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Human Influence

Humans have lived in the Lake Huron to Lake Erie Corridor for more than 9,000 years. Aboriginals, fur traders, European settlers and modern Americans and Canadians have all called this region home. It is the human inhabitants of the last 150 years who have most dramatically changed the landscape and destroyed habitat. Today, large-scale development, pollution and exotic invasive species threaten the existence of natural communities and the amazing diversity of life they support. Protecting the region's rich natural resources and abundant waterways is essential if their benefits and beauty are to be enjoyed for generations to come.

ROBERT STEWART

A modern view of the City of Detroit. This land was once lined with coastal marshes where thousands of waterfowl stopped to rest and feed during migration.

10,000 B.C. – Archaic Indian Period: Indian cultures advanced through social and technological developments. The increasing diversification and sophistication is reflected in craft and ceremonial items. Native metal was mined to make tools, decorative items and weaponry, fish weirs were developed, and extensive trade routes around the Great lakes and beyond brought items from the east coast of North America.

8,000 B.C. – Early Woodland Indian Period: Native people experiment with growing crops and storing grain (beans and squash), nuts, and dried meat; harvesting sap from sugar maple (for sweetener) and birch, walnut, and bitternut (for vinegar); and making pottery.

1,000 B.C. – Late Woodland Indian Period: Native people use gill nets to fish, store fish for winter consumption, develop corn that would mature in a 140-day growing season, and replace the spear with bow and arrow to hunt deer, bison, elk, bear, and wild turkey.

600 A.D. – Cadillac arrives by canoe to establish the settlement at Detroit.

1701 – European settlement brings infectious diseases, such as smallpox, that killed many Indian elders and caused the loss of oral traditions regarding human interaction with the environment. Farms and windmills line the Detroit Riverfront.

1700s – Detroit Riverfront becomes dominated by commercial and excursion vessels.

1800s – Settlement of southeastern Michigan begins in earnest. Within a generation, the land was cleared and towns, farms and mills were constructed throughout the Rouge River watershed.

1820s – Welland Canal opens, allowing invasive species, such as the sea lamprey, to migrate westward from Lake Ontario.

1824 – U.S. Congress passes Swamp Land Act, which increases the drainage of wetlands in Michigan.

1850s – Gum Bed discovered in Inniskillen, Ontario, resulting in the birth of the oil industry in North America.

1851 – The Ontario Drainage Act passes, allowing for the mass drainage of wetlands and the establishment of townships and drainage systems.

1854 – Lumbering peaks in southeastern Michigan and southwestern Ontario as the lands were stripped of forests.

1890 – Industrialization begins to dominate the Detroit Riverfront.

1900s – Canadian and U.S. governments pass the Migratory Bird Species Act, the first international recognition of the need to protect wildlife.

1919 – "Chemical Valley" begins operation in Sarnia, Ontario.

1940s – St. Clair Metropolitan Beach Association (later known as Michigan Nature Association) incorporates, marking the birth of the Land Trust/Conservancy movement in Michigan.

1952 – St. Lawrence Seaway opens, which facilitates the passage of larger ocean-going ships and migration of invasive species carried in ships' ballast into the Great Lakes.

1959 – The U.S. Fish and Wildlife Service places the bald eagle on the endangered species list.

1970 – The U.S. and Canadian governments sign the Great Lakes Water Quality Agreement.

1972 – Ontario reintroduces the wild turkey.

1984 – Detroit River is named as an American and Canadian Heritage River.

1998 – U.S. Fish and Wildlife Service removes the bald eagle from the endangered species list.

1999 – The U.S. government establishes the Detroit River International Wildlife Refuge.

2001

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e Original Inhabitants

tive peoples, or Aboriginals, first came the Lake Huron to Lake Erie Corridor ce time immemorial according to their n oral history, but scientific evidence gests they arrived 10,000 to 12,000 rs ago. Big game hunters called e runners" followed the ice edge receding glaciers to hunt large sts. During this period, known Paleo-Settlement, the Native Peoples' styles adapted as climatic changes sed spruce forests to give way to e and later to the ecosystems that st today. The Archaic, or early tures, practiced a hunting and hering way of life as they evolved m the Paleo-Indian culture.

e Early Woodland period began und 1000 B.C. when Aboriginal es changed lifestyles from nomadic ting to growing crops and making tery. This began with the cultivation unflowers and squash, followed by ns and corn. Corn is of particular portance. As a domesticated crop, vas transported north from the pical and semi-tropical climates Middle America.

erall, the Aboriginals had little effect the landscape. They coexisted with nts, animals and ecosystems that ported them. Their greatest effect the landscape probably was setting s to improve hunting grounds and maintain grassland habitat. The incredibly diverse prairie and oak savanna ecosystems of modern-day Walpole Island are the result of regular burning.

WALPOLE ISLAND HERITAGE CENTRE

Walpole Island First Nation monitors the water quality of the St. Clair River and Lake St. Clair. Heavy industry in Sarnia and Port Huron directly discharged chemicals into the St. Clair River from the 1940s to the 1970s, threatening Walpole Island's water supply through toxic contamination. The people of Walpole Island have undertaken water quality monitoring efforts to address pollution concerns as they continue to champion the clean water and healthy ecosystems that are integral to their health and way of life.

During the Late Woodland period, the Aboriginals made several important advances. Gill nets, fish weirs and impoundments were used to catch whitefish, lake trout and other fish during spawning runs. These fish could be smoked, dried or frozen for use during winter. The bow and arrow replaced the spear for hunting. Corn horticulture became practical in southern Michigan when varieties were developed that could mature quickly in a short growing season. Small clearings were made in forests to grow crops.

This agricultural adaptation was reflected in the increased density and number of villages and burial sites of the Late Woodland period. In southern Michigan, agricultural groups, such as the Miami and Potawatomi tribes, built large stockade villages near their farms. Peace and treaty agreements among the tribes decided who had control of areas. Clan chiefs inserted "Clan Poles" into shorelines to mark fishing territories.

Tribal elders established protocols for interacting with the environment. Unfortunately, Europeans brought small pox and other infectious diseases that killed many elderly, weak and very young members of tribes. As native elders died, so did much of the traditional ecological knowledge. Today, globalization has a similar negative effect on native cultures worldwide.

Native peoples incorporated rules for human interaction with the environment into their lifestyles. For instance, the Ojibwe people of Walpole Island followed a seasonal cycle of farming, hunting and fishing. During the spring spawning runs, they traveled to the St. Clair River Delta where plentiful fish were netted, trapped and speared. In late spring, they established base camps along the St. Clair River where they planted corn, gourds and squash. By early summer, additional food sources such as waterfowl, clams and water mammals became available. The people also cultivated tobacco and harvested sweet grass for ceremonial purposes. In late summer, they harvested crops and nuts, such as hickory and walnut, which were valued for their nutmeats and oil extraction. They spent late fall and winter in areas with abundant game for hunting.

s watercolor by Seth Eastman (Indian Sugar Camp ca. 1850) depicts a typical Aboriginal sugar ple camp where sap was harvested in early spring. As a horticultural practice, Native Peoples intained large groves of trees in order to harvest sap to make sugars, syrups and vinegars.

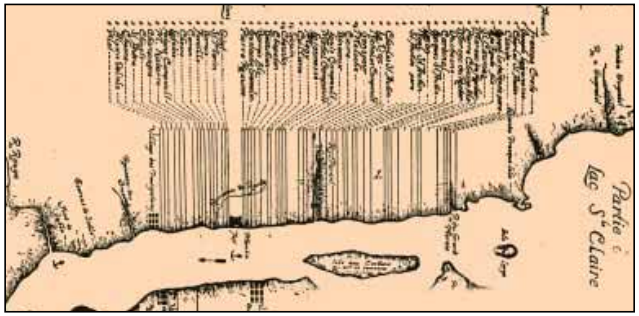
Many current members of Walpole Island First Nation still rely on the landscape for food, water and ceremonial traditions. Hunting and fishing licenses and rental of marshlands provides the community's main industry and source of income.

Many tribes have occupied the Corridor region during a long, rich and complex history of Aboriginal settlement. Generally, the location where a tribe lived was dictated by seasonal migration between hunting and farming grounds, as well as tribal warfare and climate. During the 18th and 19th centuries, Potawatomi and Wyandot lived near the Detroit River and Ojibwe lived in villages in the St. Clair River Delta.

After Michigan Territory came under American control, waves of white settlers entered the Detroit River and Lake St. Clair area of Michigan in large numbers during the early 1800s, claiming the land as a territory of the United States of America. They made native peoples live on "reservations." About 20 years later, the Native Peoples were forced to move from their water-abundant homeland to reservations in dry, hot Iowa, Kansas and Oklahoma. Today, there are no federally recognized reservations located in southeastern Michigan.

On the Canadian side of the waterway, Native People retained reserves and surrendered other lands to the British Crown in a series of treaties from 1790 to 1827. Most all of southwestern Ontario was surrendered with exception of islands in the St. Clair River Delta and the beds of lakes and rivers. The Walpole Island First Nation territory is un-ceded land. The Chippewas settled on reserves in Sarnia, Kettle Point and Stony Point. Three tribes from the Algonquin Nation – Ojibwe, Odawa and Pottawatomi – formed the Walpole Island First Nation.

European settlement activities of the 1800s and 1900s dramatically changed the landscape of the Lake Huron to Lake Erie Corridor. Lumbering, agriculture, industrial growth and urban development transformed the region from wilderness to a major center of industry. This growth has not come without cost to the natural environment and native biodiversity. In fact, more than 280 endangered, threatened and special concern plant and animal species are striving to survive in the Corridor. The primary reason for their decline is loss of habitat.



COURTESY OF THE DETROIT PUBLIC LIBRARY

Pictured is a portion of a map of Detroit from 1752. The first French settlers of Detroit and Monroe divided the land into "ribbon farms," which were long, narrow bands each bordering the river while extending several hundred yards inland. This method of land division ensured that each farmer had access to water for irrigation and easy travel. Map Title: Carte de la riviere du Detroit depuis le Lac Erie jus'ques au Lac Ste. Claire [map] / donne' par Mr. de Lery fils, 1752; adapted by C.E. Hickman.

The Fur Trade and Early Pioneers

French explorers were the first Europeans to enter the Great Lakes region. Their sailing ships only able to go as far as the Niagara Falls area, so they headed farther inland by rowing long wooden boats – "bateaux" in French – that they made from trees growing in the area's vast forests. They encountered Aboriginals who taught them to build massive open-water canoes. Eight to 12 men could paddle the canoes, which were capable of carrying non-rowing passengers and up to two tons of cargo.

As they made their way through the Great Lakes in the early to mid-1700s, these French adventurers saw rich marshes and fur-bearing mammals. They saw that the natives used animal skin for clothing. Realizing the pelts could be shipped to France to make fashion attire, they started what became known as the fur trade. They traded European textiles, jewelry, containers, alcohol and firearms with the natives for the furs, which many traders sold at trading posts.

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s painting shows the Detroit waterfront in 1794, more than three decades after the British gained control of Michigan territory. Not until 1796 did they hdraw in favor of the Americans, who had been awarded the area in 1783 at the end of the Revolutionary War. Michigan was admitted as one of the ited States in 1837. Print courtesy of the Burton Historical Collection, Detroit Public Library.

ne of the early Frenchmen enjoyed nique relationship with the native ople and were quick to adopt the originals' respect for life and land. ey worked enough each day to subsist l set stores for winter, while they also eled in their leisurely outdoor way ife. They were known as "Muskrat nch" because they adapted so well to ir new environment.

toine de la Mothe, Sieur de Cadillac nded Detroit. He was a Frenchman o believed that the wealth and ition of France in the New World pended upon control of the fur trade. considered Detroit's strategic ation, connecting the upper and er Great Lakes, important to ieving this goal.

e book, *Detroit: A Wilderness Outpost Old France*, describes the site upon ich Fort Ponchartrain du Detroit was lt in 1701 (now Fourth Street) as curving and rather flat topped hill" t "was wooded with big oak and other dwood trees and all were as straight rrows. Like huge posts they rose from forest floor, and high overhead was nick green cover formed by the nches. In the daytime little sunlight ne in through the tree tops, and what cast a green gloom over the ground." on this site, Cadillac instructed men to fell the trees and build ockade, the area's first permanent structure. These first settlers depended upon trading, trapping and subsistence agriculture to survive.

This first wave of immigration to the region set the theme for European colonization – exploitation of resources. Once one resource was exhausted, another one was quickly harvested. Over the years the demand for commodities such as fur, lumber, fish, farmland, and more recently property for development, has led to a reduction in natural biodiversity.

*Lewis, Ferris E. 1951. *Detroit: A Wilderness Outpost to France.* Wayne State University Press. Detroit, MI.

Lumbering

The lumbering boom began in the early 1800s and lasted for nearly 80 years. The peak years, 1870 to 1880, coincided with the advent of the Steam Age, when steamships plied the waters and steam locomotives pulled trains. These powerful engines, which connected the Great Lakes with eastern North American cities, were fueled by wood. In the Sydenham and Thames watersheds of Ontario, accounts from that era describe piles of cordwood lining roads to fuel steamship transportation at ports, such as Sarnia, Ontario. Canadian records document nearly 1.67 million cords of wood taken from Kent, Lambton and Middlesex counties between 1870 and 1900. That volume represents more than 213 million cubic ft (6.4 million cubic m) of wood. Forests were logged until the lumber was exhausted. Often lumber companies would purchase land, log it, then sell it to settlers who would remove stumps and complete the conversion from forest to farm field.

PORT HURON MUSEUM, PORT HURON, MICHIGAN

The first steam sawmills of the Great Lakes were located along the St. Clair River and its tributaries. Pictured is the Black River Steam Mill of Port Huron in 1863. Built by Francis Browning of Detroit in 1833, it was the first steam sawmill in what was then known as the Northwest Territory. At its peak, the mill could produce 5 million board feet of lumber annually.

NORA PENHALE, THE OBSERVER, SARNIA, ONTARIO

Farm fields are in close proximity to the urban fringes of Sarnia, Ontario. Agriculture is expected to continue to be the major land use in southwestern Ontario over the next decade.

Agriculture

The pattern of settlement in the region followed major river systems. Navigable rivers were needed for transportation because vast wetlands and swamp forests made inland travel difficult. Tallgrass prairies, which were relatively dry and already void of trees, were the first ecosystems to be converted to farmland. However, the prairie grass' sinuous roots often ran deeper than the plants grew tall. Teams of four or more horses or oxen were needed to pull a plow through those roots. The tearing of roots created a sound that early farmers compared to thunder.

The wet, flat clay soils of the lakeplain in Michigan were not suitable for farming until the Swamp Lands Act of 1850 encouraged settlers to drain wetlands. The drained areas proved to be some of the most valuable agricultural lands in Michigan. By 1873, most of the land between the Detroit and Clinton rivers had been converted to agriculture. In Canada, passage of the Ontario Drainage Act in the 1880s resulted in the creation of farm and township drainage systems that made land usable for agriculture. The wettest areas–swamp forests, as well as wet prairies and marshes–required dikes and pumps, which encouraged more and more settlers. By the early 1900s, these mass drainage projects had converted about 90 percent of southwestern Ontario's original woodlands to agriculture.

Agriculture dominates land use and remains a major industry in southwestern Ontario. In fact, it is the second-largest sector of Lambton County's economy. In contrast, agriculture has declined in southeastern Michigan. Between 1990 and 2000, agricultural land use declined by 13 percent. Farms continue to disappear as lands are converted from agricultural to residential use in the Metropolitan Detroit area.

Like logging, agriculture has greatly altered the Corridor's landscape. With greater knowledge of how their industry impacts the land and surrounding waterways, more farmers have begun to utilize low-impact farming practices. These include crop rotation and rotational grazing, conservation tillage and contour plowing, buffer strips and reduced use of pesticides, herbicides and chemical fertilizers.

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r Industrial Heritage

e Lake Huron to Lake Erie Corridor ds a unique place in the history North American industry. From the covery of oil to the mass production utomobiles, industrial advances made he region changed not only the dscape but also the way we live.

nada's oil industry was born in central mbton County. In 1858, James Miller lliams dug North America's first mmercial oil well in the oil gum beds Enniskillen Swamp. He soon built efinery to produce illuminating oil rosene) for lamps. Williams has ome known as the Father of North erica's Oil Industry

e location was aptly named Oil ings. Men rushed in to extract oil. e world's first oil gusher occurred re in 1862. With no effective controls place, oil spewing from new wells wed into local waterways. Refineries ang up in the area and excess oil was nsported on rough roads made from e logs for shipment by rail and boat processors elsewhere in Ontario and overseas. Although the booms in Oil Springs and nearby Petrolia ended long ago, some oil production continues in the area to this day.

The historic oil industry led to the development of Chemical Valley in Sarnia, where industries were able to locate along the St. Clair River to make use of its water for their processes and shipping.

Chemical Valley began with the 1942 opening of the Polymer synthetic rubber plant. It was built to provide the Allies with a replacement for natural rubber they could no longer get from Far East plantations. Several companies soon built chemical plants nearby. After World War II ended in 1945, the industry continued to thrive and more plants were built along a 19-mi (30-km) stretch of the St. Clair River to produce various chemicals, petrochemicals and plastics.

Another factor in Chemical Valley's development was the existence of a huge bed of salt, lying 1,500 to 2,000 ft (450 to 600 m) below the surface of Southwestern Ontario and southeastern Michigan. Salt mines and wells were developed throughout the Lake Huron to Lake Erie Corridor, most prominently in Sarnia, Windsor and Detroit. The chemical plants used the salt, to make certain products, and the emptied underground salt wells to store hydrocarbons.

Detroit is known as the Motor City, the automotive capital of the world. It was here that Henry Ford emerged as a leader among early inventors of the motorcar, the "horseless carriage." The Ford Motor Company, created by Ford and his business associates in 1903, introduced the assembly line in 1913. With the ability to economically produce hundreds of cars each week, Ford's factories employed thousands of men and women. Many other industries grew in concert with the automotive industry, making Detroit one of the most important manufacturing centers in the Midwest U.S.

All of these events were good for the economy but had harmful effects on the environment.

Throughout the 1970s, industrial and chemical pollution was prevalent throughout industrialized Canada and the United States, including the Great Lakes Basin. Public outcry in the 1960s that "Lake Erie is dead" was punctuated by a fire on the Cuyahoga River near Cleveland, Ohio, which burned with an eerie glow due to high concentrations of petrochemicals on the water's surface in 1969.

In 1972, Canada and the United States signed the first Great Lakes Water Quality Agreement to rid the Great Lakes of "persistent toxic substances." Other statutes have since been passed in both countries. The measures have helped reduce industrial pollution and allow water quality to improve.

RICHARD W. FORD AND SHELL CANADA

Fineries were built to process crude oil extracted in Lambton County, Ontario in the mid-to -1800s. Pictured is a refinery in Petrolia.

GLENN OGILVE

ROBERT STEWART

(Top) A modern view of "Chemical Valley" in Sarnia, Ontario.
(Above) The riverfront of the lower Detroit River is dominated by industry in Michigan.

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ur Most Valuable Resource: Water

mans and wildlife rely on clean
er for survival. Our water resources
threatened by contaminated
iments, shoreline development,
bitat loss, storm water and agricultural
off, and the direct discharge of animal
l human wastes. There is a critical
d to protect the environment from
se influences if native biodiversity
l our own health are to remain secure.

intaining aquatic biodiversity requires
ential actions: protecting water quality,
serving coastal and riparian zones,
oring degraded habitats and
ntrolling invasive exotic species.
ch one of these actions is important
the health and diversity of our
er resources.

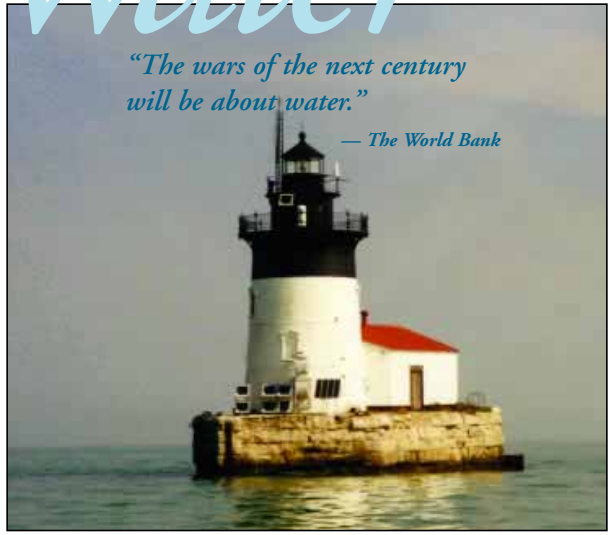
ressors to the Aquatic osystem

e Lake Huron to Lake Erie Corridor
ubject to many stressors from many
rces: habitat loss and degradation
m development, chemical
ntaminants from industry, agricultural
off, bacteria from municipal sewage
charges, and invasive exotic species.

e Michigan shoreline is extensively
veloped with marinas, cottages, homes
l industry; little of the natural
racter of the land is left. The Ontario
oreline has many hectares of
icultural usage as well as recreational
l residential development. Materials
dged from waterways have been
posited on both sides of the Corridor.
velopment has resulted in widespread
s of coastal wetland and extensive
oreline modifications.

ughly 90 percent of the Michigan
re and 20 percent of the Canadian
re have been modified with
etments and other shoreline
dening structures. Wetlands have
n lost due to dredging, bulkheading
backfilling. Wetlands that do remain
nerally exist on the islands of the
Clair and Detroit rivers and the
Clair River Delta.

ricultural runoff from lands
Michigan and Ontario has added



KAREN JOHNSON

Built in 1885, this lighthouse is a familiar sight in the lower Detroit River.

DEBRA A. BOUSSEY

Dawn at Belle River Beach on Lake St. Clair in Essex County, Ontario. With more than 93 public and private marinas along both sides of the connecting channels, the Corridor supports more boats per square nautical mile than anywhere else in the world.

nutrients such as nitrogen and phosphorous to the waterways and disturbed their chemical balance, which can lead to the excessive growth of algae. Intensive agricultural practices can cause soil erosion and sedimentation, as runoff from farms is deposited into water bodies.

Dredging to facilitate shipping has changed the waterways' morphology.

ROBERT STEWART

The role of the Lake Huron to Lake Erie Corridor in moving cargo is vital to economies in Canada, the United States and other countries in the world.

ROBERT STEWART

Southeastern Michigan boasts the highest concentration of registered boats in Michigan and has the largest number of recreational watercraft per capita in North America.

Detroit is the busiest port in the Great Lakes. In 1969, a channel for commercial shipping was dug to a depth of 28 ft (8.5 m) in the Detroit River. Since the channel construction, large ocean-bound freighters have become a common sight.

Wave action from the heavy shipping traffic places stress on coastal marsh communities. Winter ship travel, along with the ice clearing that aids navigation, have destroyed ice bridges once used by mammals to move between Michigan and Ontario.

Beaches in the Corridor are often deemed unfit for swimming due to bacterial contamination, much of it caused by the discharge of untreated sewage. Building and upgrading community sewer systems is essential to protecting water quality and enjoyment of the beaches.

Invasive Aquatic Species

At least 139 aquatic organisms have been introduced to the Great Lakes Basin since the 1800s. Many of these exotic, or non-native, species have arrived in ballast water brought by ocean-going ships from elsewhere in the world. Their rate of entry increased after the St. Lawrence Seaway opened in 1959, allowing more transoceanic traffic to travel the Great Lakes.

Without natural predators, some exotic species populations rapidly grow and pose a major threat to the stability of the aquatic food chain. In fact, invasive exotic species are the second-greatest threat (behind habitat loss) to the Corridor's ecosystems. Some of the most common aquatic nuisance species in the Corridor include the sea lamprey, zebra mussel, round goby, purple loosestrife and Eurasian water milfoil.

DAVID JUDE

Native to the Black and Caspian seas, the tubenose goby **(Proterorhinus marmoratus)** *is a recent invader of the Great Lakes. It first appeared in the St. Clair River in the late 1990s after being released in the ballast water of an ocean-going freighter.*

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AREAS OF CONCERN AND CONTAMINATED SEDIMENTS IN THE LAKE HURON TO LAKE ERIE CORRIDOR

e dots on the map do not indicate the specific location of contamination

NTAMINATED SEDIMENTS

ny parts of the Detroit and St. Clair rivers Lake St. Clair are contaminated with heavy als, oil, dioxins, PCBs and other toxic micals. The heaviest pollution is in ustrial areas, although pollution has been nd 60km downstream from any known lution source.

ce passage of the Clean Water Act in 1972, ter pollution control standards have greatly reased point source pollution in the Lake ron to Lake Erie Corridor. However, historic lution remains a problem in the form of taminated sediments.

taminated sediments negatively impact aquatic ecosystem in a variety of ways. diversity and abundance of benthic anisms is very low in contaminated areas. s many sections of the Corridor have aired benthos. Fish have absorbed toxic lutants, prompting authorities to issue rictions on the amount, size and type ish that people should consume. Toxic micals also are blamed for birth defects, reproductive success and some tumors deformities in fish and wildlife.

ay, ensuring the proper disposal oxic chemicals and the regulation ndustrial discharges into waterways are important measures to curb pollution and foster healthy aquatic ecosystems.

AREAS OF CONCERN

The International Joint Commission (IJC) was created by the U.S. and Canada in 1909 to assist governments in monitoring and improving water conditions in the Great Lakes-St. Lawrence River system. The IJC has classified five parts of the Lake Huron to Erie Corridor as Areas of Concern due to degradation of the water and/or surrounding habitat. These degradations are called Beneficial Use Impairments. An impaired beneficial use means that enough of a change has occurred in the chemical, physical, or biological integrity of an area to cause any of the following:

- Restrictions on fish and wildlife consumption
- Tainting of fish and wildlife flavor
- Degradation of fish and wildlife populations
- Fish tumors or other deformities
- Bird or animal deformities or reproduction problems
- Degradation of benthos
- Restrictions on dredging activities
- Growth of too much algae or undesirable algae, which is known as eutrophication
- Restrictions on drinking water consumption, or taste and odor problems
- Beach closings
- Degradation of aesthetics
- Added costs to agriculture or industry
- Degradation of phytoplankton and zooplankton populations
- Loss of fish and wildlife habitat

Within each Area of Concern, volunteers representing all population sectors have developed Remedial Action Plans (RAPs) to restore the beneficial uses of water in the Great Lakes Basin.

The St. Clair and Detroit Rivers are binational projects, while only the U.S. addresses the Clinton, Rouge and Raisin rivers. The design and execution of RAPs involve collaborative efforts by the public, non-governmental organizations, educators, First Nations and government agencies. The goal of these plans is to delist the rivers once all impairments have been removed. By mid-2003, of the IJC's original list of 43 Areas of Concern in the Great Lakes-St. Lawrence River system, Collingwood Harbour and Severn Sound in Ontario have been delisted, while many others are working towards that goal.

BRUCE MANNY

Contaminated sediments have been known to cause tumors in fish.

NONPOINT AND POINT SOURCE POLLUTION

There are two types of pollution that affect water quality: point source and nonpoint source pollution.

Point source pollution refers to the direct discharge of contaminants to a water body. Sources include overflows from sewage treatment plants and discharges from industries.

Nonpoint source pollution is a result of urbanization and poor agricultural practices. Urbanization has created many impervious surfaces that water can't penetrate such as rooftops, sidewalks, roads and parking lots. Rainwater runoff from these surfaces, as well as farm fields, carries such contaminants as antifreeze and pesticides to the nearest available sewer or waterway.

THE BALD EAGLE

The bald eagle (*Haliaeetus leucocephalus*) is not only a symbol of the United States, but an outstanding example of the impact of environmental contaminants on wildlife.

These large birds of prey feed primarily on fish. They are permanent residents of Michigan and Ontario, wintering as far north as open water permits. During the winter of 2001-2002, the Michigan statewide annual survey found the county with the most bald eagles was Monroe, where 70 were counted.

Bald eagles once nested throughout the Corridor region. During the 20th Century, gradual population declines were attributed to habitat loss, hunting, trapping and nest robbing. In the middle of the century, disaster struck. The use of chemicals that persist in the environment, most notably the insecticide DDT, began demonstrating a profound impact on wildlife.

Chemicals in the environment, such as DDT, are passed up the food chain as organisms are consumed. The chemicals are stored in animals' tissue, so the concentrations increase with each step up the food chain, a process known as bio-magnification. Since eagles and other birds of prey are at the top of the food chain, the contaminant level in their systems is high. It causes a variety of health complications, especially reproductive problems that can include not laying eggs, laying eggs that don't hatch and the hatching of unhealthy chicks that don't survive.

Populations of eagles in both countries plummeted. By the 1970s, fewer than 100 pairs of bald eagles nested in Michigan. Although DDT was banned in 1972, bald eagles failed to raise a single chick in the Great Lakes region in 1980.

Since the mid-1980s, the number of bald eagles has started to rebound. However most bald eagles in the region still have reproductive problems. While the typical lifespan of bald eagles is about 30 years, those in Ontario live only eight to 10 years. Examination of dead birds has found elevated levels of mercury and lead, showing that environmental contaminants are still playing a role in the Great Lakes ecosystem.

U.S. FWS, NATIONAL IMAGE LIBRARY

The bald eagle is slowly coming back to the shores of the Lake Huron to Lake Erie Corridor.

In the Great Lakes region today, most eagles nest in upper Michigan, northwest Ontario, and along the northern Lake Erie shoreline. Only a few have tried to nest in the Lake Huron to Lake Erie Corridor in recent decades. A successful nest in 2001 at Lake Erie Metropark was the first in Wayne County, Michigan in 100 years. But until nesting attempts are consistently successful, there is still a need for concern and vigilance.

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pervious Surfaces

oking down from the Blue Water dge or the Ambassador Bridge, the es of Sarnia, Port Huron, Windsor l Detroit appear to be covered with es. But amid those trees are large tracts mpervious surfaces such as rooftops, veways, streets and parking lots.

ese surfaces cause water to run directly o storm sewers and streams rather n be slowly absorbed into the ground. is absence of lingering water is rimental to humans and animals. ntaminants carried by runoff into terways harm aquatic life.

dies performed at the University Michigan have determined that water, d and the species that live in both ironments are significantly harmed en only eight percent of the land is ered with impervious surfaces.

ewise, subdivisions and shopping lls, especially those built in former al areas, cause habitat loss, wetland radation and fragmentation of natural dscapes. Shoreline development ates a barrier to migration for birds l aquatic creatures. Such changes ce plant and animals species to live solated pockets, causing them to ntually lack genetic diversity.

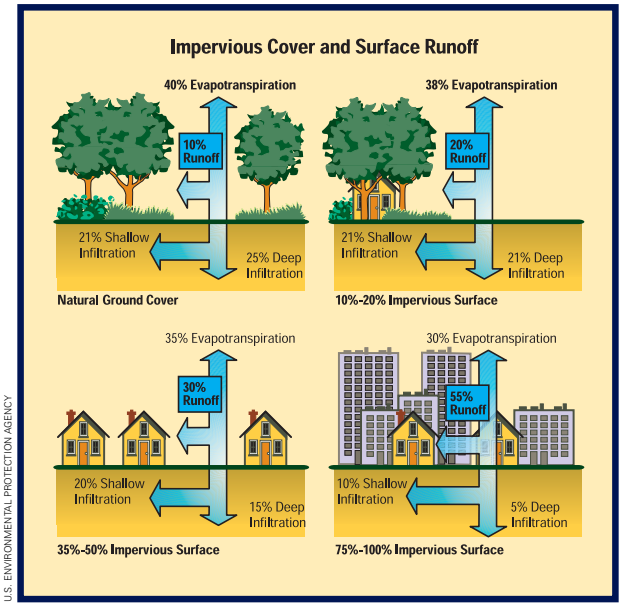
fortunately, little can be done to core places where homes and sinesses already have been built. But ch can be done - when society and vernment work together-to keep ther development within existing an districts rather than allowing it to ead into open areas.

ater and Land; nd and Water

ter is constantly moving, whether ving downhill, seeping deeper into ground, evaporating into the air or urning to Earth as precipitation. hough water and land are distinct ments, they are inherently linked. ter defines a beach. Land embraces a e or river. Water saturates soil. Soil l rock contain underground aquifers.

ROBERT STEWART

Road repair on Michigan's Interstate 75. Highways are becoming increasingly congested as more and more workers commute from the outer fringes of the Detroit Metropolitan area.



U.S. ENVIRONMENTAL PROTECTION AGENCY

Hydrology is the study of water's properties, distribution and circulation on and within Earth and the atmosphere. The judicious use of land is called land use planning. Like water and land, hydrology and land use planning go hand-in-hand. Indeed, they must. Both land and water are necessary to maintain vegetation. And vegetation is necessary to provide shelter and food for humans and animals.

There is a natural interplay of land and water, even during seasonal fluctuations that include winter snows, spring thaws, early summer rains, and late summer draughts. But mankind has a way of manipulating nature.

Farmers, landowners and municipalities sink wells that pump groundwater from the aquifer for irrigation, consumption and industrial usage. People construct ditches, dikes, and drains to carry surface water away quickly. All these actions adversely affect underground water resources. Impervious surfaces built on top of the ground add to the problem by preventing fresh rainwater from seeping into the soil to recharge the aquifer. Short-rooted monoculture lawns such as non-native Kentucky bluegrass, which require watering, fertilization and herbicides, contribute unhealthy nutrients and chemicals to rivers and lakes.

Fortunately, as the impact from humans becomes better known and understood, there is an increasing willingness by farmers, landowners, and municipalities to make the connection between land and water in their everyday lives. They have begun to make land use decisions and adopt land use policies that preserve woodlands and protect wetlands and waterways. These measures are necessary because, as an old Aboriginal phrase puts it: "Without water, we are not."

FORD MOTOR COMPANY

A killdeer **(Charadrius vociferous)** *nest of eggs is spotted on the 10.4-ac living green roof at Ford Motor Company's Ford Rouge Center in Dearborn, Michigan. The roof is constructed of a bioengineered storm water management system that includes drought tolerant sedum and a recycled fabric growing medium. Many innovative solutions have been put into place at the Ford Rouge Center to manage the flow of water on the property in a way that is beneficial to the environment. The use of porous pavement, buffer strips and living green roofs all help to filter and clean stormwater run-off helping protect water quality and providing wildlife habitat.*

Urban Sprawl

Development is quickly gobbling land in the Corridor. In fact, it is estimated urban sprawl will lead to more than 400,000 people moving to the headwaters of southeastern Michigan's major river systems in the next 20 years. Areas surrounding Windsor, Sarnia and London, Ontario are also subject to this type of pressure.

The definition of urban sprawl varies among professionals. Generally, it means the growth of low-density residential and commercial developments on the outer edges of cities and towns. Open spaces such as farms, forests and recreation areas – suddenly are filled by houses, roads, and strip malls.

There are a number of negative effects that run counter to the benefits of urban sprawl:

Loss of fish and wildlife habitat– The natural areas on the fringes of urban centers often still support ecosystems and biodiversity that are important to the region's natural heritage. In southeastern Michigan, for example, high-quality headwater areas are important sources of aquatic biodiversity to re-colonize the degraded lower reaches of rivers.

Poor water quality–The addition of impervious surfaces increases the amount of polluted runoff entering nearby rivers and streams.

Flooding–As wetlands that once absorbed and held rainwater are lost, and impervious surfaces are added in headwater areas, flooding could occur downstream.

Higher taxes–A common misconception is that new subdivisions bring greater community wealth. On the contrary, the increased cost of building new schools, roads and other infrastructure outweighs the increase in tax revenue. A study conducted by the U.S. Department of Agriculture, Economic Research Service (Agricultural Report No. 803, June 2001) noted that "residential development requires $1.24 in expenditures for public services for every dollar it generates in tax revenues, on average. By contrast, farmland or open space generates only 38 cents in costs for each dollar in taxes paid."

TRISH BECKLORD

Urban sprawl transforms natural areas into expansive subdivisions that are costly to local governments and harmful to the environment.

US EPA ARCHIVE DOCUMENT

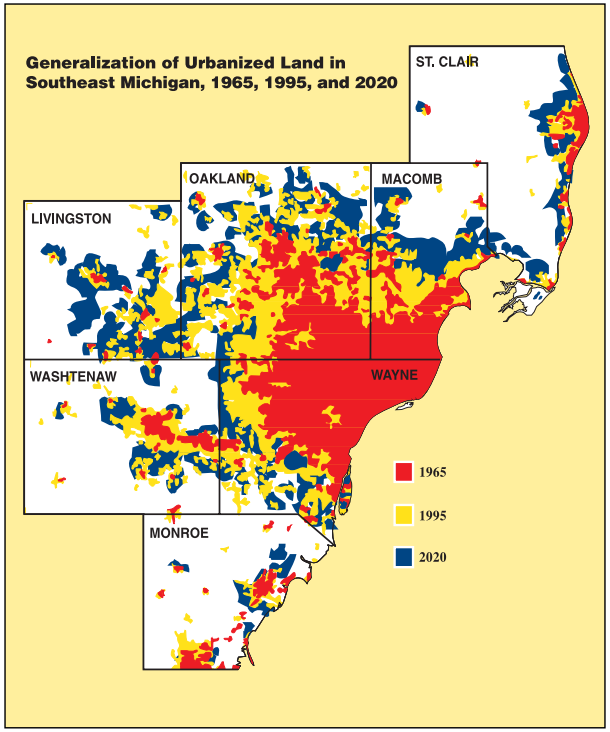
ral character is lost – Ironically, the tic quality of the countryside that first acted homeowners quickly changes urban sprawl's buildings, roads and king lots take over the fields, farm actures and natural areas of the rural nmunity.

ght pollution–Illumination of ldings and neighborhoods creates outdoor glow that obscures the night , preventing enjoyment of the stars l other celestial objects, and actually atively impacting the ability of grating birds to navigate by the stars.

s exercise, more pollution–Often subdivisions are not within walking tance of workplaces, stores or public nsportation. Consequently the dents depend heavily on vehicles get around.

k of foresight and planning leads to problems that arise with the onset urban sprawl in an area. The carefully nned use of the land and good dership to address the needs of mans while respecting natural ources can direct development in ay that benefits both humans and ure.

ny innovative solutions have been eloped to alleviate the negative effects urban sprawl. Land use planning and nland preservation policies are two ls that communities can use to direct elopment in better ways.



MAP COURTESY OF THE SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS, SEMCOG.

Growth and development pattern predictions for the next 30 years show the outer regions of Metropolitan Detroit changing from undeveloped and agricultural land to subdivisions, strip malls, gas stations and fast food restaurants.

Government Land Use Planning

Local governments have a responsibility to take the lead in land use planning. If they don't, land use decisions are at the mercy of private interests that usually place a higher value on profit than environmental protection.

To plan, local governments can:

- Conduct an inventory of important natural features to identify areas worthy of protection.
- Develop a master plan (also called an official plan) for land use that provides for environmental protection and encourages the use of native landscaping and cluster development.
- Make zoning decisions that preserve high-quality areas and are consistent with the master plan.
- Create incentives and encourage reuse of land in urban areas.

ROBERT STEWART

Farms like this one in Oakland County, Michigan are likely to be developed in the next decade unless protections are put in place.

Farmland Preservation Efforts

The threat of urban sprawl to farmland has been intense in recent years. Farmers can make a greater profit from selling their land to a developer than they can from farming. Many farmland preservation efforts are under way to help farmers keep their land in agricultural use. Efforts include programs to purchase the development rights to a property as well as conservation easements that allow for certain tax benefits and exemptions.

US EPA ARCHIVE DOCUMENT

hiawassee and Huron Headwaters esource Preservation Project

e northern part of Oakland County, chigan has experienced rapid growth recent years as the population of tropolitan Detroit has spread ward. Land has been consumed by division developments, strip malls l gas stations. This trend has resulted he loss of natural areas and open ces, as well as additions of paved faces that threaten the water quality sensitive headwater areas.

ingfield Township has managed elopment in a way that protects al natural resources and benefits the nmunity. Located in the Interlobate ion of northwest Oakland County, township contains the headwaters he Clinton, Huron, Flint and awassee rivers. The hilly terrain has ny lakes, streams and wetlands. k-hickory forests and tallgrass prairie w on the uplands. Rare natural nmunities, such as prairie fens and meadows, are found in the lowlands. me of these habitats are globally significant, harboring rare species of plants and animals found only in the Great Lakes region.

Springfield Township always has valued its natural resources, which residents feel add to the quality of life in the area. In order to protect these natural resources, the township partnered with the Michigan Natural Features Inventory to conduct the Shiawassee and Huron Headwaters Resource Preservation Project. The project included:

- Developing a method to identify and rank ecosystems in the township
- Conducting field inventories in sites that ranked as high-quality ecosystems
- Reviewing land use planning documents from surrounding municipalities
- Collecting information on natural resource protection tools and techniques through a national literature search

This work resulted in the identification of high-quality natural areas, threats to these ecosystems and methods to protect them. It was determined that encouraging the use of native plants in residential and commercial landscaping was an important way of protecting native ecosystems and preserving water quality. To help residents and developers incorporate native plants into their landscapes, an informational CD-ROM was created through the Springfield Township Native Vegetation Enhancement Project. It provides a database of 230 native plants for use in landscaping and helps build awareness of the region's natural heritage.

The township also incorporated policies into its master plan to promote the retention of natural areas and open space. As a result, each new proposed development is screened to determine if it contains a significant natural area. If it does, the natural area is permanently preserved within the development. Homes are clustered outside the natural area and conservation easements are granted to the local land conservancy. Landscape plans integrate native plants and avoid the use of exotic, invasive species that could invade the natural areas. Efforts are even being made between subdivisions to link protected open spaces, preventing habitat fragmentation.

Overall, these policies benefit the community. Natural areas are preserved and residents can enjoy their beauty. Developers gain from lower construction costs and higher sale prices for lots adjacent to nature preserves. The Shiawassee and Huron Headwaters Resource Preservation Project serves as a model for other municipalities to protect themselves from the hazards of urban sprawl and to preserve their high-quality ecosystems.

ingfield Township protects ecologically fragile areas by acquiring them. One such example he Long Lake Natural Area, a 37-ac (14.8-ha) parcel that lies within an already protected 600-ac 0-ha) ecosystem complex. This natural area contains one of the highest quality irie fens in the Midwestern U.S.

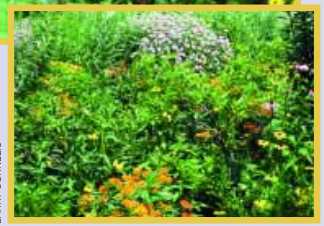
Keep It Natural

Many homeowners have discovered the joys of native landscaping. Using native plants in the landscape can be as simple as incorporating native wildflowers into a flowerbed or creating a rain garden. Large-scale projects include converting a lawn to a meadow or allowing a property to naturalize to a woodland setting. Each of these actions provides benefits to wildlife and homeowners.

The Benefits of Using Native Plants

- Native plants are attractive and reflect the beauty of the area before it was developed. Planting a native wildflower is like planting a piece of ecological history.
- Native plants are well-adapted to local conditions and don't need fertilizers, pesticides or lawn equipment for maintenance, which saves the homeowner time and money.
- Most native species are perennial, coming back year after year, which reduces the need to buy annual plants.
- Native plants promote biodiversity and provide food, rest, and shelter to local wildlife. Even a wildflower garden in an urban setting can attract native butterflies and songbirds.
- Native landscaping can reduce air pollution and save energy. Gasoline or electric mowers no longer need to be used once a lawn becomes a wildflower meadow.
- Native plants improve water quality and reduce soil erosion. The deep and fibrous root systems of many native plants anchor soil and create millions of tiny channels for rainwater to follow back into the earth. In contrast, the depth of roots in a typical lawn grass is only six inches (15 cm), causing heavy rainfall to run off and carry fertilizers and pesticides with it.

LARRY CORNELIS



LARRY CORNELIS

Native prairie plants fill a backyard in Chatham-Kent, Ontario all summer long with gorgeous blooms that require little maintenance.

Invasive Exotic Plant Species

Plants that grow outside of the location where they evolved are considered to be exotic. Invasive exotic species are a worldwide problem, impacting nearly every corner of the globe economically and environmentally.

Invasive exotic plants usually are highly adaptable and can survive in a range of conditions. Without the insects, fungi, diseases, herbivores and competition from other plants that control them in their native settings, the exotics can spread quickly to natural areas, agricultural lands and waterways. Purple loosestrife can overtake prairie fens and other rare wetland types. Even high-quality forests can be invaded by garlic mustard.

Exotic plants can diminish local wildlife populations by displacing native plants that normally provide them with food and cover. For example, the invasion of common reed grass in wetlands affects waterfowl.

The spread, and control, of exotic invasive plants can be costly. In the U.S., exotic weeds cause an overall reduction of 12 per cent in crop yields, costing $24 billion in crop losses and $3 billion in control expenses annually. This amount is growing each year as existing exotic invasive plant species spread and new ones are introduced.

Citizens can help by learning which plants are invasive in their area and not planting them in their gardens. Volunteering with a local land conservancy or other conservation organization to remove exotic invasive plant species also will help to maintain the biodiversity of local nature preserves and parks.

US EPA ARCHIVE DOCUMENT

tewardship: The Restoration nd Management of Natural Areas

ven the great loss of habitat in the ke Huron to Lake Erie Corridor, toration of native ecosystems helps serve the region's natural heritage. ny projects, such as prairie toration, tree plantings and the ation of wetlands, have been plemented throughout southeastern Michigan and southwestern Ontario.

But it is impossible to fully replace what had been created through 10,000 years of evolution. Restoration projects often take years to provide tangible benefits to wildlife. This is why protection of existing natural areas is imperative if native biodiversity is to exist in the future.

The identification and management of existing natural areas are important to maintaining biodiversity. Ways of protecting and restoring natural areas can include controlled (prescribed) burns, removing invasive exotic species and sowing native plant species.

Crosswinds Marsh Project

Crosswinds Marsh is an example of a successful large-scale wetland mitigation project that created a wetland in Sumpter Township, Michigan. The project was designed to make up for destruction of a wetland when the Detroit Metropolitan Airport was expanded. Although this project was successful, studies show that most wetland mitigation projects undertaken by developers are predominantly unsuccessful. They are expensive, difficult to properly locate, and take many years to establish before they benefit wildlife. Some wetlands like swamp forests, fens and bogs are impossible to replace.

The whole restoration area at Crosswinds had once been wetland, but it was drained and farmed for a century. It took three years for marsh construction and another three for re-vegetation. In 1997 the 1,050-ac (420-ha) site opened as a public park, owned by Wayne County.

The project included transplanting endangered plant species from the airport site to Crosswinds. Deep and shallow water areas were created in the marsh. Deepwater areas are 12 to 20 ft (3.6 to 6 m) deep and support a diverse fish community. Only 120 ac (48 ha) of the site was seeded; the remaining vegetation established on its own.

So far, ecologists have identified more than 200 species of birds, both migratory and resident, at Crosswinds. A nesting pair of bald eagles has been seen, although no young have been raised yet. The site also is the home of coyote, mink, muskrat, raccoon and red fox. Current management efforts include removing invasive exotic species, such as purple loosestrife, giant reed grass and Eurasian watermilfoil, and monitoring the project's success.

Wildlife Habitat Council

The Wildlife Habitat Council (WHC) is an international nonprofit organization that provides resources and alternative methods for companies to protect and enhance wildlife habitat, reduce their environmental footprint, and promote environmental stewardship at corporate facilities. Corporations can become members of WHC and become involved in their Wildlife at Work℠ program whereby a team of company employees create a wildlife team and create a wildlife management plan for their property. The team can then implement wildlife habitat improvement projects on their business property, often with the assistance from local environmental groups, community groups, and governmental agencies. Habitat projects on corporate properties are varied, but have included the transformation of lawns to meadows, the installation of nest boxes to provide for cavity-nesting birds, reforestation, and prairie restoration. Partnerships with the community help create important links between the company and conservation efforts in the region. Currently, there are twenty Certified

DTE ENERGY

Corporate Habitats in southeastern Michigan and southwestern Ontario. They include several DTE Energy sites in Michigan and Ontario Power Generation's Lambton Generating Station south of Sarnia.

Tallgrass Prairie Buffer

RURAL LAMBTON STEWARDSHIP NETWORK

The Rural Lambton Stewardship Network installed a tallgrass prairie buffer on a farm in Lambton County, Ontario. This organization works in partnership with local farmers on conservation projects that are beneficial to wildlife and water quality.

NATURAL SHORELINES BENEFIT WILDLIFE AND WATER QUALITY

Steel breakwalls and other shoreline-hardening structures dominate shorelines of the Lake Huron to Lake Erie Corridor. Studies have shown that this has negative effects, including:

- Reduction of water quality because of siltation and nutrient enrichment
- Destruction of physical habitat such as woody debris and gradually sloping shorelines
- Loss of aquatic plants that protect shorelines from erosion and provide places for reptiles, amphibians, waterfowl and mammals to bask, feed, rest and breed
- Degradation of nearshore waters, either directly from habitat loss or indirectly from poor water quality. Many fish and aquatic insects depend on nearshore waters for habitat.

Waterfront property owners can help improve water quality and increase wildlife habitat by establishing a buffer of native vegetation at their shoreline. Shoreline buffers reduce erosion, filter pollutants from runoff and provide habitat for fish and wildlife.

In areas where erosion needs to be prevented, new types of shoreline structures are being developed through soil-bioengineering. They incorporate vegetation into the erosion protection structures, improve habitat and usually cost less than traditional engineering practices that use concrete and steel.

The Macomb Buffer Initiative

The Macomb Buffer Initiative Program transformed the edge of an eroded shoreline in Lake St. Clair to a buffer of native vegetation, blooming with wildflowers. One of the major focuses of the initiative is on lawns that are mowed to the water's edge. Landowners are encouraged to install buffers with native flowering shrubs, wildflowers, grasses, sedges, and emergent and submergent aquatic plants that enhance the natural beauty of the shoreline. Buffers of native vegetation reduce soil erosion and trap fertilizers, chemicals and other potential pollutants, including pet wastes and pesticides. They also deter overpopulation by Canada geese.

SETH HOPKINS

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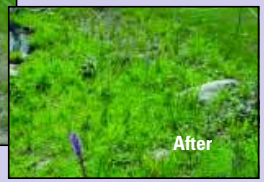

SETH HOPKINS

Blue Heron Lagoon

ROBERTA URBANI

The shoreline of Blue Heron Lagoon on Belle Isle in Detroit, Michigan was restored to a natural condition through a partnership with the U.S. Fish and Wildlife Service, U.S. Forest Service and DTE Energy, which supported the involvement of local students in planting native plant species.

Soil Bioengineering

Citizens help to alleviate erosion on the Pine River's shoreline through installing fascines and other soil-bioengineering practices at Goodells County Park in St. Clair County, Michigan. Soil-bioengineering combines mechanical, biological and ecological concepts to stabilize eroding slopes and provide habitat restoration. Supported by the Southeast Michigan Resource Conservation and Development Council, this project demonstrates practical low-cost techniques that can be used to prevent erosion in a habitat-friendly way.

DEBORAH BASSETT-MAXWELL

US EPA ARCHIVE DOCUMENT

MARIE BOYLE

FERN WILSON

ban Wildlife

ny wildlife species have adapted the man-made environment. Raccoon, tontail rabbit, squirrel, striped skunk, fox, opossum, woodchuck and in ne cases even coyote are common mmals in urban and suburban areas. many cases, these wildlife species e been able to meet their needs food, water, space and cover in parks, backyards, abandoned lots l cemeteries.

eons, gulls, grackles and house rrows are common sights most urban areas, where they feed garbage. In suburbia, starlings l blue jays thrive in habitats provided lots edged with trees and shrubs. e jays steal from the nests of gbirds and starlings nest in ities that would otherwise used by native bird species.

ny bird enthusiasts attract ariety of songbird species their yards through d-friendly gardens and ders. Northern flickers, dinals and song sparrows are ong birds known to frequent roperly managed backyard. ese habitat enhancements help migrating birds that s through the region on ir way to their summer l winter homes.

JOEL HILL

MARIE BOYLE

blic parks could be important refuges diverse wildlife populations in an urban setting. Communities could improve their parks' habitat value through such actions as removing invasive species, restoring native plant communities and reducing manicured lawns.

JOHN SCHAFER

The Peregrine Falcon

Peregrine falcons are birds of prey, known for their swift flight. Distributed worldwide, they once nested throughout North America. They occupied high cliffs in Ontario and northern Michigan before those areas were settled.

By the mid-1960s, peregrine falcon populations were declining throughout the U.S. and had disappeared completely east of the Mississippi River. The main threat to the peregrine falcon and other birds of prey was the common use of organo-chlorine pesticides, such as DDT. Studies show the peregrine falcon retains the highest DDT residue of all vertebrates, causing reproductive problems. The species has recovered slowly since DDT was banned in North America in 1972. Unfortunately, the birds are still exposed to toxic pesticides at their wintering grounds in Central America.

The peregrine falcon's resurgence has been aided by recovery efforts begun in the late 1980s, particularly restocking programs. They involve breeding peregrines in captivity and releasing them into the wild. Birds released from Sudbury, Ontario and Pittsburgh, Pennsylvania formed a pair that became the first to successfully nest in Michigan, at a downtown Detroit location in 1993. Peregrines recently have been seen nesting in five spots in the downtown Detroit area. They also nest in Canadian urban centers such as London, Ontario.

Peregrines bred in captivity apparently adapt better than their wild relatives to the urban environment. Instead of natural high places such as cliffs, the adapted birds make use of artificial structures such as skyscrapers and power plant stacks. They feed on pigeons, mourning doves, starlings, flickers and woodcocks. Populations of pigeons and starlings often grow so large that they become a nuisance in urban areas.

The Michigan Department of Natural Resources has provided funding through its Natural Heritage Program to monitor falcon populations in the Detroit area and gain a better understanding of this unique raptor.

JUDITH YERKEY

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