAN (RLSN 1995)

This management plan encompasses an area including the North Branch of the Sydenham River, the Chenal Ecarte, the southern end of the St. Clair River and the eastern portion of Lake St. Clair. It is a multi-year fish and wildlife habitat creation/enhancement strategy designed to increase populations and expand upon the internationally significant habitat that exists in the area. A landscape approach to fish and wildlife management and rehabilitation is undertaken, recognizing the importance of agriculture, wetlands, woodlands and grasslands, and the intrinsic role each plays in wildlife habitat management.

Over 8,800 ha (21,736 ac) of agricultural and wetland areas were identified as potential rehabilitation sites with the goal of establishing demonstration sites showing best management practices or state of the art techniques for managing agriculture land, wetland, woodland, prairie lands, fisheries and wildlife. Of this 8,800 ha (21,736 ac), nearly 1,300 ha (3,211 ac) is publicly owned. Securement of the remaining lands will be attempted through several techniques, some of which include: simple acquisition, lease, tax rebate, dedications, donation and conservation easements.

Proposed management techniques for the area include a tall grass prairie seed cooperative that will act as a source for native stock. Experimental test plots will be conducted to determine the most suitable seed mixes for site specific conditions. Dyke breaching, dyke creation, drop tube inlets and water control valves will be employed for wetland creation on areas that fall within the floodplain. Dyke fjords will be created to provide fish access into water impoundment wetlands while allowing management of aquatic vegetation by lowering the water levels. Wetland pothole creation will be employed in an attempt to imitate the western prairie pothole formations.

Travel corridors to connect isolated areas to riparian and wooded areas are targeted for planting with native species. Areas of marginal farmland will be selected throughout the proposal area to plant several herbaceous species that will benefit all types of wildlife. Management of forest openings and edge by mowing, burning and planting, will improve the conditions of these areas for wildlife. Stream bank stabilization where erosion is severe, eliminating livestock access to streams, spawning bed improvements and creation, fish ladders, and offshore island creations are a few other techniques that will be employed. Demonstration sites promoting conservation tillage and strip cropping trials were proposed to help encourage farmers to adopt best management practices.

To date, specialized equipment for conservation tillage and strip cropping have been purchased through the cleanup fund to be shared among communities and landowners. Some other projects that have been initiated and completed which support the goals of habitat rehabilitation and water quality improvement within the area of concern include:

Tall Grass Prairie Nursery - two nursery sites totaling 20 ha (49 ac) have been planted to date. Over 40 species of grasses and flowering plants are available.

Wilkesport Wetland Creation/Demonstration - A pit created from the removal of gravel for a bridge constructed in Lambton County was chosen as a wetland creation site. Two wetland potholes were graded totaling 3.2 ha (8 ac) of wetland. 3.6 ha (8.9 ac) of riparian habitat surrounding the wetland was planted with 19 species of tallgrass prairie.

MacDonald Park, located on the St. Clair River Parkway, was a marsh in its natural state. Over the years, the marsh gradually became filled from localized dredging activities. This site was chosen among several sites to demonstrate how fish and wildlife habitat can be rehabilitated. Some of the activities included: shoreline restoration by reworking the shoreline to a more gradual slope and meander; excavation of a wetland and fish spawning channel; revegetation of native plant species, and bioengineering to stabilize the shoreline. Throughout the park over 30,000 prairie plugs were planted, and over 200 m (656 ft) of shoreline was stabilized using bioengineering methods.

Stag Island Rehabilitation - Stag Island is on the St. Clair River near the town of Corunna in Lambton County. Eight ha (20 ac) of land has been targeted for planting with tallgrass prairie and shrubs. In June 1997, 200,000 plants were planted for wildlife habitat and shoreline protection.

Wellington Prairie Project - this project involves the planting of native Tall grass prairie plants on 4 ha (10 ac) of a hydro corridor in the city of Sarnia in 1997 and a further 4 ha (10 ac) planned for 1998.

3.3 AN EVALUATION FRAMEWORK FOR NATURAL AREAS IN THE REGIONAL MUNICIPALITY OF OTTAWA-CARLETON (Brownell and Larson 1995)

This report was completed for the planning and property services department to identify natural areas in the region. This project uses a gap analysis approach to identify biodiversity needs. The procedure for this project was:
The selection of candidate core natural areas and linkages; Conduct a gap analysis to determine if there are significant features or critical functions being performed that are not adequately represented on public lands

Implementation guidelines for the Comprehensive set of Provincial Policy Statements which came into effect on March 28, 1995, under planning reform in Ontario (Ontario Ministry of Municipal Affairs, 1995 in RMOC 1995) suggest 40 ha (100 ac) as an appropriate standard for natural woodlot protection in areas with 15% to 30% forest cover. For townships with 5% to 15%, any woodlot 4 ha (10 ac) in size or larger may be considered (i.e. many of the townships in the St. Clair River watershed).

The quality of the woodlot also needs to be considered along with size, as well as percentage of forested area occurring on physiographic features such as limestone, clay or sand plain. This would provide a more ecologically based representation.

A gap analysis has a significant role to play in the final assessment of significant core natural areas and linkages. It will reveal three types of areas:

- Areas that are protected already through legislation or public ownership
- Areas that appear to fulfil final evaluation criteria for designation as an excellent core area
- Areas highlighted as potentially significant based on initial selection criteria

For this project, seven criteria were used. Criteria based on size and shape was avoided as the exact extent of their relationships to biodiversity is not well understood. Criteria that employ a more accurate measure of biodiversity, productivity and hydrology should be used. Vegetation based criteria are excellent because vegetation integrates underlying physical habitat variables. All living things ultimately depend on vegetation; therefore it should have primal importance. It also avoids having to manage and inventory each species individually therefore it is more cost effective.

3.4 St. Clair River Watershed, Black River Resource Plan, Southeast Michigan River Basin Study (U.S. Department of Agriculture, 1997)

The aim of the study was to enhance and complement existing or ongoing plans and studies, and to identify resource problems, concerns and opportunities in the St. Clair River watershed. The report focuses on the Black River watershed due to the range of land uses and provides a plan that identifies the major sources of land and water degradation occurring in the St. Clair River watershed. Strategies are also developed as a means of solving resource concerns.

A local coordinating committee was organized to provide input regarding resource concerns and to assist in locating data. The coordinating committee selected the following concerns/issues and provided potential solutions for: sewage disposal; runoff from agriculture, golf courses, lawns, construction; misuse of toxic chemicals; inadequate land use control; lack of preservation of existing natural cover; and, landfills.

The priority concern of the committee was untreated sewage overflowing into the River, either through combined sewer overflows, or outdated poor land use policies on private properties. Some of the proposed solutions included stronger regulations to be enforced on violators; expansion of recycling; septic tank inspection; and, use of Best Management Practices for households through education. Matching funds were also mentioned as incentives, as well as, mandating larger lot sizes to accommodate sewage disposal, promoting multi-jurisdictional discussions and approaches, separation and treatment of stormwater from sewage, education of decision-makers, and new appropriate technology.

Runoff was noted as a pervasive problem and the committee identified public education as the greatest challenge. It was also noted that many laws related to runoff were not being enforced, or that the penalties were not high enough. The farming and general construction industry were blamed for improper calibration of equipment, not adopting new technology, and, improper installation of materials. Potential solutions included public education, working with government to offering tax breaks to those complying with runoff prevention programs, and additional water quality sampling.

The committee felt there are too many toxic chemicals being misused by landowners and that there was a lack of coordination of agencies to collect those materials. Potential solutions included identifying those who misuse toxic chemicals, educating landowners, offering incentives to companies that produce environmentally-friendly products, conducting more hazardous household waste collection days, and undertaking a study on the long-term effects of toxic chemical misuse on the environment and economy.

The study concluded that a lack of coordinated land use planning among communities contributes to degraded water quality. Secondly, inadequate training of local officials has contributed to a misunderstanding of the role and authority of local government in managing growth and development within its jurisdiction, was another problem. Many potential solutions were concluded: jurisdictions in land use planning, as well as, public and private section stakeholders, should work with the County Planning Commission to create a comprehensive and coordinated land use plan for the County; the existing informal base of concerned citizens could be strengthened to a watershed planning coalition; educational and technical skills of local planning officials was identified as a priority of the County Planning Commission; more effort should be made to inform citizens of the county and watershed of the land use and environmental quality connection; organizations should as the Natural Resources Conservation Service, County Health Department, Michigan State University Extension and others should identify property owners within priority areas of the watershed for educational campaigns; opportunities to reduce environmental impacts through recycling and composting should be encouraged, coordinated and pursued by the County; knowledge of land use management tools should become a priority of local and county planning officials; and, the pursuit of legislation that enables local land use planning jurisdiction should be a priority to make wider use of tools designed to inventory and conserve unique natural features and that would discourage unmanaged development.

The study concludes that laws that are intended to stop destruction of natural cover are not strongly enforced. Potential solutions include instituting land use controls that support: open space zoning techniques; cluster developments; preservation of prime agricultural lands; and preservation of valued woodlands. Citizens and community leaders should be educated regarding: alternative development patterns; sustainable development of land; development of sustainable economies; and, value of natural cover in protecting/preserving community character and water quality. Also, working with Wildlife Habitat Council and Bluewater Land Conservancy was concluded.

Landfills were identified as the final problems in the watershed, with general concerns being flow control of waste, operating without a license, lack of integrity of the people, and lack of enforcement. It was also felt that machinery to process the waste should be improved and the method of transporting waste through the County should be addressed in feature studies. Potential solutions include finding owners, selecting suitable locations, obtaining money for proper closures, and improved enforcement. Efforts to divert waste from disposal, such as bottle returns and education were also concluded. Old community dump sites should identified and tested for contamination with funds appropriated for the Huron Development and FGSL. Additional, it was concluded that the Huron Development and FGSL should be closed.

Six pages of detailed implementation activities follow the identification of problems within the watershed, with each strategy being used for one or more of the problems.

APPENDIX 4:CRITICAL HABITATS IN THE ST. CLAIR RIVER WATERSHED

Wildlife habitat can be described as broadly as an upland forest block, a small pond or marsh, right down to the surface of a stone lying on a creek or river bottom. Numerous habitats can be found and described in the St. Clair River Watershed including forest, riparian zones and instream fish habitat to name a few. For the purpose of this document, only a few of the larger habitats that have been recognized as endangered or imperilled (e.g. wetlands, prairie, Carolinian species) will be described briefly. Other habitats chosen for discussion are based on those specifically identified in the Environment Canada Framework and a NHS for the St. Clair River Watershed (e.g. upland forest and riparian zones). These are the habitats that will be initially targeted for rehabilitation and preservation as they will lead to an overall increase in habitat in the AOC thus striving towards the goal of delisting.

4.1THE LAKEPLAIN SYSTEM

The lakeplain system holds the highest number of globally significant elements. Lakeplains occur where the ancestral Great Lakes occupied different basins than those present today. These former lakebeds are characterized by sandy, silty or clay soils and a high water table. They support extensive prairies, savannahs, swamps and wet meadows, sand barrens and coastal plain ponds. About 22% of elements restricted to the basin occur in this system. Ground water movement is a dominant process in maintaining this system and, Lakeplain systems have played a historical role in maintaining floodwaters of the Great Lakes (The Nature Conservancy, 1994).

Lakeplain Oak Openings are thought to be impaired globally, and are known to be critically imperiled within the State of Michigan (Bauer et al, 1994). Lakeplain prairies and oak openings were formerly developed along the shorelines and low-lying near shore areas of the western Lake Erie basin, occurring as almost a continuous strip on the American side from Sandusky Bay, Ohio, northwards along the southwest corner of Lake Erie to Detroit. It was also present on Canadian shores of the Detroit River, from Windsor and along the river channel north to the eastern shore of Lake St. Clair and farther north to Point Edwards in Sarnia, Ontario. In Michigan, the only relatively intact examples remain in St. Clair County at Algonac State Park, with some potentially restorable fragments on Dickinson and Harsens Island. In Ontario, Walpole Island contains the best remaining remnants (Bauer et al 1994).

<u>Oak Ecosystems</u>
Lakeplain oak openings were historically found adjacent to lakeplain prairies on post glacial sand lakebeds (Bauer et al 1994). Communities were dominated by open grown white oak and black oak growing on dry sandy ridges and slightly raised level areas, and swamp white oak and bur oak growing in wet depressions. The current conditions of lakeplain oak implies a more open canopy with a predominate understory of prairie grasses to a more closed canopy with a herbaceous understory. Shrubs such as hazelnut, blueberries, and huckleberry are found in the uplands, while dogwoods, buttonbush, Michigan holly and willow in the swales. In the absence of fire however, the sedge and grass dominated understories become dominated by successional tree species such as red maple and black cherry or lowland hardwoods such as silver maple, elm and ash, and is represented by a closed canopy forest (Bauer et al, 1994).

Oak savannahs and woodlands are disturbance maintained systems. Three major causes of disturbance exist: fire, drought and herbivory. Other less important disturbances include disease, floods, tornadoes, and ice storms. Species diversity can often be correlated with disturbances - both positively and negatively. The highest level of diversity often occurs when disturbances are not too severe, and frequency is intermediate (Midwest oak plan 1995).

Fire is a necessary component to the survival of oak systems. In this community, plant debris often accumulates faster than it can be decomposed naturally, adding to the litter layer. Litter build-up decreases primary productivity and can alter species composition. As well, the invasion of woody plants can become a threat if left untouched. Fire occurring at least once every decade, is necessary to prevent these threats (Vogl 1977 in Midwest Oak Plan, 1995). The fire will consume litter, and stimulate the growth of fire-adapted species while controlling non-adaptive species. Oaks have many features allowing them to thrive in fire disturbed areas.

One known species of the oak ecosystem is now extinct - the Passenger Pigeon. Ten of 83 breeding species listed, are threatened or endangered. Many of the mammal species once part of the oak ecosystem are still thriving today, and include the fox squirrel, cottontail rabbit, woodchuck and white-tailed deer. Others such as the bison, elk, timber wolf, and black bear have been extirpated from large areas of their former range.

Oak woodland systems are estimated to have increased biomass and greater net productivity than prairies or savannahs. Large-scale oak recovery should therefore be an important component of the global strategy to control atmospheric carbon (Midwest Oak Plan, 1995).

Prairies

These communities are made up of native grasslands on level sites that are moist to saturated and are seasonally or occasionally inundated with water. They are historically found adjacent to oak openings. Natural processes include seasonal and annual water fluctuations, fire, and grazing, which maintain the open system. Post settlement and agricultural drainage, has altered the hydrology in the remaining prairies, making them vulnerable to shrub invasion and succession to lowland hardwoods in the absence of fire (Bauer et al, 1994).

Native prairies or grassland communities are endangered ecosystems in Canada today. Less than 1% of the original tall grass prairie, and less than 20% of mixed grass prairie remains today. Historically, prairies covered many regions of Canada including British Columbia's inter-mountain grasslands (short grass prairie), southern Alberta, Saskatchewan, and southwestern Manitoba's mixed grass prairies, and southeastern Manitoba's and southern Ontario's tall grass prairie (Morgan et al, 1995).

Of the 542 species of plants officially considered rare in Ontario, approximately 20% of them are prairie related (Ludolph and Rochette, 1995). Many rare and endangered species of wildlife depend on native prairies including logger-head shrike, long tailed weasels, burrowing owls, numerous butterflies and other insects, song birds, shorebirds and waterfowl. In southern Ontario, tall grass prairie remnants are widely scattered, very scarce and rarely larger than 1 hectare in size.

The three dominate species of tall grass prairie are Big blue stem, Indian grass and Prairie cord grass all three of which may grow up to nine feet tall. Big blue stem is very nutritious to cattle and other grazing animals, and has been re-discovered as commercial hay and forage plants. All together, about 150 species of tall grass prairie are known.

Native prairie species thrive in extreme environmental conditions. Drought, flood, fire and grazing pressures all play important roles in their long-term maintenance. Often, grasslands are found where conditions are too severe to support tree species in large numbers. In other conditions, regular fire, and extensive grazing stops the successional process thus maintaining the community in a prairie state. Prairie plants have extensive, deep root systems, and maintain their growing tips about one inch below the ground. This protects the tender growing tips from damage by grazing animals and fires. During droughts, their specialized roots are able to find moisture deep in the soil. These properties along with their perennial nature, also make these plants ideal choices for soil conservation plantings as they are tolerant and adapted to a wide variety of soil types, such as dry, wet, saline, heavy and light soils.

4.2 WETLANDS

Wetlands are classified as areas that are dominated by wetland plants (hydrophytes), a substrate of predominantly undrained soil or, a non-soil substrate that is saturated with water or covered by shallow water at some time during the growing season of each year (Hammer 1997, Weller, 1987). Wetlands represent a very small fraction of land area in Canada, but they contain a very large percentage of our wildlife. Representatives from almost all avian groups use wetlands to some extent during their lifecycle, while one-third of North American bird species rely directly on wetlands for some resource. Wetland loss has been extensive in Ontario, where almost 80% of the original wetlands have been drained, diked, filled and developed or used for agriculture (Hammer, 1997).

In Canada, there are 5 classes of wetlands provided in the Canadian Wetland Classification System (National

Wetlands Working Group, 1988):

- Bogs: Peat covered wetlands in which vegetation shows the effect of a high water table and a general lack of nutrients. The bog surface is often raised, but if it is flat or level with the surrounding wetlands, it is virtually isolated from mineralized soil waters. Hence, surface waters of bogs are strongly acidic and upper peat layers are deficient in nutrients. Sphagnum mosses are common, along with heath shrubs. Trees are open-canopy forests of low, stunted trees.
- Fens: Peatlands characterized by a high water table, but with very slow internal drainage by seepage down very low gradient slopes. Oxygen saturation is very low, but higher than bogs. The slowly moving water table enriched by nutrients from upslope materials makes fens more minerotrophic than bogs. Peat thickness is greater than 40 cm (16 in), and vegetation reflects water quality and quantity available.
- Swamps: standing or gently moving waters seasonally or for long periods, leaving the surface continually waterlogged. There is little oxygen deficiency, and communities are made up of dense coniferous or deciduous forest, or tall shrub thickets. They are usually nutrient rich, productive soils, and trees are productive.
- Marshes: periodically inundated by standing or slowly moving water and hence are rich in nutrients. They are mainly wet, shallow, mineral-soil areas, and well-decomposed peat may be present. Water remains within the rooting zone of the plants for most of the growing season. There is high oxygen saturation, and vegetation consists of reeds, rushes or sedges. Distinct vegetation zoning occurs according to water depth, frequency of drawdowns and salinity.
- Shallow Open Waters: these are locally known as ponds or sloughs, and are small non-fluvial bodies of standing water representing a transitional stage between lakes and marshes. Floating, rooted, and aquatic macrophytes may be present, and depth is usually less than 2 m (6.6 ft) at mid-summer levels. The open waters are usually free of emergent vegetation.

In Southern Ontario, marshes and swamps are the most common type of wetland found. Most wetland basins are landforms created from tectonic actions such as mountain building, water movement, glaciers or other ice actions, soil slippage's or even meteorites. Rivers sometimes form marshes indirectly through meanders as they cut new channels and abandon old courses.

Wetlands provide many different beneficial uses to the ecosystem including critical habitat for many wildlife species, recreational and educational uses, and economic uses such as hunting, fishing and the harvest of vegetative products. Probably the two most critical functions aside from that of critical habitat, is water level control (flood and drought prevention) and water quality control.

Wetlands provide free treatment of many types of pollutants entering waters (Hammer, 1997). They can remove or convey large quantities of pollutants from point sources (industrial and municipal wastewater) and non-point sources (mine, agriculture and urban runoff) through natural filtration, sedimentation and other processes. Chemical reactions and biological decomposition break down complex compounds into simpler substances. Through absorption and assimilation, wetland plants remove nutrients for biomass production. One abundant byproduct of the plant growth process is oxygen, which increases the dissolved oxygen content of the water and also of the soil in the immediate vicinity of the plant roots. This increases the capacity for the aerobic bacterial decomposition of pollutants as well as the capacity for supporting a wide range of oxygen-using aquatic organisms, some of which directly or indirectly use additional pollutants.

Many nutrients and pollutants are held in the wetland system and recycled through successive seasons of plant growth, death and decay. If water leaves the system through seepage to groundwater it will be filtrated by the soil, peat or other substrates which will remove excess nutrients and other pollutants. If water leaves the system over the surface, the nutrients trapped in the substrate and plant tissues during the growing season will not contribute to pollution problems in downstream rivers and lakes (Hammer, 1997).

Wetlands along coasts and lakes have a valuable role stabilizing shorelands and protecting them from the erosive battering of tides, waves, storms and winds. Along streams and rivers, wetlands act as a natural flood control system by slowing and storing water during high flow periods thus buffering downstream areas by reducing peak flows.

During drying periods, the slow release of stored water from wetlands helps to maintain and stabilize base flows within the stream system (Hammer 1997, Weller, 1987).

Wetlands are dynamic systems, and depend on natural disturbance for their maintenance. Changing water conditions such as depth, tide and wave action, and temperature gradients are all important in supporting a vast number of vegetation species that create many habitat niches (Weller, 1987). The major structural feature of a marsh is determined largely by the distribution of aquatic plants. Water depth is the dominant physical factor influencing the kind of adaptations required by plants to survive and different plant species have evolved strategies to deal with such environmental conditions. Characteristics such as leaf form, stem or stalk, root structure and water tolerance are important attributes determining where a plant will become established. All the species collectively influence the kind of community of plants present, thus influencing the type of animals present.

There are four major groups of plants found within marsh systems, all having different strategies to withstand different water conditions.

1. Emergents: grow with their roots and often bases in wet soil or water part or all of their life. Some examples are rice cutgrass, whitepop, sedges, softstem bulrush, river bulrush and other three-squares, cattail, and hardstem bulrush.

2. Floating Leaves: this group is rooted in deeper water and sends up broad leaves to the surface where photosynthesis takes place. These plants can grow in much deeper water than emergents and respond well to fluctuating conditions. Examples are the water lilies.

3. Submergents: these plants have their stems and leaves mostly if not entirely under water. They are rooted plants that are efficient at gathering light in even murky water. They have fine complex and compound leaves growing in clusters. An example is Bladderwort, which has combined green leaves with tiny animal traps in which the plants catch and use crustaceans and protozoans.

4. Floating: these plants are not rooted and remain on the surface. Flowering plants with dangling roots derive nutrients from the water. These plants are strongly influenced by the distribution of wind. Duckweed is one example.

All the organisms of a wetland community play different and important roles, and the system can only function well when all the components are present and effective. Plants are the primary producers converting water and carbon dioxide into carbohydrates through the energy of sun and the action of chlorophyl. They provide a physical environment trapping heat, reducing wind, stabilizing the soil and providing substrates for shelter and nesting as well as food.

The St. Clair delta is an example of the coastal marsh system. This system supports relatively few species that are globally rare, but a tremendous number and diversity of resident and migratory species (The Nature Conservancy, 1994). Large numbers of common or regionally rare bird, mammal, herptile and invertebrate species rely on these highly productive marshes for food and shelter. Most of the lake's fish species depend on them for some portion of their life cycles as well. Lake levels play a critical role in sustaining this system. Periodic inundation slows or eliminates succession maintaining the herb-dominated community.

4.3 RIPARIAN HABITAT

Riparian comes from the Latin word "*rip*" meaning bank (of a stream). Riparian habitat or vegetation, refers to the plant communities established immediately adjacent to stream, river, lake and/or wetland system. A riparian ecosystem is the complex assemblage of organisms and their environment adjacent to waterways (Lowrance et al, 1985).

Water quality can be protected or improved by establishing riparian vegetation (Weller, 1987; Nener, 1995; Best Management Practices, 1995). Vegetation in general, is essential to maintaining a proper water balance within any ecosystem. Leaves and stems help to break the impact of raindrops, and extensive underground root systems help to hold soil in place. This allows much of the rainfall to soak well into the ground, ultimately lowering flow velocities. Overhanging vegetation also helps to control instream temperatures, particularly important for the survival of coldwater fish. The amount of dissolved oxygen found within the water is also directly related to lower water temperatures.

Streams covered by little or no vegetation will carry large suspended loads due to bank erosion (Weller, 1987). Without the extensive root systems stabilizing the soil, larger amounts of soil and sediment will wash directly into the water. Nutrients such as nitrogen and phosphorous, pesticides or other contaminants may be attached to the soil as it travels into the system. Levels of suspended loads will especially be increased during storm events without riparian vegetation to help slow the runoff. Well-vegetated streams carry dissolved rather than suspended loads, and will be better protected from contamination.

Probably the most important role of vegetation is the uptake and long-term storage of nutrients. Nutrient uptake into leaves and other deciduous parts of trees can be and important factor in short-term nutrient storage (Lowrance et al). Because deciduous plant parts drop each year, nutrients become available for transport.

For these reasons, riparian vegetation often acts as a buffer between activities that can be detrimental to water quality such as mining, forestry practices, agriculture and urban runoff to name a few, and the water system.

In summary, riparian zones provide (Nener, 1995; Weller, 1987; Best Management Practices, 1995; Cairns 1995):

- A diversity of plant species which support a broad variety of bird and wildlife species which have differing needs for food supplies, nesting and denning sites and shelter from predators;
- A buffer from potentially adverse impacts that could potentially harm water quality and fish habitat. Buffers protect from soil erosion, act as wind breaks, and filter out harmful chemicals and nutrients that would otherwise enter the stream;
- Corridors for wildlife;
- Shelter and cover by contributing woody debris to the waterway, which provides shelter, and nutrients to the system. Riparian vegetation also shelters streams from extreme weather conditions by moderating light, humidity, air and temperature;
- Shade and protection from solar radiation, minimizing temperature fluctuations.
- Food supply for fish and wildlife. Riparian areas support rapid growth of vegetation due to the constant availability of water.

The width of the buffer strip necessary to protect water quality varies depending on the activity in the watershed. It is thought that 25 to 30 m (82 to 98 ft) is necessary to protect water quality and fish from adverse land management practices (Cairns, 1995).

4.4 UPLAND DECIDUOUS FOREST

The area of southern Ontario from approximately the lower end of Lake Huron to the western shore of Lake Ontario is part of the Deciduous Forest Region. This region with the exception of a few northern species, is where all of Ontario's species of hardwood or broad-leafed trees are found. Many species including certain oaks and hickories, chestnut, mulberry, cucumber-tree, tulip, papaw, sassafras, red-bud, coffee-tree, honey locust, hop-tree, flowering dogwood, blue ash, hackberry, black gum, sycamore and walnut reach their northern limit of growth in this area (OMNR, 1986).

Forest ecosystems are highly complex communities and support many wildlife species. In southern Ontario, much of the forest has been cleared for development and agricultural use. In the St. Clair River watershed, only 13% forest cover exists, and much of it is distributed as small, highly fragmented patches. These forest patches resemble ecological islands where migration between patches becomes difficult or impossible for low mobility species (Riley and Mohr, 1994). When species are unable to migrate to new areas, breeding becomes difficult, and the genetic integrity of the population is reduced. Greater than 90% of modern bird extinction's, and 75% of mammal extinction's, have been on islands. Natural areas in a fragmented landscape resemble islands in size and isolation. Habitat fragmentation is the most serious threat to biological diversity (Riley and Mohr, 1994). In a heterogeneous landscape, a variety of smaller sites can provide better representation than a single large one. Multiple small sites build necessary replication of species and protection systems. Smaller areas may particularly apply to the plant and animal species with low mobility and dispersal capacities (Riley and Mohr, 1994).

Many species, particularly birds and mammals with large home ranges, require huge forest tracts for survival. These forest interior species, can only survive and breed deep in the forest – far from the outside influences of solar radiation, wind, noise, predators, disease and parasites and particularly human disturbances (Riley and Mohr, 1994). Species that are adapted to open, disturbed landscapes tend to be aggressive, opportunistic, habitat generalists that function well in human landscapes. They are often non-native in origin, and survive in high population numbers that are completely different from those species that require continuously forested landscapes. Many of these habitat generalists are predators and parasites including nest predators such as Common Grackles, Blue Jays, Mockingbirds, Gray Catbirds, Opossums and Raccoons. In fragmented landscapes, forest-interior habitats are rare, and specialist species such as Wood thrushes, Red-eyed Vireos, Ovenbirds, Pileated Woodpecker and Scarlet Tanagers cannot compete with these generalists (Riley and Mohr, 1994).

It is not always clear what the optimum forest size should be to support a maximum number of species. In one study, cowbirds were shown to parasitize nests as far as 300 m (984 ft) from the edge. In another, edge-related predation extended as much as 600 m (1,967 ft) into the forest. It can be concluded that many forest patches several hundred hectares in size is truly necessary in the landscape to ensure species diversity is maintained.

Old-growth forests

Over time, forests are subjected to both small- and large-scale disturbances such as fires, floods, disease, herbivory or simply the falling of dead trees, which creates a gap in the canopy. Small-scale disturbances are the most common, particularly the creation of gaps in the canopy. Gaps provide space and nutrients for saplings to grow, and adjacent trees to mature. They also lead to an increase in diversity, as gaps tend to show increases in insect use, flower and fruit growth. Herbivory helps to re-distribute seeds, and the selective diet of some herbivores may lead to a complete change in composition of tree species in a particular area. Over a long period of small-scale disturbances, old growth forests become patchy and uneven-aged with a wide variety of succession stages. Because of this, they support a diversity of ecosystem processes, not well developed in immature or plantation forests.

Old-growth forests provide some of the best examples of pre-settlement landscapes. They offer a baseline for studying species diversity, forest growth, forest management and restoration. They provide a means for studying the response and recovery of old-growth systems after disturbances (Riley and Mohr, 1994).

4.5 TRIBUTARIES

Tributaries are also a relatively important component of the St. Clair watershed, and support about 15% of the globally significant elements, which occur exclusively or predominantly within the basin (The Nature Conservancy, 1994). Most of the imperilled elements known are the mussels, however, the tributaries and aquatic communities in general, have not been as extensively studied thus there is likely many more imperilled elements that have escaped notice. Tributaries provide sediments, nutrients and organic materials to the Great Lakes, and are important spawning grounds for many fish species and migration corridors for other biota.

As identified in Appendix 1, the St. Clair River watershed contains several important major tributaries, as well as a few smaller ones. Although the exact contribution provided by each of the tributaries to the River itself is unclear, it is known that tributaries do play important roles in the overall ecosystem processes, and must be given a specific place in overall management goals.

4.6 CAROLINIAN LIFE ZONE

A small portion of the deciduous forest region, otherwise known as the Carolinian Forest, which is widespread across the mid-western U.S., also extends into Southwestern Ontario. The rich soils, climate moderated by the Great Lakes, creating seasonally hot summers and cold winters, have created suitable growing conditions for a diverse mixture of species. The diversity of life is the highest in this region of Ontario (van Hemessen, Reid and Symmes, 1996).

The Carolinian region encompasses the most concentrated area of urban development in Canada. It also includes the most productive combination of soils and climate in the country. Farming is the dominant land use with about 73% of its total area in agriculture. Carolinian forests which once covered well over 80% of the region, now occupy 11.3%. Interior forest (the deep woods with at least 200 m/656 ft form the nearest edge) have dropped to 0.39% of the Carolinian landscape.

Carolinian Canada once held a substantial part of the tall grass prairie and Oak Savannah in North America. On a continental basis, only 0.06% of the original tall grass prairie and 0.02% of the original oak savannah now remain.

Most of the land base of Carolinian Canada is privately owned. Public lands, the majority being conservation authority lands, compose 1.9% of the land area of the Carolinian region. First Nation lands comprise approximately 2% of the region.

The Carolinian region is comprised of 11 landscape types. Each landscape type differs in materials, topography and drainage which strongly influence the kind of vegetation found in each area, and the human uses of the land. The St. Clair River watershed falls within the St. Clair Clay Plains landscape type. A flat till plain with clay surface soils and pockets of shallow sands and organic soils characterizes the Clay Plains. The historical vegetation consisted of oak, elm, red and silver maple and hickory, with extensive wet to dry prairies and oak savannah (20,000 ha/49,400 ac). Forest cover is now much reduced with only 3% to 4% of the area remaining in isolated remnants.

Since European Settlement, 36 species of plants have been lost, none of which occur anywhere else in Canada. The Sydenham River, once the richest river in Canada for freshwater mussels, has lost 20 of its 33 species. Many other species are very threatened - 30 species of plants are known only from a single site, 31 species have only two known sites, and another 40 species are limited between 3 and 5 sites. Over a third of the most imperiled plants in the province are restricted to the Carolinian region, and half of the Ontario total, are found largely in this area. Fifty two percent of vertebrate species most at risk in Ontario are found in Carolinian Canada.

APPENDIX 5:DEFINITION OF ESA'S and ANSI'S

ONTARIO

Areas of Natural and Scientific Interest (ANSI's)

Areas of Natural and Scientific Interest or ANSI's are areas of land and water containing landscape or features which have been identified as having values relating to protection, natural heritage, scientific study or education (OMNR, 1980).

ANSI's of greatest significance are designated as Candidate Nature Reserves (CNR). These sites contain the best examples of the landform and vegetation features of each site district, and may contribute to the provincial protection objective, thus they are also known as Provincially significant sites. Each site possesses sufficient ecological integrity, buffering capacity and size that protection appears to be the most viable management strategy. A site district is defined by a characteristic pattern of physiographic features. ANSI's not rated as a CNR are called Significant Sites (SS) or Regional significant sites.

The MNR will play a role in protecting CNR's, and will encourage municipalities to protect SS's. On private lands, the MNR attempts to ensure landowners are aware of significant natural features on their properties, and cooperates with them to protect significant features.

Ten ANSI sites exist within the watershed and three of these are CNR's.

Environmentally Sensitive Areas (ESA's)

Environmentally Sensitive Areas (ESA's) were identified in Lambton county in the summers of 1979 and 1980. An area was designated as an ESA if it met one of seven predetermined criteria. The criteria used are as follows:

- If rare, endangered or indigenous species occur in the area or if it is a known breeding site for highly mobile species.
- If plant/animal associations or landforms are unusual regionally, provincially or nationally, or are of a highly restricted nature physically or are remnant of what were once much larger habitat types.
- If plant/animal associations or landforms are highly representative of their type.
- If the area performs a vital ecological function
- It the area contains an unusual diversity of plant/animal communities due to geomorphologic features of slope, soils and water, coupled with inherent microclimatical effects.
- If the area us unusually large and/or undisturbed, potentially affording habitat for species which are intolerant of human disturbance.
- If the area serves as a linking unit necessary for establishment of a non-continuous corridor necessary for wildlife movement over considerable distances.