LAKE ERIE

LAKEWIDE MANAGEMENT PLAN

Lake Erie LaMP

2002

Acknowledgements

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Canada

- Fisheries and Oceans Canada
- FOCALerie (Federation of Conservation Authorities of Lake Erie)
- Health Canada
- Ontario Ministry of Agriculture, Food and Rural Affairs
- Ontario Ministry of the Environment
- Ontario Ministry of Natural Resources

United States

- Agency for Toxic Substances and Disease Registry
- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources
- Natural Resource Conservation Service
- New York State Department of Environmental Conservation
- Ohio Department of Natural Resources
- Ohio Environmental Protection Agency
- Pennsylvania Department of Environmental Protection
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

Binational

- Great Lakes Fisheries Commission

Photo: Black Swamp Bird Observatory, Oak Harbor, Ohio

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In keeping with the spirit of binational cooperation, the reader will note the alternation between Canadian and U.S. preferred spellings on a number of occasions.

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Photo: Upper Thames River Conservation Authority

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Introduction

Section 1

Section 1: Introduction

In 1999, the Binational Executive Committee (BEC) passed a directive to accelerate the Lakewide Management Plan (LaMP) effort from the four-stage process outlined in the Great Lakes Water Quality Agreement (GLWQA) (IJC 1988). By accelerate, it was meant that there should be an emphasis on taking action and adopting a streamlined LaMP review and approval process. The LaMPs should treat problem identification, selection of remedial and regulatory measures and implementation as a concurrent, integrated process rather than a sequential one. The BEC recommended a LaMP be produced for each lake by April 2000, with updates every two years thereafter. This Lake Erie LaMP 2002 document represents the first update report. To fully appreciate the history of the Lake Erie LaMP process and to place this document in its proper, broad perspective, the reader should review the Lake Erie LaMP 2000 document. LaMP 2000 is available at a number of libraries and agencies in hard copy or CD, and can be accessed on the Lake Erie LaMP binational web site using the U.S. or Canadian urls: www.epa.gov/glnpo/lakeerie or www.on.ec.gc.ca/glimr/lakes/erie, respectively.

Photo: Steve Sauder

The GLWQA directs that the LaMPs take an ecosystem approach to assessing problem definition and implementing remedial actions. This concept is evident throughout the report, but particularly in the sections on ecosystem objectives and habitat strategy development. The environmental integrity of Lake Erie is dependent not only on various characteristics and stressors within the lake itself, but also on actions implemented throughout the Lake Erie watershed and beyond. Urban sprawl, shoreline development, climate change, the introduction of exotic species, the exploitation and destruction of natural lands and resources, the dominant agricultural and industrial practices within the lake basin, and long-range transport of contaminants from outside the basin all impact the health of Lake Erie. The LaMP provides a binational structure for addressing these environmental and natural resource issues, coordinating research, pooling resources, and making joint commitments to improve the environmental quality of the Lake Erie.

Due to the many chemical, physical, and biological complexities of the Lake Erie ecosystem, and the often-competing interests of diverse stakeholders, the Lake Erie LaMP necessarily takes an "adaptive management" approach. Ongoing research may bring new problems to light and resources constantly fluctuate as governmental and societal priorities shift. Following this approach, the Lake Erie LaMP 2002 document provides updated information on environmental conditions, presents a summary of the actions completed or underway to improve the lake, and discusses what additional plans or changes to ongoing management actions are needed.

The Lake Erie LaMP 2000 introduced the concept of ecosystem alternatives or future environmental states for the lake. The four ecosystem alternatives proposed represent different levels of recovery of natural system form and function. The extensive ecosystem alternative exercise that was carried out by the LaMP clearly identified what can be expected if particular management actions are implemented. Based on the results of that effort, the Lake Erie LaMP chose to support Ecosystem Alternative 2 as the one most consistent with sustainable development and providing multiple benefits to society. The LaMP 2002 report presents the potential ecosystem management objectives needed to achieve Ecosystem Alternative 2. These objectives are listed under the four main management categories of land use, nutrients, resource exploitation, and contaminants. Recognizing that management efforts to achieve Ecosystem Alternative 2 may require "trade-offs", it is important that consensus on the preferred alternative and associated management actions is reached among the diverse Lake Erie stakeholders.

The LaMP continues its efforts to locate and reduce or eliminate sources of pollutants particularly the Lake Erie LaMP designated critical pollutants of mercury and PCBs. The LaMP 2002 presents the results to date of a LaMP project to map the extent of sediment contamination in the Lake Erie basin for PCBs, mercury and dioxin. Tables listing the many critical pollutant reduction activities underway have been updated from those in the LaMP 2000 report. The beneficial use impairment assessment report for Degraded Wildlife Populations and Loss of Wildlife Habitat has been completed and the conclusions are highlighted in LaMP 2002. Updates on the fish beneficial use impairment assessment are presented as well.

The LaMP 2000 document presented an extensive list of habitat related projects underway or proposed in the Lake Erie basin. Rather than reporting out on the status of these projects and listing new ones, additional background research on preparing a habitat strategy indicated that the LaMP might better play an oversight role in creating general lakewide habitat objectives, supporting development of tools that might map areas of critical habitat, and coordinating with the many existing programs and efforts currently in place to improve habitat conditions in the Lake Erie basin. The success of habitat restoration and preservation will also depend on efforts to improve or protect the ecological processes that create and maintain habitats.

The Lake Erie LaMP is a program in which ongoing efforts, some of which may be conducted independently of the LaMP, can be strategically synthesized. Some of these actions include: the State of the Lakes Ecosystem Conference (SOLEC) efforts to develop Great Lakes indicators; the Lake Erie Millennium Plan initiative to identify, prioritize and pursue research needs; the efforts of Canadian and U.S. conservation agencies in controlling non-point sources and agricultural land use management; the land acquisition and preservation efforts of environmental groups such as The Nature Conservancy and the Nature Conservancy of Canada; the pollution prevention based activities of the Great Lakes Binational Toxics Strategy; implementation of the Remedial Action Plans in the 12 Lake Erie areas of concern; the fishery management plan of the Great Lakes Fishery Commission's Lake Erie Committee; implementation of wildlife management plans; and the efforts of the Lake Erie Binational Public Forum and others encouraging stakeholders across the basin to become involved in the decision-making process to determine the future status of Lake Erie. The LaMP remains mindful of emerging issues that may need to be adapted into the LaMP management scheme.

The Lake Erie LaMP focuses on measuring ecosystem health, teasing out the stressors responsible for impairments, and evaluating the effectiveness of existing programs in resolving the stress by continuing to monitor the ecosystem response. The role of the LaMP, as a management plan, is to define the management intervention needed to bring Lake Erie back to chemical, physical and biological integrity, and to further define agency commitments to those actions. Although Environment Canada (EC) and the U.S. Environmental Protection Agency (U.S. EPA) are the lead agencies for the LaMP, it continues to take an array of federal, local, state and provincial agencies and stakeholders to successfully implement the Lake Erie LaMP.

Ecosystem Management Objectives

Section 2

Section 2: Ecosystem Management Objectives

2.1 Ecosystem Alternative Selection

The Lake Erie ecosystem is managed by a variety of agencies with different responsibilities. There is a need to determine a set of goals and objectives for this ecosystem, consistent with the Lake Erie LaMP concept paper (U.S. EPA and Environment Canada 1995), so that agencies can co-ordinate their actions for effective management. Based on the results of extensive input and review, and the development of the Lake Erie ecosystem model (Colavecchia et al. 2000) a series of four alternative states for the future of Lake Erie has been identified (Lake Erie LaMP 2000).

This approach, which differs from that used for developing objectives for other Great Lakes, has resulted in a better understanding of which Lake Erie management actions impart the greatest effect and which components of the ecosystem are most directly impacted. The four ecosystem alternatives represent different levels of recovery of natural ecosystem form and function. The extent of recovery is dictated by the combination and strengths of various management interventions (Table 1).

Changes in land use that represent return towards more natural landforms or that mitigate impacts of urban, industrial and agricultural land uses, are the most significant actions that can be taken to restore the Lake Erie ecosystem. Alternative 3 represents moderate loss of natural landforms relative to status quo (Alternative 4), while Alternatives 1 and 2 represent small gains in the amount of natural landforms in the basin. Alternatives 3, 2, and 1 represent increasingly more progressive mitigation of agricultural, industrial and urban land use. The mitigation results in very strong reductions in phosphorus export from land, and in total suspended solids concentrations. The alternatives differ in the level of reduction of phosphorus exports from sewage treatment plants (STPs) with Alternative 2 requiring moderate reduction, Alternative 3 a strong reduction and Alternative 1 a very strong reduction.

The selection of an Ecosystem Alternative toward which to manage Lake Erie is not a trivial issue. There are many competing, and incompatible, uses of Lake Erie, and multiple agencies (federal, state, provincial and local) have jurisdictions over one or

Table 1: Summary of Lake Erie Ecosystem Alternatives

Management Lever or Effect	Action or Effect	Ecosystem Alternatives			
		1	2	3	4
Agricultural land use	Mitigation of impact	very strong	strong	strong	status quo
Industrial land use	Mitigation of impact	very strong	moderate	moderate	status quo
Urban land use	Mitigation of impact	very strong	strong	moderate	status quo
Natural landscapes	Restoration	small gain	small gain	moderate loss	status quo
Phosphorus concentration	Reduced concentrations in tributaries, nearshore and lake	very strong	strong	strong	status quo
Phosphorus from land	Reduction in loadings	very strong	very strong	very strong	status quo
Phosphorus from STPs	Reduction in loadings	very strong	moderate	strong	status quo
Total suspended solids	Reduction in concentration	very strong	very strong	very strong	status quo

more components of the ecosystem. Societal factors that influence the choice include economics, social justice, land use, and others. To be an effective tool, the LaMP, including the desired ecological state for Lake Erie, must have the support and commitment of the various environmental managers, decision makers and the public. Without a consensus on ecological conditions to be achieved, multiple management efforts could easily be competing, ineffective, and/or counterproductive. Ultimately, the process for choosing an Ecosystem Alternative for management purposes becomes one of identifying which one is most closely compatible with societal values of the residents in the basin.

The Lake Erie LaMP Work Group considered several options for soliciting opinions and comments on preferred Ecosystem Alternatives from government agencies, environmental groups, industry and the general public. Opinions were solicited through informal discussions, the Lake Erie Binational Public Forum, and agency reviews. In June 2001, the LaMP Work Group reached consensus that Ecosystem Alternative 2 would represent the preferred ecosystem of the Work Group. In September 2001, the LaMP Management Committee endorsed this conclusion. Additional discussions with stakeholders, including the public, are being held to present the selection of Ecosystem Alternative 2.

Photo: Upper Thames River Conservation Authority

Ecosystem Alternative 2 is consistent with the themes of sustainable development and of multiple benefits to society of a healthy Lake Erie ecosystem. The analysis supporting Ecosystem Alternative 2 highlights the importance and urgency of improving land use activities, continued diligence in nutrient management, and the vulnerability of fish and wildlife species to human activities.

2.2 Selection of Ecosystem Management Objectives

Ecosystem management objectives are targets that, when all are achieved, should result in the preferred ecosystem alternative being realized. The Great Lakes Water Quality Agreement addresses the large areas of the lake and considers them homogenous when establishing phosphorus loading targets and target concentrations. A target concentration in western Lake Erie may be achieved while having large areas of highly enriched waters due to the effect of watersheds like the Maumee River. Eastern Lake Erie may be at target concentrations of phosphorus while the lower Grand River (Ontario) is highly enriched. Watersheds and their area of influence in the lake are the natural building blocks with which to strategize this new phase of ecosystem rehabilitation. The challenge for developing ecosystem objectives for the Lake Erie ecosystem lies in its distinct three basins, each with very different characteristics. As a result, ecosystem management objectives for the whole of Lake Erie may require the development of sub-objectives for each basin. There shall be substantial emphasis on watersheds and land use activities therein.

Ecosystem Alternative 2 does not prescribe the necessary management goals to realize the desired ecosystem. Management goals are dependent on the ecosystem management objectives formulated to be consistent with the Ecosystem Alternative, and are based on the present state of the ecosystem components. Input from the Lake Erie community on the preferred Ecosystem Alternative 2 helps define the degree of implementation that is necessary and acceptable to be consistent with the ecosystem alternative. Additional ecosystem management objectives, not explicitly defined through the ecosystem alternative selection, may also be identified as being important to the community.

The Lake Erie ecosystem has three very distinct basins, and within the entire watershed of the lake there are 34 sub-watersheds, many of which have unique features

and pressures. The impact of exotic species in the Lake Erie ecosystem contributes to instability, and new species continue to access the ecosystem. Implementation of the management strategies moves the ecosystem in the right direction, and leads to improvements in biological integrity. The process is iterative. Tracking of recovery in relation to management interventions leads to projections of reasonable and feasible endpoints for biological integrity at appropriate units of the ecosystem (i.e. watersheds and areas of influence in the lake, bays, basins).

The overall ecosystem management objectives are presented as principles for management actions to achieve Ecosystem Alternative 2. The objectives are presented in relation to the main management categories influencing the status of the lake: land use, nutrient management, natural resource exploitation and contaminants. In proposing these ecosystem management objectives, it is recognized that each watershed and basin may require varying degrees of implementation. Management sub-objectives provide the context for the degree of managerial actions that may be required to achieve the status of ecosystem elements expected under Ecosystem Alternative 2. The management sub-objectives are considered for the whole lake basin. Although each individual watershed may require greater or lesser degrees of management action, taken together, achievement of the management sub-objectives should lead to the attainment of the management objectives. The *status quo* or "current conditions" are generally reflective of conditions found in the mid-to-late 1990s. In the management sub-objectives presented below, descriptive adjectives are used to imply a relative degree of management intervention required[1].

2.2.1 Ecosystem Management Objectives, Sub-objectives and Rationale

Land Use

All land use activities within the basin result in gains in the quantity and/or quality of natural habitat to the extent that native biodiversity and community integrity can be realized to the greatest degree possible throughout the basin and be sustained for the benefit of future generations.

- Strong reductions (from 1990s' levels) of the impacts of land use on the structure and function of the Lake Erie ecosystem shall be achieved.
  - The impacts of agricultural land shall be strongly mitigated by continuing reductions in the use of conventional tillage, agricultural chemicals and fertilizers.
  - Conventional urban land use practices shall be strongly mitigated through implementation of environmentally friendly strategies.
  - Conventional industrial land use practices shall be moderately reduced in impact through implementation of environmentally friendly strategies.
  - Natural landscapes and habitats shall be maintained and small increases in natural landscape area should be realized, relative to the 1990s.

Rationale: Ecosystem Alternative analysis identified land use practices as the dominant management category affecting the Lake Erie ecosystem. Key elements within the category were gains in quality natural lands and environmentally sound management practices for rural, urban and industrial landscapes.

Best management practices (BMPs) can mitigate many deleterious land uses and their impacts to the extent that natural habitat quality and quantity can improve. It is expected that there will be increasing demands and pressures for land conversion in the Lake Erie basin. Proactive planning for these pressures needs to include the protection of critical habitat corridors that connect and link habitats between the lake,

[1] Adjectives were derived from differences in the model results for Ecosystem Alternative #2 relative to conditions in the 1990s: slight (% < 10), small (11 < % < 20), moderate (21 < % < 40), strong (41 < % < 60), very strong (61 < % < 80), major (% > 80). % does not necessarily translate directly into acreage, biomass, or other units but provides a relative, qualitative guide to the difference between conditions for Ecosystem Alternative #2 and those of the 1990s (Colavecchia et al., 2000)

the wetlands and the upland habitat. Specific watershed targets need to be established, which include securing, protecting and restoring natural lands. A watershed approach is critical to developing local solutions and to maximizing gains with partners.

"Best Management Practices" (BMPs) are mitigating strategies that are crosscutting and invaluable to achievement of all of the objectives. Agricultural "BMPs" create natural land habitat and wildlife corridors, and protect aquatic habitat and fisheries. If soil particles are not trapped by buffer strips and prevented from entering watercourses, they degrade aquatic habitat as silt and suspended solids, and they have carried nutrients, pesticides and contaminants with them. Widespread implementation of agricultural BMPs is critical to achievement of objectives. Greening strategies for urban and industrial landscapes have similar benefits and all contribute to reduced "flashiness" of stream flows.

Photo: Upper Thames River Conservation Authority

Nutrients

Nutrient inputs from both point and non-point sources shall be managed to ensure that loadings are within bounds of sustainable watershed management and consistent with ecosystem requirements as described in Ecosystem Alternative 2.

- Total phosphorus loadings may be moderately reduced below the GLWQA maximum allowable rate of 11,000 metric tons/year.
- Phosphorus export from non-point sources, including agricultural land use, in accordance with the alternative, is to be very strongly reduced in order to favor recovery and maintenance of healthy aquatic communities in the immediate receiving waters.
- Sewage treatment plants may be acted on to discharge phosphorus at a concentration moderately below the GLWQA rate of 1 mg/l.

Rationale: It is important that all sources that contribute to the watershed nutrient load and ultimately to the basin load, be managed to limit local and regional impacts. Best management practices and point source controls need to be implemented with consideration of the ecological requirements for the maintenance or recovery of healthy aquatic communities in the watershed, the hydrologic cycle and water usage. Other nutrients and their various forms, such as nitrates, need to be included in assessments of watershed and basin impacts.

Exploitation

Exploitation and disturbance of aquatic and terrestrial species shall be managed to ensure that the integrity of existing healthy communities be maintained, providing benefits to consumers. In addition, exploitation and disturbance should be managed to ensure that these factors do not prevent recovery of degraded communities, to the extent

allowed by habitat. The harvest of valued timber resources, extraction of aggregate deposits and the utilization of other features of the working landscape should be done in a manner that is sustainable and that affords the greatest opportunity to preserve and enhance the biological context integrity of the Lake Erie ecosystem.

- Disturbance of wildlife by human activities (boating, hiking, etc.) shall be substantially reduced from levels during the 1990s.
- Fishing shall be maintained at sustainable levels recommended in the Fish Community Goals and Objectives for Lake Erie for the 1990s (Lake Erie Committee 2002).

Rationale: Commercial and sport fishing, hunting, trapping, and disturbance by human presence or activity have negative impacts on target species and habitats and more broadly on other components of the ecosystem. Integrity is a general term for the recurring structure and composition of a community over time, due to internal regulation. Fisheries managers look to top order predators to provide this regulation in aquatic communities and, for example, are managing walleye in recognition of their ecological role as well as a capacity to provide a valuable fishery.

Sustainable management of timber stands can realize harvest of valued trees for present and future generations and still maintain essential habitat function. Resource extraction is recognized as valued economic activity but should be done in a manner to prevent or mitigate to the greatest extent possible the negative environmental impacts.

Contaminants

In order to achieve Ecosystem Alternative 2, toxic chemical and biological contaminant loadings within the basin must decline to a level that would permit sustainable use of natural resources.

- Toxic substances shall not exist in amounts to the detriment of human health or wildlife.
- Exotic species should be prevented from colonizing the Lake Erie ecosystem and controlled where feasible and consistent with other objectives. Exotic species shall be reduced to a point where they do not impair the ecological function of the Lake Erie ecosystem.

Rationale: The amount of toxic contaminants in the Lake Erie ecosystem is the result of the combined inputs from point and non-point sources within the basin, loadings from the Detroit River, and upstream and long-range transport from regional and global sources. Degraded watersheds not only impact local fauna, but they can have lakewide impacts, particularly if used by fish for spawning or nursery habitat. Effective management of local point and non-point sources can improve watershed and basin ecosystem quality. However, broad based actions such as those promoted in the Great Lakes Binational Toxics Strategy and the United Nations Agenda 21 (addressing global atmospheric pollutant transport) are also required to fully reach this objective.

Biological contaminants, defined as species exotic to the Lake Erie ecosystem, are the result of intentional or unintentional introductions, or range expansion and colonization. The LaMP has identified exotic species as one of the key problems impairing the Lake Erie ecosystem. Successful invaders may prey upon native species or compete with them for limited resources, altering the structure of the local and lakewide ecosystems. The impact of exotics needs to be minimized where feasible by preventing access, and controlling or managing them once they have entered the ecosystem.

The Lake Erie ecosystem management objectives assume that toxic contaminant loadings are managed according to the principles of virtual elimination. As such, levels of contaminants should be declining, not be present at varying levels, and not be controlling other ecosystem components.

2.3 Indicators

Indicators are measurable features that identify the current state of the ecosystem relative to the desired state. The desired state is defined through the ecosystem management objectives, which are compatible with the modeled results as expressed in the Ecosystem Alternative. Indicators shall be identified to track progress toward the ecosystem management objectives.

A set of Great Lakes indicators has been, and is continuing to be, developed through the State of the Lakes Ecosystem Conference (SOLEC) process, and biennial assessments of the condition of Lake Erie ecosystem components are being made. To the extent possible, indicators for the Lake Erie ecosystem objectives shall reflect those for SOLEC reporting. However, Lake Erie has many unique features that may require specific indicators not included in the SOLEC set. In other cases, the indicators may be similar, but the target or desired end-state may be unique for Lake Erie.

Currently over 90 surveillance and monitoring programs are underway in the Lake Erie basin. To the maximum extent possible, Lake Erie Ecosystem Alternative Indicators shall utilize these existing programs to track progress.

Beneficial Use Impairments Update

Section 3

Section 3: Beneficial Use Impairments Update

3.1 Introduction

A detailed beneficial use impairment assessment (BUIA) was presented in the Lake Erie LaMP 2000 document. It serves as the foundation for charting the future direction of the Lake Erie LaMP. Table 2 summarizes the impairment conclusions and causes of impairment as listed in the Lake Erie LaMP 2000 document. A full report for the Degraded Wildlife Populations and Loss of Wildlife Habitat BUIA was not yet complete for the LaMP 2000 report, so this section focuses heavily on the specific findings in that report. Also included are updates for several of the other BUIAs, although no changes in impairment conclusions have occurred during the last two years.

Table 2: Summary of Beneficial Use Impairment Conclusions from Lake Erie LaMP 2000 (updates for 2002 are noted in italics)

Use Impairment	Impairment Conclusions	Type of Impairment	Causes of Impairment
Fish & Wildlife Consumption Restrictions	**Impaired**	**FISH***- sport fish consumption advisories in open and tributary waters of all basins. **WILDLIFE** - human consumption advisories for snapping turtles (including eggs) and waterfowl in NY waters, eastern basin. *Ohio will issue advisory for snapping turtles in 2002.*	**FISH** - PCBs, mercury, lead, chlordane, and dioxins **WILDLIFE** - PCBs, chlordane, DDE, DDT, mirex, *mercury, lead*
Tainting of Fish & Wildlife Flavor	Not Impaired	NONE	NONE
Degradation of Fish Populations	**Impaired**	Unmet fish population objectives; loss of spawning and nursery area; loss of population diversity; rare, threatened, endangered and special concern species; reduced predatory function; unnaturally high fish community instability; inefficient use of food web energy.	Habitat loss and degradation; non-indigenous species (exotics); forage fish availability reduced; over-exploitation; loss of native stocks/species, particularly keystone predators.
Degradation of Wildlife Populations	**Impaired**	Unmet wildlife population objectives; population fragmentation, isolation, and instability; loss or reduction in species indicative of quality habitat; loss of source populations; rare, endangered, threatened, and special concern species; accelerated parasitism/predation; competing uses of a given habitat; changes in ground temperature and moisture conditions in forested area; loss of travel lanes; loss of range/area-sensitive species (e.g. amphibians & reptiles, rails, bitterns, sedge wrens, bald eagle)	Fire suppression; logging; filling and draining of wetlands; high water levels, storm surges; dredging and channel modifications; water diversions; shoreline hardening and back-stopping; contaminated sediment; contaminant and nutrient loadings; navigation/ boating activities; exotics.
Fish Tumors or Other Deformities	**Impaired**	Incidence rates of fish tumors or other deformities exceed rates at least impacted sites within the LE basin; presence of neoplastic or preneoplastic liver tumors in brown bullheads	PAHs (brown bullhead), unknown (other species)
Animal Deformities or Reproduction Problems	**Impaired**	Exposure above effect levels in bald eagle, herring gull, cormorant, common tern and eastern spiny softshell turtle; deformity impairments in mudpuppy; likely impairment in mink, river otter, snapping turtle, and frogs and toads	PCBs and other organochlorines, dieldrin (eagles), DDE, PAHs (mudpuppy), nitrates (frogs and toads)

Use Impairment	Impairment Conclusions	Type of Impairment	Causes of Impairment
Degradation of Benthos	**Impaired**	Degraded benthic community (composition and interactions among components) compared to reference conditions. Dominant species indicate degraded environment. Keystone species absent or nearly gone: **all basins* - unionid *mussels, Gammarus* amphipods; **east & central basins - Diporeia* amphipods; **east and western basins* - fingernail clams; **middle* of western basin - *Hexagenia* (mayflies). Unmet objectives for benthic density, biomass or productivity; toxicity to benthic organisms; elevated incidence of deformities or other abnormalities; contaminant burden is high enough that predators may be at risk of bioaccumulating toxics.	Contaminated sediments, non-indigenous species or exotics, loss and degradation of habitat particularly in wetlands
Restrictions on Dredging Activities	**Impaired**	Dredged materials require confined disposal in certain tributary mouths and harbors of all basins.	PCBs, heavy metals
Eutrophication of Undesirable Algae	**Impaired**	Maumee Bay, lake effect zones of Maumee/Ottawa Rivers, *western basin*; nearshore and river mouth areas of Canadian *eastern basin* (excessive *Cladophora*; P levels above Canadian guidelines in tributaries). Potentially impaired - lake effect zones of certain Ohio tributaries (degraded fish communities), *western and central basins*; Rondeau Bay and nearby nearshore and river mouth areas, Canadian *central basin.*	Phosphorus
Restrictions on Drinking Water Consumption or Taste & Odor Problems	Not Impaired	NONE	NONE
Recreational Water Quality Impairments	**Impaired** (nearshore areas, all basins)	Exceedances of bacterial guidelines established to protect human health	*E. coli* and/or fecal coliform, PAHs**, PCBs**
Degradation of Aesthetics	**Impaired**	High turbidity; obnoxious odors; decaying *Cladophora* on the shoreline; seasonal fish die-offs because alewife/ other exotics are not acclimated to colder winter water temperatures; hindrances to recreational use due to floating garbage and debris/zebra mussels.	Excessive Cladophora, point/non-point source stormwater runoff, excessive floating garbage and debris, dead fish, excessive zebra mussels on shoreline areas.
Added Costs to Agriculture or Industry	Not Impaired	NONE	NONE
Degradation of Phytoplankton & Zooplankton Populations	**Impaired**	**PHYTOPLANKTON** - *eastern basin* - total standing crop and photosynthesis are below the potential set by P loading in the nearshore; loss of keystone species; loss of trophic transfer to *Diporeia.* **ZOOPLANKTON** - *eastern basin* - loss of dominant cold-water species; *eastern and west-central basins* - reduction in mean size points to potential impaired trophic transfer; *west central basin - Bythotrephes* acts as an energy sink; *western and central basin* lake effect zones - habitat loss and degradation.	Zebra and quagga mussel grazing; high planktivory.

Use Impairment	Impairment Conclusions	Type of Impairment	Causes of Impairment
Loss of Fish Habitat	**Impaired**	Unmet fish habitat objectives; loss of habitat diversity and integrity; loss of spawning/nursery areas; barriers to migration; changes in stream temperature, water quality and hydrology; high turbidity; loss of aquatic vegetation; changes to benthic species composition.	Destruction and draining of wetlands;dams, dikes, dredging/ channel modifications, water taking; streambank/shoreline filling and hardening; sediment/ chemical contaminant/nutrient loadings; navigation/recreational boating activities; exotics, *Cladophora* fouling (eastern basin nearshore)
Loss of Wildlife Habitat	**Impaired**	Unmet wildlife habitat objectives; habitat fragmentation and loss of niches; loss of diversity and integrity; population demands exceed available habitat (e.g. colonial waders that use the Lake Erie Islands); loss of stopover habitat along migratory corridors (birds, butterflies, bats); loss of cover for protection from predation; loss of or accelerated succession patterns; loss of area available for habitat expansion; loss of buffer functions between one habitat type and another; loss or reduction in quantity/quality of nesting/denning areas; loss or reduction in quantity/quality of food sources.	Fire suppression; logging; destruction and draining of wetlands; high water levels, storm surges; dredging/channel modifications, water taking, streambank/shoreline filling, hardening and backstopping; sediment/chemical contaminant/ nutrient loadings; navigation/ boating activities; exotics.

*Commercial fishermen in Ontario are prohibited from selling carp that are 32 cm or larger, due to PCBs.
** PAHs are the basis for a human contact advisory in the Black River Ohio Area of Concern and PCBs are the basis for a human contact advisory in the Ottawa River (Maumee Area of Concern).

3.2 Degraded Wildlife Populations and Loss of Wildlife Habitat

A summary of the Degraded Wildlife Populations and Loss of Wildlife Habitat Technical Report (Lambert et al. 2001) has been completed. A wide variety of interest groups and agencies (wildlife managers, natural heritage biologists, academics, etc.) assisted in providing information and reviewing draft documents. There was consensus that habitats in Lake Erie are impaired and need attention.

Fifteen general habitat types and 300+ wildlife species were assessed for evidence of impairment in the Lake Erie basin. Terrestrial invertebrates were not assessed because they were not included in the ecosystem management objective modeling process developed for the Lake Erie LaMP. Wildlife populations or habitats were considered impaired if one or more of the definitions below applied to a species or habitat in one or more jurisdictions of the Lake Erie basin:

- The wildlife population or amount or condition of habitat is below a stated objective (objectives were taken from management plans/strategies already underway and applicable to the Lake Erie basin);
- The wildlife population or amount or condition of habitat is below the demand placed on it;
- The wildlife population or habitat is rare, threatened, endangered, or of special concern;
- The wildlife population or habitat is unable to sustain itself in terms of amount or condition;
- Available data is insufficient or inconclusive, but the wildlife population or habitat is suspected to be degraded;
- The wildlife population or habitat has contaminant burdens that may impair behavior or reproduction, either at that level or in higher trophic level organisms.

Table 3 identifies the impairment status of the habitats used in this assessment of the Lake Erie basin. Assessment of the selected general habitat types clearly indicated there was impairment; therefore, it was not necessary to conduct further assessments based upon individual vegetation communities or plant species.

Table 3: Summary of Lake Erie Wildlife Habitats and Their Impairment Status

Habitat	Impairment Status*
Islands	Impaired in OH; likely impaired in ON; do not occur in MI, NY and PA
Sand Beaches / Cobble Shore	Sand beaches impaired in OH, PA, NY, and ON; no MI assessment provided; cobble shore does not exist along Lake Erie shoreline in MI, is rare in ON and status is unknown in PA; where it does exist it is impaired
Unconsolidated Shore Bluffs	Impaired in PA; suspected impaired in NY and ON; do not occur in MI; not impaired in Ohio, but impacts to this habitat are key contributor to sand beach habitat impairment
Interdunal Wetlands	Impaired in OH, PA and ON; do not occur in NY; no MI assessment provided
Sand Dunes	Sand dunes and wooded beach ridges are impaired in OH, PA, NY and ON; no MI assessment provided; sand barrens are unique to Ohio and are impaired
Submerged Macrophytes	Impaired in PA, NY and ON; not impaired in OH; no MI assessment provided
Floating Macrophytes	Impaired in NY and ON; likely impaired in OH; suspected impaired in PA; no MI assessment provided
Emergent Macrophytes	Impaired in MI, PA, and NY; likely impaired in OH; suspected impaired in ON
Wet Meadow	Impaired in OH, PA, NY, and ON; no MI assessment provided
Mesic Prairie	Impaired in OH and ON; suspected impaired in PA; does not occur in the Lake Erie basin of NY; no MI assessment provided
Shrub Swamp	Impaired in OH and ON; suspected impaired in NY and PA; no MI assessment provided
Bogs and Fens	Impaired in OH, PA, NY and ON; no MI assessment provided
Upland Marsh	Impaired in OH and NY; suspected impaired in PA and ON; no MI assessment provided
Mesic Forest	Impaired in NY and ON; oak-hickory suspected impaired in OH; beech-maple suspected impaired in PA; no MI assessment provided
Swamp Forest	Impaired in OH, PA, NY and ON; no MI assessment provided

* Causes vary from historic human intervention, to natural, current practices, exotic species, and contaminants. Land use management provides the key to restoration.

The main cause of wildlife habitat impairment is the dramatic change to Lake Erie basin land use since European colonization began. Land use alterations have had an effect on almost all natural habitat-structuring forces (e.g., Lake Erie water levels, location of groundwater table, soil types and their associated nutrient values, bedrock, precipitation and associated storm surges, wind, fire, and the relative abundance of the wildlife species using a particular habitat). Human response to these structuring forces fall into three categories: 1) those that could not be changed must be protected against (water levels, precipitation, wind); 2) those deemed "undesirable" must be eliminated (fire, shallow groundwater); and 3) the "accidental" addition of new forces such as the introduction of exotic species and contaminants. The result has been, and continues to be, extreme pressure on both the natural functions of the habitat complex that historically

defined the region, and the wildlife populations that depend on these habitats.

The wildlife species and species guilds in this assessment were chosen based on a number of criteria including: consistency with the Lake Erie LaMP ecosystem management objectives modeling exercise; usefulness as an indicator of ecosystem health (particularly aquatic ecosystems) or wildlife function; existence of unmet objectives; and availability of data from monitoring programs. In this assessment, 16 amphibian species, 27 reptile species, 14 mammal species, 200+ bird species (36 individual species/10 guilds) were evaluated. A guild is a group of species with similar roles in the wildlife community due to similar ecological resource requirements and foraging strategies. Bird guilds assessed included dabbling ducks, diving ducks, mergansers, migrant passerines, breeding passerines, shorebirds, marsh birds, migrant raptors, herons and egrets, and gulls and terns.

Of the 300+ wildlife species assessed, 38 (10 reptiles, 5 amphibians, 19 birds, 4 mammals) were clearly impaired in all five Lake Erie jurisdictions, in all Lake Erie jurisdictions that provided data, or in all Lake Erie jurisdictions that are known to be within their range. An additional 11 (2 reptiles, 3 amphibians, 6 birds) were impaired in four out of five Lake Erie jurisdictions, in all but one of the Lake Erie jurisdictions that provided data, or in all but one of the Lake Erie jurisdictions that are known to be within their range.

Wildlife species that are largely or totally limited to the Lake Erie basin, species for which jurisdictions in the basin have a high stewardship responsibility, or species suspected or proven to be adversely affected by contaminants were highlighted in the report. As examples, the eastern fox snake and the Lake Erie water snake are both endemic to the Great Lakes basin.

Photo: Scott Gillingwater

The eastern fox snake inhabits coastal marshes and other nearshore areas along southern Lake Huron, Lake St. Clair and the Detroit River, east along the northern Lake Erie shore to Long Point Bay (Norfolk County, Ontario) and along the southern Lake Erie shore in the extensive marshes of Lucas, Ottawa, Sandusky, and Erie counties in Ohio. On Lake Erie, fox snakes inhabit Pelee Island and other islands. In Ontario, the western basin of Lake Erie, Long Point, Rondeau, Pelee Island, and Point Pelee comprise over 50% of the eastern fox snake's global range. The eastern fox snake does not occur in the Lake Erie basin of New York or Pennsylvania; however, it is impaired in all of the other jurisdictions bordering Lake Erie (i.e. Michigan, Ohio, and Ontario). The eastern fox snake has legal protection in Michigan and Ontario and is listed as threatened in both jurisdictions. In Ohio, the eastern fox snake is considered a species of special interest (a designation assigned to species, or subspecies, that might become threatened in Ohio under continued or increased stress). In Canada it was listed as threatened in 2000.

The Lake Erie water snake is a semi-aquatic reptile entirely dependent on specialized western Lake Erie island habitat (rocky shoreline areas and nearshore waters). The total range of this species is divided between Ontario (4,138 ha or 62% of its global range) and Ohio (2,479 ha or 38% of its global range). Some of the major islands where this subspecies occurs include Middle Island, East Sister Island, Hen Island and Pelee Island in Ontario, and South Bass, Middle Bass, North Bass and Kelleys islands in Ohio. Historically, the Lake Erie water snake occurred on the Ohio mainland, two or more nearshore Ohio islands, and 22 or more offshore islands and rock outcrops. Today, the Lake Erie water snake has disappeared from four islands (West Sister Island and Green Island in Ohio and Middle Sister Island and North Harbour Island in Ontario), and has declined significantly on the remaining islands. The current estimate for the U.S. population ranges from 1,530 to 2,030 adults and is restricted to only eight islands. Recent data show that the number of Lake Erie water snakes has declined by 75% on North Bass Island and by 81% on Middle Bass Island - two key study sites in Ohio. In Canada, the population of Lake Erie water snakes could number over 1,600 adults, based on maximum population estimates from surveys in the early to mid-1980s. Human persecution of this subspecies on the islands, as exemplified by

an extermination program on Middle Island, has likely contributed to the species' decline over the years. Persecution by humans is still a serious problem on several islands. The Lake Erie water snake is listed as endangered in Canada and threatened in the U.S. and has endangered status in both Ohio and Ontario. Over the past 60 years, key shoreline habitat within the Lake Erie water snake's range has been altered, degraded, and developed through the construction of cottages, marinas, docks, sea walls, the filling of lagoons, and quarry mining. Contaminant concentrations (PCBs) in Lake Erie water snakes from Pelee Island are high enough to justify a study of health and reproductive effects.

The objectives and priorities of several existing wildlife and habitat management plans were used in the evaluation of habitats and wildlife in the Lake Erie basin. Management plans target specific objectives and goals for their planning regions (many of which fall within the Lake Erie basin); natural heritage plans help identify priority species or habitats in need of protection; recovery plans outline the biology, threats and limiting factors, research needs, and recovery goals for endangered and threatened species; and a variety of conservation plans provide guidelines for the protection of habitats and biodiversity. Some of the key management programs: recovery plans, natural heritage plans and conservation plans consulted for this habitat and wildlife assessment are outlined in the BUIA report.

3.3 Next Steps

Information on habitat and wildlife impairments from this assessment will be used in the development of a habitat strategy for the Lake Erie LaMP and will help focus habitat protection, restoration, and enhancement efforts in the Lake Erie basin. Information gathered from this assessment and other beneficial use impairment assessments have also contributed to the development of draft ecosystem objectives for Ecosystem Alternative 2.

Lake Sturgeon Making a Comeback

In 2001, 21 sturgeon were reported in Ohio waters. Lake sturgeon provided a lucrative commercial fishery across the Great Lakes in the mid-1800s for caviar and smoked fish. Historically, Lake Erie produced the largest number of sturgeon in the Great Lakes. Over-fishing, pollution and damming of rivers greatly reduced the populations by the early 1900s. A slow maturity rate was also a factor, as a female sturgeon doesn't spawn until 20 years of age, and then only every 4 to 7 years. Recent observations and catches of this prehistoric-looking fish have fishery biologists hoping for a reversal in the lake sturgeon's diminished presence in Lake Erie. Especially noteworthy are a number of catches of juvenile sturgeon three to six years old (measuring 14 to 24 inches), and a 7-inch fish, spawned last spring, suggesting sturgeon are reproducing in Lake Erie. Of concern to New York States biologists are the 27 dead sturgeon that washed onto shore in 2001, possibly suffering from a botulism outbreak.

Photo: Gene Emond

One of the sturgeon reported in Ohio waters this year was the recapture of a fish tagged from a current monitoring project in the Lake St. Clair and Detroit River region; the first recapture outside the Lake St. Clair/ Detroit River system. Since 1995, more than 4,000 sturgeon have been tagged. Recaptures of these highly migratory fish, aid in the population and habitat management of this species. Overall biologists are very optimistic about the comeback of Lake Erie's sturgeon and hope to someday find evidence of spawning grounds. A Cleveland angler caught a 5 1/2-foot sturgeon on the Cuyahoga River last September. Two adult sturgeon caught in the Maumee River last year could be an indication that sturgeon are returning to these streams.

3.4 Fish BUIA Update

The major points on fish BUIAs from the LaMP 2000 report were that the fish community was unstable due to loss of habitat, loss of top fish predator stocks, negative impacts of non-indigenous species (exotics) and inefficient flow of energy through the food web. These factors continue to create instability in the Lake Erie fish community.

Since 2000, round gobies have spread throughout Lake Erie and have increased in abundance. They are now among the most abundant fish species on rocky substrates, feeding on a variety of organisms ranging from plankton to zebra mussels and other benthic invertebrates to fish eggs. They also have become a major prey of essentially all benthic fish predators, including smallmouth bass, yellow perch, walleye, and freshwater drum. In July 2001, the first tubenose goby was captured in western Lake Erie. Given the St. Clair River experience (where both tubenose and round gobies were initially found but round gobies eventually dominated), it is anticipated that tubenose gobies will not substantially add to the impacts of the round goby.

Walleye stocks should improve in the near future as Lake Erie's five fisheries management agencies support a Coordinated Percid Management Strategy, which will significantly reduce fishing mortality on walleye through 2003. The strategy also allows for the further development of adaptive fishery management on an interagency level. Strong walleye hatches in 1999 and 2001 should bolster the adult stocks in coming years with improved survival rates that result from reduced fishing. Yellow perch stocks should also benefit from the Coordinated Percid Management Strategy.

A five-year fisheries restoration program has been initiated by Ontario for eastern Lake Erie. In cooperation with the New York State Department of Environmental Conservation, Ontario is establishing regulations for conservative harvest, initiating a major stock assessment program, and implementing a program of fisheries inventory and habitat assessment for nearshore waters and lake-affected zones of rivers.

Positive signs in the western basin fish community are that white bass stocks appear to be increasing in abundance and prey fish populations have recovered from low levels during the mid-1980s. Increased populations of mayflies have increased the forage base for many fish species, including yellow perch. The silver chub, a benthic-feeding high-energy food source for other fish, is reappearing in abundant numbers. The silver chub practically disappeared from the lake simultaneously with the catastrophic decline of the mayfly in the early 1950s (Troutman, 1981). Coincidently, silver chubs feed on zebra mussels. Trout-perch, another benthic species that declined dramatically in the 1950s, is also making a comeback. These changes suggest that the historic benthic-feeding community in Lake Erie is beginning to recover (Thoma, personal communication).

[Section 4 Cover Page]

Section 4: A Habitat Strategy for Lake Erie

4.1 Introduction

The Lake Erie LaMP has identified habitat loss and degradation as one of the top three stressors that must be addressed to restore Lake Erie. The alteration of natural ecosystems through the loss of forests, wetlands, and grasslands has had marked effects on biotic processes and fish and wildlife populations in the Lake Erie basin.

The Lake Erie LaMP beneficial use impairment assessment found fish habitat in Lake Erie tributaries (including riverine estuaries), shoreland areas (including coastal wetlands), and nearshore areas to be impaired. Over 80% of historical coastal wetlands have been lost and most of the remaining wetlands are diked or have degraded physical or chemical properties. All 15 of the general habitat types representative of, and inextricably tied to, the aquatic components of the Lake Erie environment are impaired within at least one Lake Erie basin jurisdiction. Degradation of 14 of these habitat types are resulting in unmet wildlife population management objectives for particular wildlife species. Upland marsh, wet meadow, emergent macrophytes, bog/fen and interdunal wetlands are the five most commonly degraded habitats responsible for this problem. Benthic habitats in the lake have also been lost or disrupted. The loss of chironomid larvae and benthic invertebrate diversity in Lake Erie tributaries indicates that these habitats are also degraded.

In addition to loss of habitat, the beneficial use impairment assessment reports identified the loss of ecological function, or how efficiently the habitat supports the biological community that inhabits it. For example, dams prevent fish from swimming upstream to spawn; dredging and/or filling wetlands reate avenues for exotic invasive species, such as purple loosestrife, to proliferate and greatly reduce the nutritional value provided by the wetland. Ecological function is impaired not only because of outright habitat destruction, but also because of anthropogenic activities that have increased sediment loads to the lake and its tributaries, increased soil and water temperatures, and altered river flows and hydrology. There is a direct connection between land use, non-point source runoff and habitat quality.

4.2 Habitat Strategy Development

In order to address the key issue of habitat loss and alteration, the Lake Erie LaMP 2000 document sought to present a habitat action plan. With the emphasis on “action”, the LaMP 2000 effort focused on identifying ongoing or planned projects that would lead to removal of a habitat impairment and serve to meet the ecological objectives of the LaMP. Considerable review since then suggested there was a larger need for strategic planning rather than trying to prioritize projects for implementation. There are already a large number of habitat related projects underway by a variety of agencies and local groups. It is the LaMP’s role to determine what it can best do, from a value added perspective, to tie existing efforts together and address gaps to see impacts/results on a lakewide basis.

The habitat strategy provides a framework to guide and coordinate habitat protection and restoration efforts in the Lake Erie basin. The limited amount of existing habitat monitoring has been focused largely on species presence or absence and the amount of

habitat acquired or restored. More attention needs to be placed on population numbers and habitat function. For example, marshes may still remain in some areas, but if they consist of a monoculture of cattails or purple loosestrife, they may not be providing the necessary diversity of plants and communities to support the wildlife that depend on the marsh during migration or the breeding season. The focus of the habitat strategy is on habitat preservation and restoration and improving the ecological function of habitats. It also considers the preservation, restoration and enhancement of the ecological processes that create and maintain habitats.

One of the first steps in development of the habitat strategy is working with key groups and agencies involved in habitat protection, restoration and management in the Lake Erie basin to determine appropriate basin-wide goals and the value of the Lake Erie LaMP's support and involvement. The Lake Erie LaMP has already compiled a long list of the many programs and organizations that may support the development and implementation of a Lake Erie Habitat Strategy.

The results of the ecosystem modeling exercise for the Lake Erie LaMP indicate that land use management is the key to restoring Lake Erie. Land use is also the key to improving habitat. Land use management generally includes actions in the following categories; agricultural non-point source runoff; urban and land use development controls; preservation; and restoration, including stewardship incentives. To illustrate the types of existing programs with which the LaMP will need to coordinate to influence land use practices affecting the lake, several examples of representative programs are described below. The impact of exotic species is also important to habitat in the Lake Erie basin, and an example of how Phragmites many be impacting habitat is presented. A brief description of several of the habitat mapping projects that will be useful to the LaMP is included. Planning for long-term fluctuations in water levels and climate change must also be considered.

4.3 Agricultural Non-point Source Runoff

Ontario Environmental Farm Plan

The Ontario Environmental Farm Plan is a successful self-risk assessment tool involving partnerships with broad stakeholder involvement from farm groups and government. The Ontario Farm Environmental Coalition stakeholder groups drive the initiative, and partnered with government ministries, agencies, non-governmental organizations and farm groups to develop the Environmental Farm Plan process. Through the Environmental Farm Plan, farmers learn about environmental strengths on their farms; identify areas of concern; and implement actions to improve environmental conditions. Dollars put toward corrective on-farm actions by government and from farmers' pockets have shown that contributions have been made toward 3 important areas: soil management, nutrient storage and water wells. Lake Erie county farmers have spent $16.9 million of the $29.6 million available on on-farm environmental actions. Moreover, Lake Erie counties have received 52% of incentive grant dollars paid to Ontario farmers for undertaking on-farm environmental actions. (Ontario Soil and Crop Improvement Association, 2001). The 28,594 registered farm businesses in the Lake Erie basin represent approximately 50% of the 56,207 registered farm businesses for the whole province. The Ontario Farm Environmental Coalition was presented with a "Success Story" award for the Environmental Farm Plan at the State of the Lakes Ecosystem Conference (SOLEC) in 2000. (Roberts, Personal Communication 2001).

Ontario Rural Clean Water Programs

Currently, many Ontario Conservation Authorities have programs targeting rural land use that encourage the use of Best Management Practices (BMP). The continuation and expansion of these programs within the Lake Erie basin will be critical to achieve the objectives for rural land use established by the Lake Erie LaMP. While each watershed has developed a program tailored to its needs, there are common elements:

- Best management plan implementation projects that recognize the private landowner is key.
- Information is provided to landowners regarding the impacts of their activities on the Lake Erie ecosystem. The decision to act is that of the landowner.
- The project integrates aquatic and terrestrial habitat conservation and water quality on private lands.
- Where landowners express an interest, local participation from community groups, fish and game clubs, and schools is encouraged.
- The thrust of the program is to encourage sustainable land use practices that foster soil, water and wildlife conservation in the Great Lakes basin.

Photo: Craig Merkley

The strength of this program is that it facilitates improvements in rural/ agricultural land use practices by the group most qualified to do the work, the innovative landowners themselves. These innovative farmers are willing to try new approaches, but of course there are no guarantees of success. The incentive grants offered through this program can offset some of the financial risk, allowing an innovator to invest in updated equipment and technology. Incentive grants are provided through a variety of partners including government and industry and coordinated by a central contact. This allows the land user to "put it to the test". If it is proven to work, other land users become willing to try it and the technology spreads. For information on where these programs are offered in the Lake Erie Basin see Table 4.

Table 4: Rural Clean Water Programs offered in the Ontario Lake Erie Basin

Conservation Authority Contact	Regional Municipality/County
Grand River Conservation Authority	Counties of Wellington and Brant, Regional Municipality of Waterloo-Wellington
Catfish Creek Conservation Authority	Elgin, Brant and Middlesex Counties
Kettle Creek Conservation Authority	Elgin and Middlesex Counties
Long Point Region Conservation Authority	Elgin, Kent, Oxford, Brant, Haldimand, and Norfolk Counties
Lower Thames Valley Conservation Authority	Kent, Middlesex, and Elgin Counties
St. Clair Region Conservation Authority	Middlesex County
Lambton County Stewardship Network	Lambton County
Upper Thames River Conservation Authority	Middlesex, Oxford and Perth Counties
Essex Region Conservation Authority	Essex County

Clean Water Act Section 319 Program

The Clean Water Act Section 319 Program provides grant money to States, territories, and Indian tribes to support non-point source projects (both agricultural and urban). The U.S. EPA administers these funds. The 319 program has supported successful agricultural projects focusing on phosphorus reduction in the Maumee River basin in Ohio, as well as in Southeast Michigan (Monroe, Washtenaw, and Wayne counties). Agricultural non-point source projects funded by 319 are currently underway in the Black River basin in Ohio.

Conservation Reserve Enhancement Program

The Conservation Reserve Enhancement Program (CREP) is a U.S. Federal-State conservation partnership that targets significant environmental effects related to agriculture. It combines the existing Federal Conservation Reserve Program (CRP) with State programs to provide a framework for the U.S. Department of Agriculture to work with State and local interests to meet state-specific environmental objectives. This is an incentive-based program whereby landowners enter into 14 to 15 year contracts with the U.S. Department of Agriculture to convert cropland to conservation practices (buffers, windbreaks, wetlands, filter strips, grassed and wooded riparian buffers, etc.).

An Ohio CREP focused on the western basin of Lake Erie was initiated in May 2000. The goals of the Ohio CREP are: to reduce the amount of sediment entering the western basin by over 2,325,000 metric tons over the next 20 years; significantly reduce nutrients and pesticides entering the western basin and its tributaries; protect 5,000 miles of streams in the western basin watershed from sedimentation; and improve wildlife habitat in the project area. Approximately 67,000 acres have been targeted for enrollment over the next 20 years. To date, 5,259 acres have been enrolled (actually converted to conservation practices), with an additional 5,664 acres in contract, for a total of 10,923 acres.

The State of Michigan also has a CREP program. The goal is to enroll 80,000 acres in three selected watersheds across the state. The River Raisin, which empties into the western basin, is the only selected watershed in the Lake Erie basin. The goals are similar to those of the Ohio CREP. To date, 2,408 acres in the River Raisin watershed have been enrolled, with contracts pending for an additional 380 acres, for a total of 2,788 acres.

Nutrient Management Planning (NMP) Tools

Matching all nutrient inputs, such as commercial fertilizers and manure, to crop requirements is a key area where Ontario farmers are improving land use practices to reduce environmental risk. The adoption of Nutrient Management Planning tools as a production practice is allowing more farmers to optimize all sources of farm nutrients. This helps to maximize economic returns, minimize surface water and groundwater problems and maintain or improve soil health. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and the University of Guelph developed Nutrient Management Planning software (NMAN) that allows farmers to track all land- applied materials containing nutrients. The trend toward larger farm size with more livestock has resulted in the drafting and adoption of nutrient management by-laws by some municipalities.

At present, an array of legislative and regulatory provisions, guidelines, voluntary best management practices and localized municipal by-laws govern the application of materials to agricultural land in Ontario. To promote creation of a standardized process, Ontario introduced the Nutrient Management Act (Bill 81). The proposed act is enabling and will provide the authority to establish province-wide regulations and standards to address the effects of agricultural practices on the environment, especially as they relate to land-applied materials containing nutrients. These materials include manure, commercial fertilizers, biosolids generated by municipal sewage treatment plants, septage from pumped septic tanks, industrial pulp and paper residuals, and food processing wastes. The new province-wide standards would supersede municipal by-

laws and be linked to other pieces of provincial legislation such as the Ontario Environmental Protection Act.

4.4 Urban and Development Land Use Controls

Ohio Lake Erie Watershed Balanced Growth Strategy

In 2000, the Ohio Lake Erie Commission released the Ohio Lake Erie Protection and Restoration Plan. Input from 16 focus groups, public comments and state agencies resulted in 84 specific recommendations to improve the environment, recreational opportunities and economy of Lake Erie and its watershed in Ohio. One of the recommendations was to commission a panel of diverse expertise to create a "Lake Erie Watershed Balanced Growth Strategy." The panel was established in November 2001 and consists of representatives of government, business, conservation groups, academia, agricultural interests and other stakeholders. In addition to the strategy, several incentive and special recognition awards are planned to encourage adoption of balance growth practices, as well as the creation of a model Lake Erie zoning ordinance and building code.

The Grand Strategy

An integrated management plan for the Grand River watershed is now being developed as part of The Grand Strategy. The Grand River in southern Ontario suffered from years of degradation and industrialization during the first third of the twentieth century. As a result of the combination of programs undertaken by the Grand River Conservation Authority and its partners over the last 60 years, the health of the Grand River and its tributaries has improved significantly. In fact, the river has improved so much that in 1994, it was declared a Canadian Heritage River. This has resulted in many community-based and collaborative efforts to improve river health and heritage conservation. The Grand Strategy includes a community-based fisheries management plan and a dynamic model to predict the impact of sewage treatment plants, urban runoff and diffuse sources of pollution to the Grand River.

4.5 Habitat Preservation

Several major purchases occurred over the past two years to set aside some significant areas as preserves. The Nature Conservancy of Canada purchased Middle Island, which is managed through Parks Canada. The Michigan Chapter of the Nature Conservancy has protected 8-acre Calf Island, one of the last undeveloped marshes in the Detroit River. The U.S. and Canada are working toward the protection and restoration of the wetlands along the lower Detroit River. Under the Great Lakes Coastal Restoration Grant program, the Ohio Department of Natural Resources recently awarded almost $900,000 to Put-in-Bay Township to assist in the purchase of 9 acres on the East Point of South Bass Island, including the preservation of approximately ¼ mile of undeveloped shoreline. The Nature Conservancy of Canada purchased the 572 acre Clear Creek Forest along the Canadian Lake Erie shore near Chatham-Kent, an area slated for logging and home to several nationally rare species of birds. An additional 228 acres adjacent to the forest was recently purchased.

4.6 Habitat Restoration

Cuyahoga River Remedial Action Plan

With the assistance of a grant from U.S. EPA Great Lakes National Program Office, the Cuyahoga River RAP has completed four stream bank restoration projects. Bioengineering techniques were used to address erosion and flooding problems while improving stream bank habitat. Each site posed different challenges so different techniques

were used at each site. Local residents and volunteers planted hundreds of trees, shrubs and ground cover that quickly took root to hold stream bank soils in place. The foliage provides crucial shading to the streams and creates additional habitat for fish and wildlife. A series of public workshops was held to further educate homeowners, public officials, and design and construction engineers in the use of stream restoration and bioengineering techniques.

Canard Valley Habitat Restoration Project, Ontario

The 121-hectare Canard Valley site is located in the Detroit River area of concern along the Canard River, the largest Canadian tributary to the Detroit River. The site is presently comprised of old-field habitat and constitutes an entry point into one of the largest Environmentally Significant Areas (ESA) in the area of concern and the Essex region - the Canard River Kentucky Coffee Tree ESA. The goal of the project is to implement a large-scale upland forest habitat restoration project utilizing locally sourced native Carolinian species to create interior forest habitat. In addition, some riparian and wetland enhancement along the Canard River corridor will be undertaken. Interior forest habitat is critically imperiled in the Essex region and exists at only a few locations in the Detroit River watershed. The restored interior forest will provide habitat for cerulean warblers and other rare interior forest birds. The plan is to restore a total of 40 ha of habitat (54,700 trees planted and a 1.5 ha wetland created on the floodplain associated with the south bank of the Canard River) while strengthening local, community-based stewardship actions. The project is proceeding as part of the Biodiversity Conservation Implementation Program for the Essex Region. Partners in the project include the Essex Region Conservation Authority, Environment Canada, Ontario Great Lakes Renewal Foundation, and Ontario Power Generation.

4.7 Exotic Species Control

Historical Distribution and Abundance of *Phragmites australis* at Long Point, Ontario

The recent expansion of *Phragmites australis*, an exotic and invasive wetland plant, throughout many lower Great Lakes coastal wetlands has caused concern among resource managers due to the belief that it degrades waterfowl habitat and reduces biodiversity. Long Point contains some of the most important staging wetlands for waterfowl on the Great Lakes, and anecdotal evidence suggests that Phragmites has been expanding rapidly in some of these habitats. Phragmites was present in 1945, (54ha) and in 1964 (69ha) but had declined in abundance to less than 4ha by 1985. A moderate annual rate of increase occurred between 1985 (4ha) and 1995 (18ha), and an exponential increase occurred between 1995 and 1999 (142ha). The primary species and communities that were replaced or colonized by Phragmites between 1995 and 1999 were marsh meadow (33%), Typha spp. (32%), other mixed emergents (8%), sedge/grass hummock (10%), and open water (5.5%). If Phragmites continues to expand at current rates, it could theoretically cover 13,308 ha (60% of the study area) at Long Point by 2010. Evidence suggests that Phragmites abundance is negatively correlated with Lake Erie water depth and positively correlated with ambient temperature. Given the relation between Phragmites abundance and both temperature and water depth, if global warming predictions are realized, Phragmites will continue to expand on the lower Great Lakes. Wildlife use studies are presently being conducted to determine if Phragmites is in fact underutilized by wildlife at Long Point.

Effect of Dams on Stream Hydrology and Aquatic Organisms

Dams that limit or block fish access to historical upstream spawning, feeding, and nursery habitat affect most Lake Erie tributaries. Pike, sauger, muskellunge, and sturgeon have been the most severely affected, but some river spawning walleye stocks have also been depleted (e.g. Grand River, Ontario; Sandusky River, Ohio). Other effects of dams include: reducing fish biodiversity; changing light penetration, water depth, temperature and hydro-period (i.e. how deep water is for how long); create sediment traps in reservoirs behind dams, sometimes allowing build-up of contaminants; and eliminating habitat historically used by local species for some phase of their life cycle. Spawning runs of walleye, mooneye, and naturalized rainbow trout in some eastern basin tributaries are improving due to dam removal, fish-way construction, and in-stream and watershed rehabilitation projects (e.g. Big Creek, Grand River, Ontario). Dams have very complex impacts on the ecology of rivers and there is not enough data to predict all of the impacts dam removal will have on a given river's ecosystem. The effects of individual dam removal on each tributary or different stream reaches of a given tributary will vary physically and biologically. Dam removal in the lower reaches of the Lake Erie tributaries has the greatest potential to provide additional spawning, feeding and nursery habitat for fish, thereby increasing the reproductive potential of fish populations in Lake Erie. However, dam removal in some areas have increased sea lamprey production, making it necessary to initiate control via barriers and lampricides.

4.8 Bioregional Strategic and Management Planning

Little of the natural landscape of the Lake Erie basin remains unaltered by the effects of human actions. Even comparatively pristine habitat blocks are affected by fragmentation, water table alteration, and neighbouring habitat changes. Wildlife managers now try to maximize wildlife benefits through intensive management activities. As a result, many state/provincial, regional, national, and continental long range management plans have been developed or are in progress for many wildlife species and their habitats.

Management plans target specific objectives and goals for their planning regions, many of which fall within the Lake Erie basin. Natural heritage plans help identify priority species or habitats in need of protection. Recovery plans outline the biology, threats and limiting factors, research needs, and recovery goals for endangered and threatened species. A variety of conservation plans provide guidelines for the protection of habitats and biodiversity.

Baseline Data and GIS Maps

In order to develop the road map for an effective Lake Erie habitat strategy, it is important to have a good database mapping existing conditions. Several ongoing efforts provide some baseline information:

Big Picture Project

In 1999 the Natural Heritage Information Centre completed mapping of natural area cores and corridors in the Carolinian Zone (Canada), which overlaps extensively with the Ontario Lake Erie Basin. A CD version of the "Big Picture" is now available that provides the ability to zoom in on selected areas of the Carolinian Life Zone. The Big Picture is a living document housed at the Natural Heritage Information Centre and will be updated over time. A poster-sized version of the Big Picture Map, along with an explanatory newsprint tabloid was published in October 2000, and nearly 40,000 copies have been distributed. The purpose of these materials is to popularize the Big Picture vision and to champion the role of private landowners in making it a reality.

Carolinian Canada is also undertaking local pilot projects with several municipalities to move the Big Picture from theory to practice. A summary of the technical paper for the Big Picture Project can be found at http://www.carolinian.org/NHIC.htm.

Bigger Picture Project

Mapping of the natural area cores and corridors in two adjacent ecozones to the north (Ontario Ministry of Natural Resources' Site Districts 6E and 7E which include Southern Ontario and the southern portion of the Canadian Shield) is also nearing completion. The final Technical Committee meeting for the Bigger Picture project was held on November 15, 2001. Based on discussions from this meeting, additional analyses will be conducted to better incorporate coastal wetland areas that were overlooked in the preliminary analysis due to their smaller size (less than 200 ha).

US Geological Survey Gap Analysis Program

The mission of the National GAP Analysis Program is to provide regional assessment of the conservation status of native vertebrate species and natural land-cover types and to facilitate the application of this information to land-management activities. The National GAP Analysis Program is undertaken for two types of projects: terrestrial and aquatic pilots. Projects are implemented at the state or regional level and include the following five objectives: 1) map land cover at the statewide or regional scale; 2) map predicted and known distributions of vertebrate species for each state or region; 3) document the representation of vertebrate species and land-cover types in areas managed for the long-term maintenance of biodiversity; 4) provide this information to the public and to those entities charged with land-use research, policy, planning, and management; and 5) build institutional cooperation in the application of this information to state and regional management activities.

State projects in terrestrial GAP Analysis have been undertaken in all eight Great Lakes states. Land cover maps are published for New York and will be published within the next year for Pennsylvania, Michigan, Wisconsin, and Minnesota. Illinois and Ohio should be completed in 2004 and 2005, respectively, being the last states in the Great Lakes region to start terrestrial GAP Projects. An Ohio Aquatic GAP Analysis is currently underway with plans to complete GAP analyses for riverine systems and fish communities by May 2003. New projects are planned for start-up in July 2002 in Michigan, Wisconsin, and New York. Aquatic GAP projects to cover the Great Lakes region should be completed within 6 years, with work being completed for Pennsylvania, Indiana, Illinois, and Minnesota by 2007.

4.9 Upcoming Habitat Events

Work is now underway to plan a habitat workshop under the Lake Erie Millennium Plan research initiative. Researchers working on habitats of concern in Lake Erie (e.g., coastal wetlands) and on issues such as climate change, exotic species, loss of biodiversity and ecological function relevant to habitat protection and restoration in Lake Erie will be invited to attend. For further details refer to the Lake Erie Millennium Plan website: www.uwindsor.ca/erie2001.

A core committee of LaMP partner agency representatives is overseeing the development of the Lake Erie LaMP Habitat Strategy. The strategy will be in place by LaMP 2004.

Sources and Loads Update

Section 5

Section 5: Sources and Loads Update

5.1 Introduction

Monitoring programs provide insight into sources of pollutants to the Lake Erie ecosystem. The spatial distribution of pollutants in sediments and the tissues of benthic invertebrates and fish are a result of historical and ongoing inputs. When integrated with municipal and industrial discharge records and information on the use and pathways of chemicals in our society, managers can ensure that pollution prevention or remedial activities are focused in areas that warrant priority attention.

In the Lake Erie LaMP 2000 Report, the Sources and Loads Subcommittee of the Lake Erie LaMP reported on work completed to identify and review monitoring databases that might be of use in calculating loads and tracking down sources. As a continuation of the information integration efforts described in the "Characterization of Data and Data Collection Programs for Assessing Pollutants of Concern to Lake Erie" (Painter et al. 2000), and building on the efforts of the USGS described in "Areal Distribution and Concentrations of Contaminants of Concern in Surficial Streambed and Lakebed Sediments, Lake Erie - Lake Saint Clair Drainages, 1990-97 (Rheaume et al. 2001), the LaMP has expanded its information base of ambient environmental monitoring, discharge and emissions information.

The Lake Erie LaMP 2000 document identified the need to develop a "source track-down process" for the basin. The current project being guided by the Lake Erie LaMP Sources and Loads Subcommittee involves the collection, aggregation and analysis of emissions, bed-sediment, and fish-tissue data within the Lake Erie Basin for 1990-98. The goals of this effort are to generate a comprehensive database accessible by a Geographic Information System (GIS) in order to: 1) evaluate the spatial occurrence among these interconnected data types; 2) help track down and identify locations that are potential source areas for contaminants; and 3) assess whether the available data can be combined from various agencies across state and national boundaries to accomplish such an evaluation. Of particular concern are the Lake Erie LaMP critical pollutants mercury and polychlorinated biphenyls (PCBs). These contaminants are currently listed as "bioaccumulative chemicals of concern" by the U.S. Great Lakes Initiative and identified as "tier 1 contaminants" by the Canada-Ontario Agreement. Because of their persistence in the environment and their bioaccumulative nature, mercury and PCBs account for the majority of fish consumption advisories throughout the Great Lakes.

Photo: Gene Emond

To date, the project has compiled emissions data from 8,000 locations for a total of more than 2 million records. Figures 1 and 2 represent an evaluation of PCBs and mercury in bed-sediments as compared to predetermined aquatic biological effect levels (Smith et al. 1996). Fish-tissue data are in the process of being collected and aggregated, and will be mapped in 2002.

Integration of the available information identified data gaps, and several studies were initiated to ensure a more comprehensive information base. For example, when recent information on the spatial distribution of open lake sediment pollutant concentrations was

Figure 1: Total PCBs in Bed Sediments

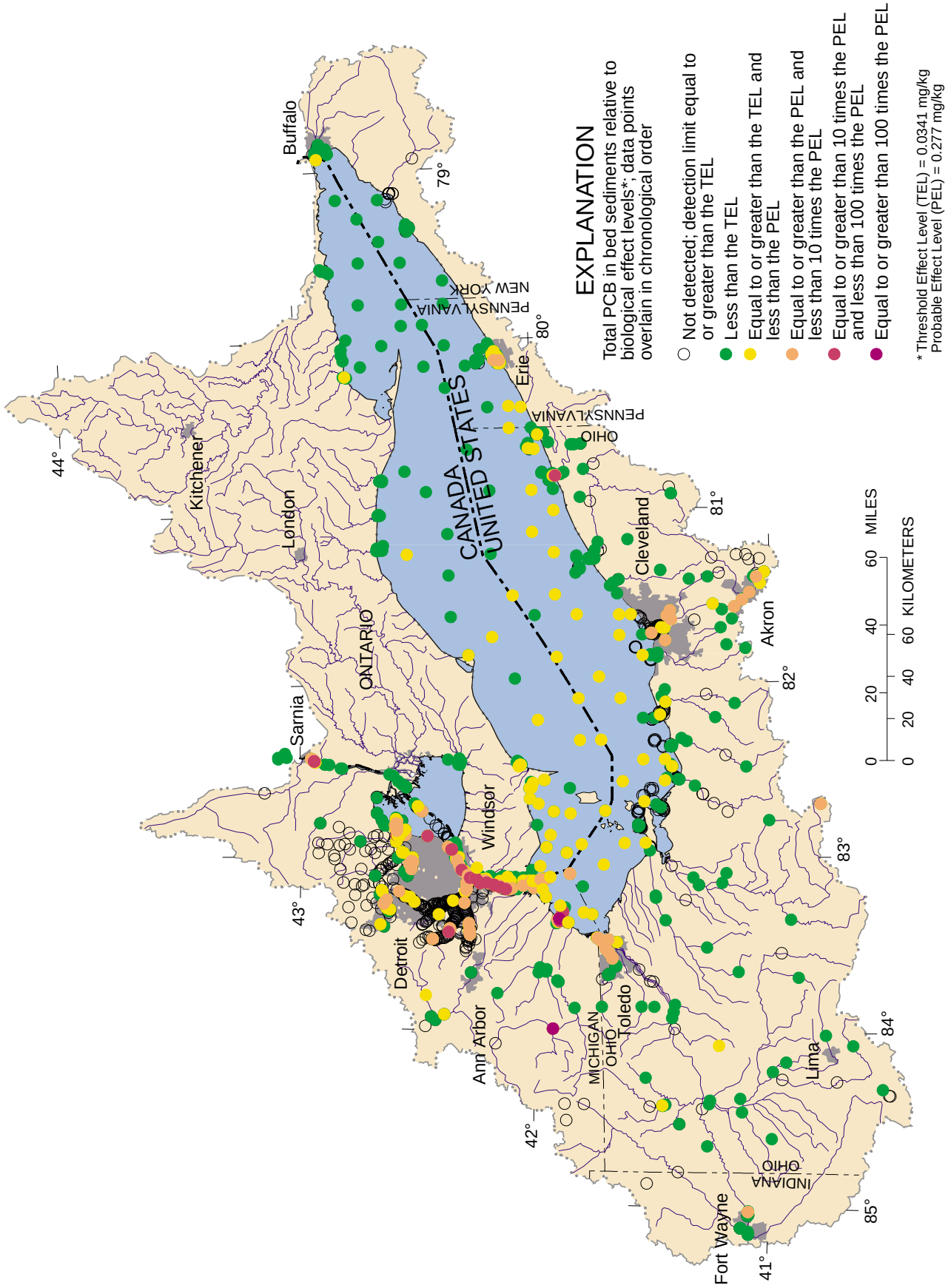
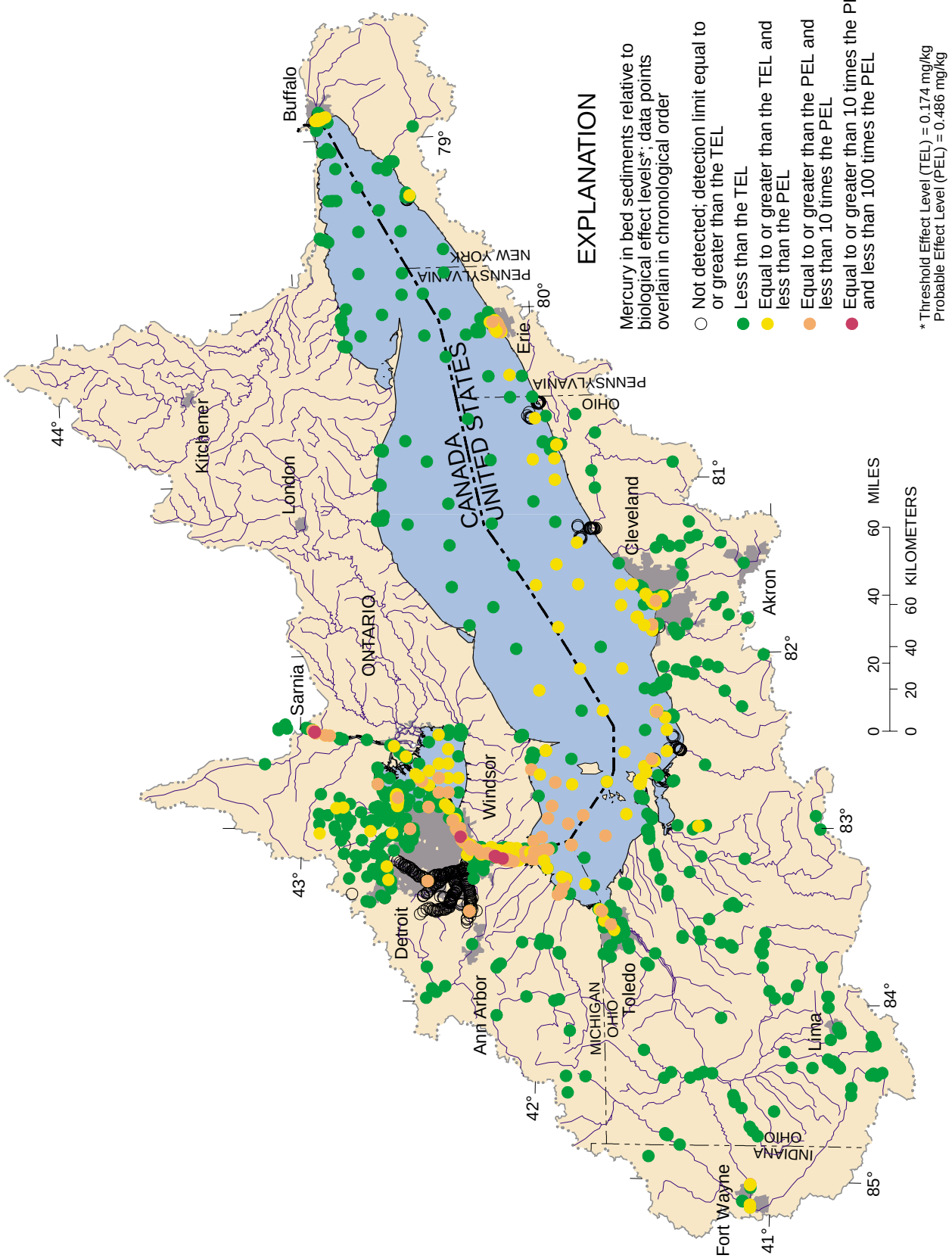


Figure 2: Total Mercury in Bed Sediments



required for the project described above, Environment Canada and Ohio EPA collaborated on a study that provided open lake pollutant concentrations in surficial sediments for many historical and emerging chemicals of concern. The 1997/98 survey conducted by Environment Canada and Ohio EPA not only provided valuable information on the open lake spatial distribution of contaminants, but because an earlier 1971 Environment Canada survey had been conducted, a retrospective analysis of the trends over time was also possible (Painter et al. 2001). Encouragingly, PCB concentrations have declined lakewide. Concentrations are one third of what they were 30 years ago. Mercury concentrations have also similarly declined.

Dioxin concentrations in surficial sediments of Lake Erie were unavailable prior to the study conducted by Environment Canada and Ohio EPA. The Canadian probable effect level (21.5 pg/g TEQ) was exceeded at 40% of the sites, all in the western and south-central basins of the lake (Figure 3).

Figure 3: Surficial Sediment Concentrations of Dioxin (pg/g TEQ)

During the data compilation for the above-mentioned source track-down GIS database, an absence of information for the Canadian tributaries was evident. Environment Canada and the Ontario Ministry of Environment have since initiated "Project Track-down" to provide additional sediment contaminant data for north shore tributaries, and to follow-up on clues that would suggest local sources. Sediment, forage fish and clams are excellent screening tools to track down remaining sources of bioaccumulative chemicals of concern, such as PCBs.

Collecting ambient concentration and source information are two parts of a three-part strategy to reduce contaminants in Lake Erie. The third piece is the source reduction and remediation efforts underway. Complementary to the Lake Erie LaMP are remedial actions in the Lake Erie Areas of Concern, state and provincial pollution prevention activities, and the efforts under the Great Lakes Binational Toxics Strategy. Although no contaminated sediment sites were cleaned up during the last two years, progress continues on efforts to remediate and restore these sites. Most of these ongoing efforts are being done at the Areas of Concern and are highlighted in the RAP Update Section of this report. Integration of this ongoing work will permit the LaMP to evaluate gaps and plan new activities based on a solid foundation. Per concerns of the New York Department of Environmental Conservation, as work on sources and loads continues, the Lake Erie LaMP will consider the potential for Lake Erie to be a source of the priority toxics identified in the Niagara River Toxics Management Plan.

5.2 Mercury and PCB Reduction Initiatives

To date, the Lake Erie LaMP has designated mercury and PCB as critical pollutants in the lake. Consequently, the LaMP 2002 concentrates on tracking activities underway around the lake that are reducing loading of these pollutants or removing them from the lake ecosystem via some type of remedial action. There are a number of mainly pollution prevention based initiatives currently ongoing under the Great Lakes Binational Toxics Strategy for mercury and PCB, as well as other contaminants of concern. Many of the actions are common to both the U.S. and Canada.

The Great Lakes Binational Toxics Strategy created a U.S. mercury reduction challenge calling for a 50 percent reduction in the nationwide use and emissions of mercury by 2006. A work group of stakeholders from federal, state and local government, industry, and non-government organizations meets twice annually to share information about mercury reduction opportunities. More information on this group is available at: www.epa.gov/Region5/air/mercury/mercury.html. With respect to small mercury source activities, there are far too many to report on in the Lake Erie LaMP 2002 report. For example, many municipalities have initiated or passed ordinances prohibiting sale of mercury fever thermometers. The Lake Erie LaMP 2000 document listed a number of specific actions that the U.S. and Canada had committed to or proposed to undertake. Tables 5 and 6 update the status of some of these key actions.

In both Canada and the U.S., several regulations are under development to strengthen existing regulations related to the control, treatment and release of PCB and mercury. Only those that have been finalized are specifically mentioned in Tables 4 and 5. A compilation of U.S. legislative actions relating to mercury reduction in products is at: www.mercury-k12.org/legisbystate.htm.

5.3 U.S. EPA Mercury Phase-out Proposal

The development of Total Maximum Daily Loads (TMDL) is a statutory requirement under Section 303(d) of the U.S. Clean Water Act. It mandates restoration of impaired waters through reduction of pollutant loadings. Lake Erie, as well as many of the U.S. Lake Erie tributaries, is listed as impaired waters under Section 303(d). The States are responsible for preparing TMDLs for their impaired waters.

In an effort to address the universal mercury contamination problem, the National Wildlife Federation developed a proposal to explore implementing a pollution control program in lieu of a TMDL for mercury in the Great Lakes. Using the basic framework suggested by the National Wildlife Federation, U.S. EPA released a mercury phase-out proposal in January 2002 that meets the technical and regulatory requirements of an alternative to a TMDL. The proposal would allow the Region 5 states to forgo developing TMDLs for all mercury impaired waters, including those waters with only fish consumption advisories for mercury, if they commit to a mercury reduction program. The U.S. EPA mercury phase-out proposal envisions reductions in emissions of mercury through incorporation of new Maximum Achievable Control Technology (MACT) standards in air permits, inclusion of Great Lakes Initiative (GLI) standards and pollution prevention measures for mercury in water discharge permits, acceleration of projects to clean up mercury-contaminated sediments, and implementation of voluntary mercury collection, reduction and pollution prevention programs on an expedited schedule. Such programs can include mercury thermometer exchanges, source identification and reduction programs for wastewater treatment plants, and negotiation of voluntary elimination of mercury switches in automobiles. The proposal also allows states flexibility to develop or expand mercury reduction programs. In addition, each state would need to develop benchmarks and a monitoring program to determine the effectiveness of the reduction efforts. The proposal is currently being reviewed by the states.

Table 5: PCB Reduction Plan Activities Update

Committed Action *From the Lake Erie LaMP 2000 Rpt	Status (2002)	Lead Agency
POLLUTION REDUCTION		
Work with automotive, iron and steel sector and electrical facilities in the Lake Erie basin to establish voluntary commitments to reduce the use, discharge or emissions ofPCBs.	Canada: 4 steel companies and 3 automotive industries initiating phase outs. U.S.: 3 automotive industries committed to voluntary reduction of high level PCBs.	EC and U.S. EPA
Coordinate LaMP and GLBTS efforts with all related partners in order to produce a cohesive, unified program to address PCBs in the Great Lakes.	Ongoing	EC and U.S. EPA
U.S. EPA Superfund commits to completing the remedies for Springfield Township Dump (MI); G&H Landfill (MI); Metamora (MI); and Fields Brook (OH) by the end of 2002.	Springfield Township Dump - Construction of remediation systems is complete, including the treatment and/or removal of 12,000 cubic yards of PCB-laden soil; operation and maintenance is expected to continue for the next several years (1-4 years). G&H Landfill - Construction of remedial technologies is complete (landfill cap and slurry wall), as well as wetlands restoration; groundwater extraction system will be operated for at least 30 years. Metamora - Landfill cap construction is complete. Fields Brook - Construction of remedial technologies at 2 PCB-contaminated operable units has been completed (Acme Scrap and Millennium Inorganic Chemicals). The cleanup of Fields Brook sediments and floodplain soils, and source controls are nearly complete.	U.S. EPA
Formalize the PCB Phasedown Program pilot project with the major utilities in the Great Lakes basin that is designed to encourage the utilities to phase out their remaining PCB equipment.	In November 2000, U.S. EPA presented the final PCB phasedown program to 11 of the major electric utilities in the Great Lakes basin. 3 of the 4 major electrical utilities in the Lake Erie basin have committed to voluntarily phase down their remaining PCB electrical equipment.	U.S. EPA
Identify federally owned PCBs in the Lake Erie basin and seek their removal by the departments or agencies that own the PCBs.	U.S. EPA has identified 9 federal facilities (with a combined total of 214 PCB transformers) in states that border the Great Lakes. Next step is to determine most effective way to seek reductions.	U.S. EPA
Organize small PCB owner workshops in the Lake Erie basin to exchange information on PCB management, decommissioning and destruction.	Information packages distributed in Sept. 2001 included PCB Owner Outreach Brochure, GLBTS-PCB Workgroup Activity Regional Update, and fact sheet on Ontario PCB In Use Inventory survey and a map showing PCB quantity and location in the Lake Erie basin.	EC and Ontario MOE
Encourage PCB owners to destroy PCBs in use or storage.	PCB phase out commitment letters have been received from Ontario Power Generation to phase out and destroy approx. 81% of their high level PCB by 2001 and 100% by 2015. PCB phase out commitment letter requests have been sent to the Council of Great Lakes Industry trade associations including: Aluminum Association of Canada and the Canadian Petroleum Products Institute.	EC

Committed Action *From the Lake Erie LaMP 2000 Rpt	Status (2002)	Lead Agency
INFORMATION		
Finalize the PCB Sources and Regulations Background Report.	The report is available at www.epa.gov/glnpo/bns/pcb/index.html	EC and U.S. EPA
Finalize the PCB Options Paper under the GLBTS that identifies options that can be undertaken to reduce PCBs in the environment.	The report is available at www.epa.gov/glnpo/bns/pcb/index.html	EC and U.S. EPA
REGULATION		
	Canada: Proposed revisions to strengthen federal regulations regarding PCB management have been initiated. Further Information can be obtained from Environment Canada PCB Website at www.ec.gc.ca/pcb/ Canada: PCB Waste Export Regulation (SOR/97 – 108) is being amended and to be published in Gazette I in 2002. Canada: A notice with respect to Polychlorinated Biphenyls in Automotive Shredder Residue was published in Gazette I on July 7, 2001 for facilities that generated residue contaminated with PCBs during 1998 – 2000.	EC
	U.S.: In the December 26, 2000 Federal Register a final rule was published temporarily deferring a portion of the original rule applying Land Disposal Restrictions under the Resource Conservation and Recovery Act (RCRA) when PCBs are present in soils contaminated with metals. The soils must still be treated for metals, but Generators are required to treat PCBs only if the total concentration of halogenated compounds exceeds 1,000 parts per million.	U.S.EPA

Table 6: Mercury Reduction Plan Activities Update

Committed Action *From the Lake Erie LaMP 2000 Rpt	Status (2002)	Lead Agency
POLLUTION REDUCTION		
Provide Pollution Prevention training at hospitals in London, Ontario with emphasis on the removal of mercury containing devices.	March 2001 training was completed for health care professionals in London, Ontario. A resource guide has been developed and is available at www.c2p2online.com. Hospitals in the Lake Erie basin with mercury reduction programs include: Cambridge Memorial Hospital and St. Mary's Hospital, Kitchener.	EC
Green Community thermostat and thermometer collection program for the City of London, Ontario.	A new organization, Canadian Coalition for Green Health Care has been established to reduce the environmental impact of Canada's health care system. The web site www.greenhealthcare.ca provides information on Cdn suppliers of mercury free medical devices including thermometers. EC is working with retailers and distributors to implement a program to encourage the public to return their mercury-containing thermometers to pharmacies. A pilot program started in February 2002, in London, Ontario in the Lake Erie basin.	EC

Committed Action *From the Lake Erie LaMP 2000 Rpt	**Status (2002)**	**Lead Agency**
As of early 2000, federal, provincial, and territorial environmental departments are investigating the releases of mercury to the environment from various commercial products and from some forms of waste. A focus on dental amalgam, fluorescent lamps, and sewage sludge that is land-applied is expected to result in Canada-wide standards in late 2000.	The federal, provincial and territorial environment ministers across Canada have agreed to a harmonized standard for managing dental amalgam waste across the country. Ministers signed the standard on September 23, 2001. The Canada-wide standard is the application of best management practices to achieve a 95% national reduction in mercury releases from dental amalgam waste discharges to the environment from a base year of 2000. Pollution Probe Switch Out program initiated in June 2001 recovers mercury switches from end-of-life automobiles before the mercury contained in these vehicles could be released into the environment. Eleven auto dismantlers in Ontario are participating including facilities in the City of Windsor and Caistor Centre in the Lake Erie basin. More information: http://www.pollutionprobe.org	Ontario MOE
The Ontario Ministry of the Environment along with Environment Canada have been working with the Ontario Dental Association to develop a "best management practices" document for dentists, scheduled for completion in May 2000.	Completed, see above.	Ontario MOE
Establish a household hazardous waste collection facility to collect and recycle household products containing mercury in the Cities of London and Waterloo.	Lamp collection facilities are available to households in London, Chatham-Kent, Guelph, Brantford, and Wellington County.	EC
By December 2000, the U.S. EPA will make a determination about whether to regulate mercury emissions from electric utilities.	In December 2000, the U.S. EPA committed to regulating mercury emissions from coal-fired power plants. U.S. EPA will propose regulations by the end of 2003, and promulgate final rules by 2004. The President has committed to proposed legislation that would reduce mercury emissions from power plants as part of a multi-pollutant strategy to reduce air pollution from the power generation sector.	U.S. EPA
Agencies will work with communities to provide sector-specific pollution prevention outreach such as workshops for the medical and dental communities, and other important sectors.	Chlor-Alkali Industry through the Chlorine Institute committed in 1996 to reduce mercury use by 50% by 2006. The industry reported in April 2001 to the U.S. EPA a reduction of 44% between 1995 and 2000. The Institute has produced "Guidelines for Mercury Cell Chlor-Alkali Plants Emissions Control: Practices and Techniques" and in cooperation with the U.S. EPA has developed draft proposed maximum available control technology regulations for chlor-alkali plants. The American Hospital Association and U.S. EPA through the Hospitals for a Healthy Environment (H2E) program have produced a Mercury Virtual Elimination Plan for U.S. hospitals. In addition, workgroups are implementing work plans on various aspects of hospital waste reduction. This year the American Hospital Association reconfirmed its commitment to the H2E program.	U.S.EPA
A mercury reduction strategy is being developed for Ohio	The Ohio Mercury Reduction Work Group was officially formalized in May. They are evaluating mercury programs and regulations; promoting the use of mercury alternatives and collection of retired mercury; and educating industry, government and the general public on ways to reduce sources of mercury. A particular focus is on mercury reduction in schools.	Ohio EPA

Committed Action *From the Lake Erie LaMP 2000 Rpt	**Status (2002)**	**Lead Agency**
U.S. EPA commits to ensuring that all Region 5 states will have enforceable regulations and the permit applications that are required to be submitted for municipal waste combustors and for hospital/ medical/ infectious waste incinerators by December 2000.	U.S. EPA has promulgated regulations controlling emissions of mercury and other Hazardous Air Pollutants from municipal waste combusters (MWCs) and Medical Waste Incinerators (MWIs). Large MWCs needed to be in compliance by December of 2000, while small MWCs will need to comply by December of 2005, at the latest. MWIs will need to be in compliance by September of 2002, at the latest.	U.S. EPA
INFORMATION		
Promote to school boards in the Lake Erie basin a mercury stewardship school curriculum program (Pilot being developed in the Toronto School Board).	Project materials and workshops were delivered in over 20 schools across the Thames Valley District School Board and London District Catholic School Board. Mercury lessons and activities for grades 4-8 are available at: www.on.ec.gc.ca/glimr/classroom/millenium/mercury/intre.html.	EC
PROPOSED ACTIONS		
Agencies will provide indirect or direct financial support to businesses, organizations and local governments for pollution prevention projects.	Great Lakes Mercury Clearinghouse: A partnership among Minnesota, U.S. EPA, the Dept. of Energy and EC to develop a prototype web-based clearinghouse on mercury pollution prevention and reduction information, "How to" resource tools, and regulatory information. Project is scheduled to be on-line by Spring 2002.	U.S. EPA EC and states

Human Health

Section 6

Section 6: Human Health

Section 6 of the Lake Erie LaMP 2000 document provided an extensive discussion of the potential threat to human health from the critical pollutants and other contaminants of concern in Lake Erie. It described the pathways of exposure relevant to human health as: drinking water, recreational water use and fish/food consumption. The Lake Erie LaMP designated drinking water use of Lake Erie as unimpaired, while both recreational water use and fish and wildlife consumption are impaired. The LaMP 2000 human health section also examined and explained the application of a weight of evidence approach to looking at potential human health effects. An extensive list of resources and references concerning human health and the Great Lakes was provided, along with a list of ongoing or potential human health related projects in the Great Lakes. The ongoing research was aimed at issues in the Great Lakes basin, not just Lake Erie, and indeed, the human health issues presented were common to all the Great Lakes. The LaMP 2000 reports for the other lakes confirmed the commonality of the issues.

For all of the LaMPs it has been difficult to set up a committee structure to focus on human health due to limited human health expertise residing in LaMP agencies and lack of additional resources. Therefore, the Binational Executive Committee (BEC), the body with management oversight for the LaMPs, has approved a proposal to create a Great Lakes Human Health Network. The Network would bring together experts from across the Great Lakes region to share information, reach consensus on Great Lakes environmental human health priorities, and enhance the work at their respective agencies through opportunities for collaboration. An initial organizational meeting has been held and an ad hoc committee of health agency representatives is developing terms of reference for operation of the Network. Once the Network is established, each of the LaMPs will provide liaison staff.

The Lake Erie LaMP Recreational Water Quality Beneficial Use Impairment Assessment (Kwavnick and Mortimer 1999) concluded that, on average, bacterial water quality standards were exceeded at Lake Erie's public beaches more than 20% of the recreational season. Bacterial indicators, monitoring programs, and criteria for issuing advisories or closing beaches varied from jurisdiction to jurisdiction. Even with no lakewide consistent measurement, it was obvious that beach use was universally impaired around Lake Erie.

In October 2000, the U.S. passed federal legislation amending the Clean Water Act referred to as the Beaches Environmental Assessment and Coastal Health Act, or BEACH Act. The BEACH Act requires states with coastal waters to adopt U.S. EPA's recommended bacteria criteria, or criteria as protective, by April 2004. The legislation requires U.S. EPA to conduct studies of new pathogens and pathogen indicators and to develop and issue any new or revised criteria guidance within five years. The BEACH Act also authorizes U.S. EPA to award grants to eligible coastal states (including the Great Lakes) to set up beach monitoring and public notification programs. In 2001, $2 million was appropriated for coastal states to develop beach monitoring and notification programs, and an additional $10 million will be awarded in 2002 to continue program development and implementation. The BEACH Act grants will result in improved beach monitoring and notification programs in the U.S. U.S. EPA's Office of Research and Development will be conducting epidemiological studies to examine health risks associated with swimming at several beaches across the country, including beaches along the Great Lakes.

In February 2001, a U.S. EPA/City of Chicago-sponsored Great Lakes Beach conference was held to share information on the science and technology of beach monitoring, and research on exposure, health effects, and water quality indicators. More than 250 environmental and public health officials, beach managers and regulators attended the three-day session. A draft *National Beach Guidance and Performance Criteria for Recreational Waters* was produced by U.S. EPA and public-noticed in the Federal Register with comment period ending in October 2001. The guidance will be used to help local health departments and beach managers implement a nationally consistent water quality-monitoring program for beaches.

In addition to refining the indicators, more work is needed to identify and eliminate the sources of bacterial contamination causing beach closures and advisories. U.S. EPA is starting to target wet weather remedial efforts near high use beach areas affected by combined sewer overflows and sanitary sewer overflows. Research is also needed to develop rapid analytical techniques to assist in more timely notification of high bacteria counts at public beaches.

[Section 7 Cover Page]

Section 7: Public Involvement

The U.S. and Canadian lead agencies for the Lake Erie LaMP have, from the beginning, believed public participation is crucial to the success of the LaMP process. Public involvement continues to be among the prime factors motivating proactive efforts taken by governments in Canada and the United States surrounding issues involving the Great Lakes. The LaMP Public Involvement Subcommittee was established to lead public outreach efforts.

To provide another mechanism for public involvement, the U.S. and Canadian governments fund the Lake Erie Binational Public Forum (Forum). This diverse and active group serves many purposes ranging from developing and implementing outreach projects and initiatives that educate the general public about Lake Erie issues, to providing advice to the LaMP Work Group based on member's individual expertise and/or input from the local constituents they may represent. The Forum works closely with the governmental representatives on the Lake Erie LaMP Work Group, including the Public Involvement Subcommittee.

As part of its public education goal, the Forum developed a colorful, informative 45-minute scripted presentation containing text and pictures describing Lake Erie's past, present, and foreseeable future under topics such as human health, recreation, habitat protection and restoration, fish and wildlife, PCB and mercury reduction, RAPs, beneficial uses, land use, drinking water and exotic species. One of the incentives for preparing this presentation was to prepare the public to make informed decisions on future Lake Erie actions, particularly the selection of an ecosystem alternative and the associated management objectives. Forum members have delivered this presentation to many local groups, and received favorable feedback. It is available on line at: www.erieforum.org.presentation/about.php.

Another project of the Forum, initiated due to their interest in environmental justice issues, was the development of "A Family's Guide to Eating Fish from the Lake Erie Basin." The easy-to-read brochure presents the benefits and risks associated with eating Lake Erie fish, where not to fish, the types and sizes of fish to avoid eating, methods for preparing and cooking fish to reduce potential health risks, and contacts for more information. Working with local health departments in the Lake Erie basin, Forum members distributed fish consumption advisory information in many venues that targeted minorities or populations of at-risk consumers. Over 17,750 brochures have been distributed. The Forum's web site provides additional information on fish identification, local health department contacts and other handy references. The web site is available at: www.erieforum.org/fishguide/fishguide.php. Also of interest is that the Forum's overall web site (www.erieforum.org) was featured as the Great Lakes Information Network's (GLIN) site of the month for December 2001. The url for the GLIN site is: www.great-lakes.net.

In addition to funding the Forum, the U.S. and Canadian governments maintain a broad-based mailing list of the public interested in LaMP progress or who are involved in other environmental activities in the Lake Erie basin. From time to time, information concerning the Lake Erie LaMP is sent to people on the mailing list to foster an active network of the public interested in Lake Erie issues. For example, the latest edition of the Lake Erie LaMP newsletter, Update 2001, which also served as a companion piece to the Lake Erie LaMP 2000 document, was distributed to this mailing list. The public is also reached through the use of displays and handouts at third party meetings, such as the International Joint Commission's Public Forum on Great Lakes - St. Lawrence Water Quality held October 2001 in Montreal. When actions and activities related to

the Lake Erie LaMP warrant, the lead agencies issue press releases to specific media markets to facilitate media exposure to the general public.

Probably the most important single effort by the Public Involvement Subcommittee of the Lake Erie Work Group has been centered on outreach efforts related to developing ecosystem objectives. Beginning with the first public workshops in 1995 seeking input on the desired future uses of the lake, an adaptive approach has been taken to consult with the public on the selection of a preferred ecosystem alternative. The Public Involvement Subcommittee first worked closely with a group of technical experts to create a method to communicate to the public how a "fuzzy logic" model, developed by the LaMP's Ecosystem Objectives Subcommittee, arrived at four viable scenarios (ecosystem alternatives) for Lake Erie's future state. Then, the Forum was consulted and adjustments made to assure that the explanation of the process could be simply presented and easily understood by the public. (Note that the Forum's Lake Erie Presentation was prepared by the Forum in response to the public need to better understand Lake Erie and the LaMP if they were to make an informed, educated choice of an ecosystem alternative.) Once the Work Group selected Ecosystem Alternative 2 as the preferred alternative, the Public Involvement Subcommittee sought the Forum's advice to develop a scripted presentation to explain how and why the Work Group chose this alternative. This presentation has been used at several public sessions throughout the Lake Erie basin during late 2001/early 2002. These efforts have provided the Lake Erie Work Group and the Lake Erie Management Committee with valuable public input and insight.

Ongoing public involvement is important to the success of the Lake Erie LaMP, and public participation, consultation, and comment are welcome at any time in the LaMP process.

More information on the Lake Erie LaMP is available on the binational web site at: www.ec.gc.ca/glimr/lakes/erie/ or www.epa.gov/glnpo/lakeerie/. For more information or to become involved, please see the back cover.

Assessment and Tracking Progress

Section 8

Section 8: Assessment and Tracking Progress

8.1 Introduction

Surveillance and monitoring provide essential information about the state of the Great Lakes ecosystem and measure the success of remediation and protection efforts. The Lake Erie LaMP is responsible for setting goals and identifying management actions to restore and protect the lake, and to track progress towards these goals. Once ecosystem objectives have been finalized and indicators have been developed, wherever possible, existing surveillance and monitoring programs will be used to track indicator changes. Where gaps in current programs exist, new programs may be developed.

In 2000, an inventory of monitoring programs in the Lake Erie basin was developed by Environment Canada based on a number of sources of information. Ninety-three independent monitoring programs were underway within the basin. These can be roughly divided into five monitoring categories (Table 7). Some of these monitoring programs are lakewide in nature. Others are more localized or created for a single specific purpose. Several of the monitoring programs that are more lakewide-oriented are described below. At this point, these are only examples of some of the programs that the Lake Erie LaMP may utilize, as the LaMP has not yet determined exactly how progress toward meeting LaMP goals will be tracked. U.S. EPA has begun to develop several tools that may be used to assist the LaMPs in monitoring progress and these are described below as well. Descriptions of several other monitoring programs are presented in other sections of the document.

Table 7: Summary of Ongoing Monitoring Efforts in Lake Erie in 2000

MONITORING CATEGORY	No.
Monitoring inputs/outputs of contaminants	19
Ambient contaminant (spatial, temporal, multimedia)	29
Populations (native and exotic) and habitat	34
Health effects monitoring	8
Exotics effects monitoring	10
TOTAL	**93**

8.2 The Lake Erie Millennium Plan

The Lake Erie Millennium Plan (www.uwindsor.ca/erie2001) was initiated in 1998 by scientists at the University of Windsor, National Water Research Institute - Burlington, F.T. Stone Lab of The Ohio State University, and U.S. EPA's Large Lakes Lab at Grosse Isle, Michigan. The purpose was to foster and coordinate research that will identify and solve basic ecological questions relevant to the Lake Erie ecosystem through a binational, collaborative network.

To be relevant to regional and binational groups responsible for Lake Erie's health, the research must address lake management needs as well as further basic knowledge of the ecosystem. To this end, the active sponsorship of agencies and organizations whose mandate concerns Lake Erie was solicited. Twelve binational, national, regional, state, and provincial organizations have contributed funds to sponsor Millennium Plan

activities. Additionally, 13 collaborating organizations are active participants in the planning, information transfer or research aspects of the Millennium Plan, providing in-kind and/or technical support that further Plan activities. Goals of the Lake Erie Millennium Plan are:

- To collectively document the research and management needs of users and agencies;
- To summarize the current status of Lake Erie from process and ecosystem function perspectives; and
- To develop a framework for a binational research network to ensure coordinated collection and dissemination of data that address research and management needs.

Activities since the Lake Erie LaMP 2000 Report include:

- Lake Erie in the Millennium Binational Conference – Progress and New Issues, March 28-29, 2001
- State of the Strait – Status and Trends in the Detroit River Ecosystem, March 27, 2001
- Contaminants in Lake Erie, September 11-12, 2000

8.3 Marsh Monitoring Program

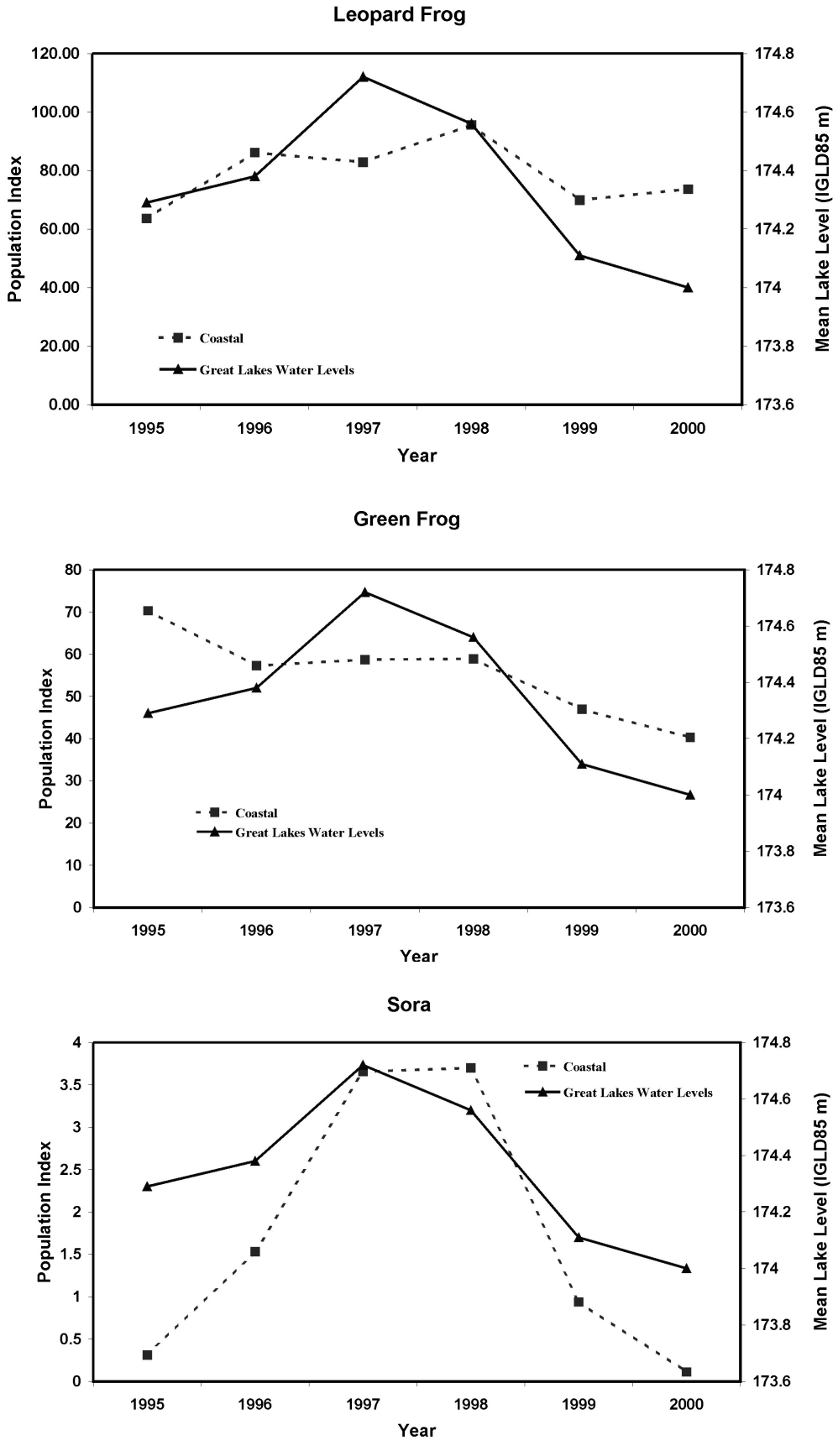
Since 1995, this volunteer based program has engaged both professional and dedicated citizen naturalists throughout the Great Lakes region (including Lake Erie) to record and monitor annual trends in populations of several calling amphibian (frogs and toads) and marsh bird species in important marshes throughout the basin. Information gathered through the Marsh Monitoring Program is relevant for assessing relative population changes in these species at local, regional and basinwide scales, and can be useful for gauging the status and ecological integrity of marshes at each of these scales.

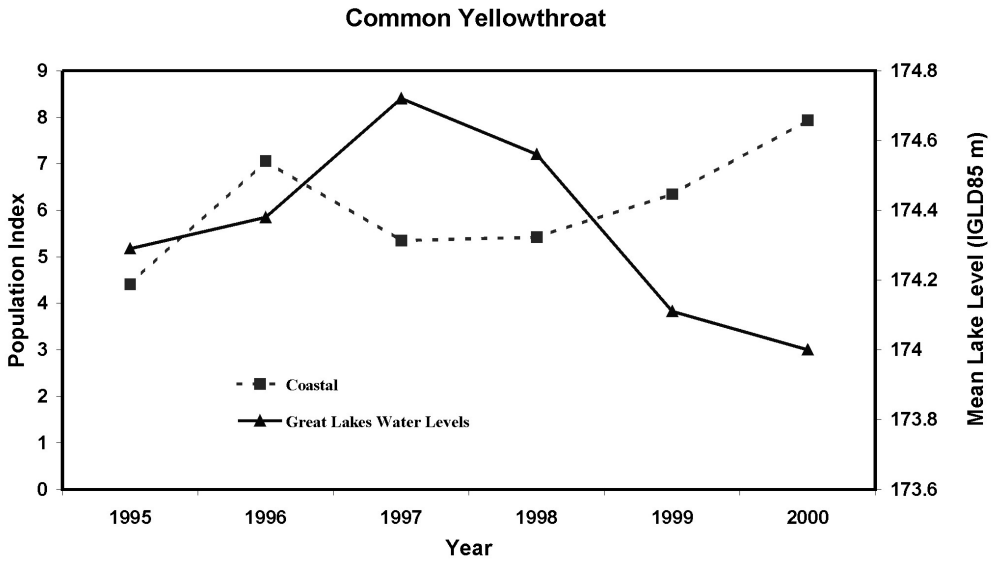
Results (1995-2000) suggest that there appears to be a relationship emerging between population trends of some marsh bird and amphibian species in coastal marshes and the trend in Lake Erie's mean annual water levels, especially since 1997, the year that marked the end of the last sustained high water period. For example, black tern and sora trends at coastal marshes have followed a similar pattern to that of Lake Erie's water levels. Similarly, trends for aquatic amphibian species such as green frog and northern leopard frog have closely reflected the trend in Lake Erie's water levels at coastal marshes. Conversely, trends for certain marsh bird species preferring drier marsh edge habitat have increased at coastal marshes during recent lake level declines. For example, the trend for common yellowthroat (a warbler that prefers marsh edge) at coastal Marsh Monitoring Program routes has been inversely related to Lake Erie's water levels (Figure 4).

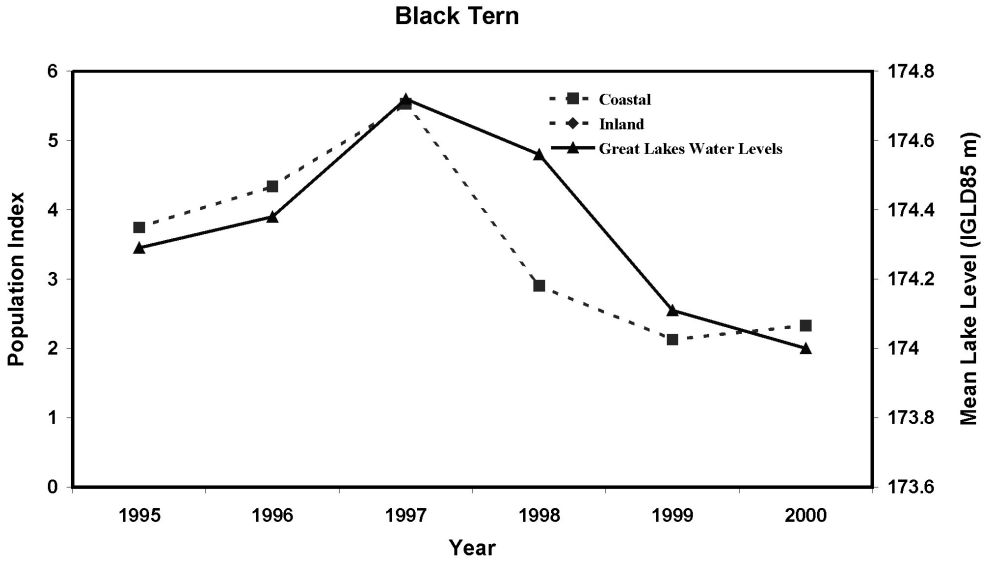
These relations could be explained, in part, by spatial movement of certain species into or out of Marsh Monitoring Program survey routes. Alternatively, as lake levels declined, if appropriate marsh habitat was not replaced at the rate at which it was lost, and appropriate marsh habitat was either not available elsewhere or was already at its carrying capacity, then declining trends in highly marsh dependent birds and amphibians may well be indicative of overall population declines.

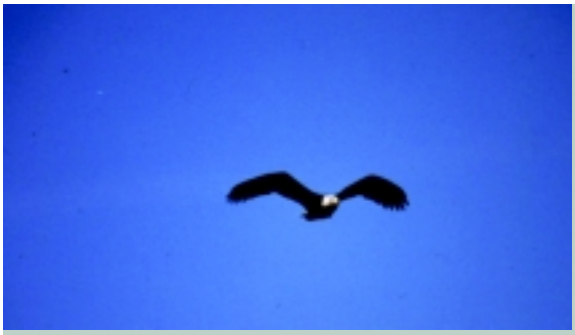
Although current lake levels are near their long-term lows, because lake levels fluctuate, and trends in certain marsh bird and amphibian species at coastal marshes appear to respond to changing lake levels (positively or negatively), when Lake Erie's levels begin to increase again, these responses should be detected by Marsh Monitoring Program data. Only by taking into account the dynamic nature of coastal marsh habitats can one examine what is really happening to populations of marsh birds and amphibians in the Lake Erie basin.

Figure 4: Lake Erie Basin-wide Trends in Relative Abundance of Selected Marsh Bird and Amphibian Species Compared to Mean Annual Water Levels of Lake Erie from 1995 to 2000. For each species, trends are presented for marshes monitored at coastal locations (i.e. within 5 km/3 miles from a lake shore).









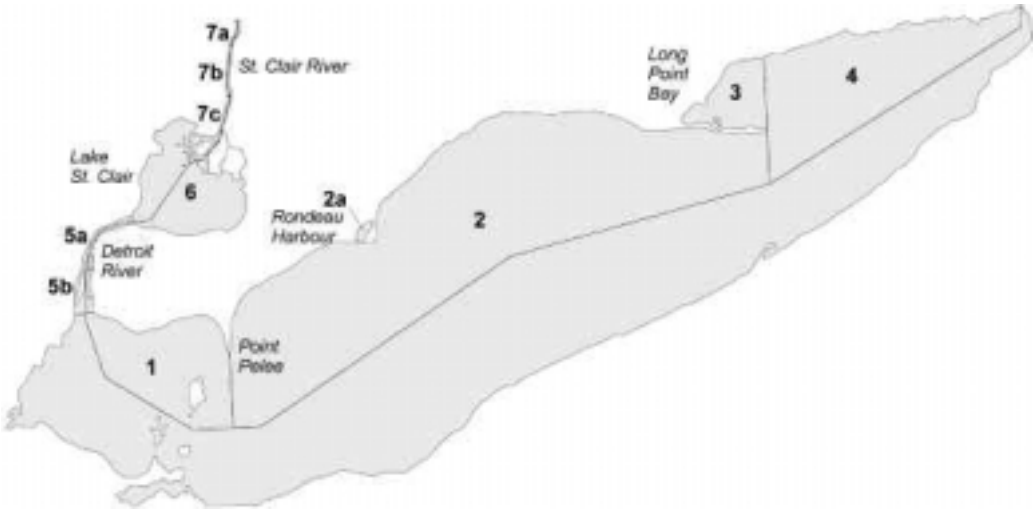
Bald Eagle Update

The status of the bald eagle population around the lake has been a highly visible indicator of the state of Lake Erie. Most of the bald eagles nesting in the Lake Erie basin are found in Ohio, particularly in the marshes in the western basin. The 2001 nesting year was excellent for Ohio Lake Erie eagles with an 83% success rate and an average 1.4 fledglings per nest. Sixty-three nesting pairs produced 89 fledglings. Weather related impacts were not experienced this year due to an absence of severe storms and strong winds. Younger birds are starting to build nests closer to human disturbance, and more nests are being found further east. Although populations continue to increase, there is still a missing definitive link between eagle reproductive success and contaminants. Failure in the nests of some of the older birds suggests contaminants may still be having an impact on reproduction (Shieldcastle, personal communication). The Ohio Lake Erie Protection Fund provided a grant in 2000 to analyze blood and feather samples collected and archived by the Ohio Department of Natural Resources in the 1990s. The samples to be analyzed are from younger nestlings and more comparable to other Great Lakes eagle samples. Previous analysis of nestling blood from Ohio eagles in the late 1980s found great concentrations of PCBs and DDE. The bald eagle blood work results should be available in 2002.

8.4 Trends in Contaminants in Ontario's Lake Erie Sport Fish

Sport fish contaminant monitoring in Ontario is coordinated by the Ontario Ministry of the Environment and conducted in partnership with the Ontario Ministry of Natural Resources. Sport fish from the Canadian waters of Lake Erie have been monitored on a regular basis for contaminants since the 1970s. Size and species-specific consumption advisories for different regions or blocks of the lake (Figure 5) are provided to the public in the Guide to Eating Ontario Sport Fish.

Figure 5: Lake Erie Blocks



Consumption advisories, provided as the recommended maximum number of meals per month, are based on health protection guidelines developed by Health Canada. Consumption restrictions on Lake Erie sport fish are caused by PCBs (70%) and mercury (30%). Other contaminants such as DDT and metabolites, hexachlorobenzene, octachlorostyrene, chlordane and lindane are often detected in Lake Erie sport fish, but do not cause consumption restrictions, and concentrations have declined over the years. In recent years, dioxins and furans have been monitored in species expected to have the highest concentrations (e.g. carp, lake whitefish), but have not caused consumption restrictions. Comparing data across the Canadian waters of the Great Lakes, Lake Erie has the lowest proportion of sport fish species with consumption restrictions at 17.4%. The proportion of sport fish species with consumption restrictions in the Canadian waters of the other Great Lakes ranges from 21.1% in Lake Huron to 43.0% in Lake Ontario.

In order to report on spatial and temporal trends in contaminants, a "standard size" was selected for each species. The standard size was close to the mean length for the species in the database and typical of the size caught and consumed by anglers. Contaminants in standard size sport fish for the last 10 years were used to evaluate spatial trends. Contaminant data from Block 1 from 1976-2000 were separated into 5-year intervals for temporal trend evaluation. Species selection was based on the availability of data.

Mercury concentrations exhibit no spatial patterns across Lake Erie blocks. Mercury concentrations in 30 cm (12 inch) white bass ranged from 0.09 to 0.15 ppm and in 45 cm (18 inch) walleye from 0.10-0.13 ppm. For both species there was no significant difference across the three major blocks of Lake Erie (Figures 6 and 7). Block 3 (Long Point Bay) was excluded from the statistical analysis because of the lack of replicate data. Over the past 25 years, mercury concentrations in Lake Erie sport fish have declined. When a comparison was made of the mercury concentrations

in white bass in 5 year intervals between 1976 and 2000 it was found that mean concentrations in 30 cm (12 inch) white bass decreased significantly from 0.22 ppm in the first period (1976-1980) to 0.13 ppm in the last period (1996-2000). The same was found for walleye. Mean mercury concentration in 45 cm (18 inch) walleye decreased from 0.30 ppm to 0.12 ppm in the same time period (Figures 8 and 9). Most of the decrease occurred between the 1976-1980 period and 1981-1985. Between 1981-1985 and 1996-2000, there was no significant difference in mercury concentrations in either white bass or walleye. Mercury concentrations in most Lake Erie sport fish are low and only the largest individuals tend to exceed the consumption guideline of 0.45 ppm. White bass and walleye do not exceed the guideline until they exceed 40 cm (16 inches) and 70 cm (27 inches) in length respectively (Figure 10).

Analysis of spatial patterns of PCBs for 30 cm white bass suggests that there is little difference in PCB concentrations between blocks in Lake Erie (Figure 11). Lower levels found in block 4 are based on only one year of data so statistical significance could not be determined. Over the past 25 years, PCB concentrations in some but not all species of Lake Erie sport fish have decreased. Mean PCB concentrations in 30 cm white bass decreased significantly from 615 ppb in 1976-1980 to 242 ppb in 1996-2000 (Figure 12). Most of the decrease occurred between the 1976-1980 and 1981-1985 periods.

Figure 6: Mercury Concentrations in 30 cm (12 inch) White Bass Across Lake Erie 1990-2000

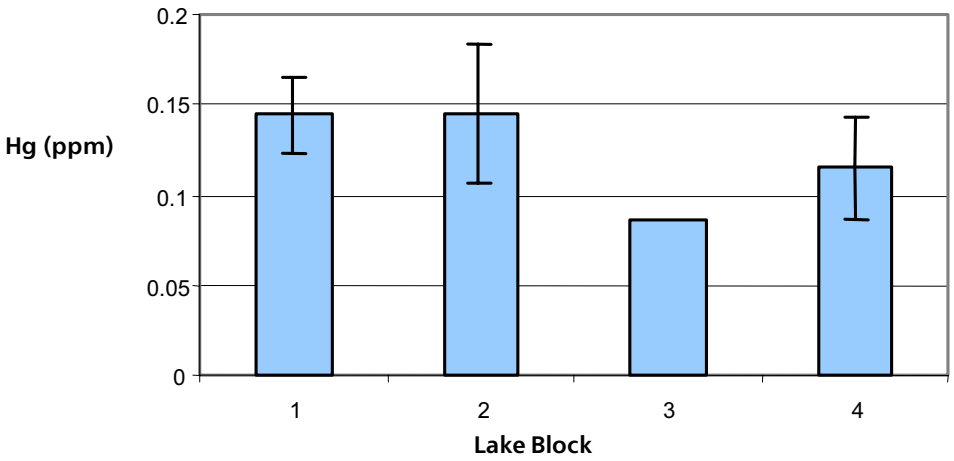


Figure 7: Mercury Concentrations in 45 cm (18 inch) Walleye Across Lake Erie 1990-2000

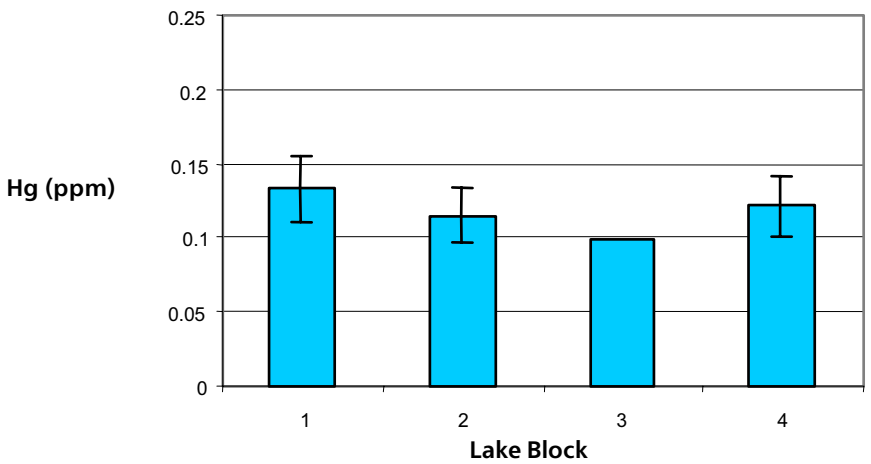


Figure 8: Mercury Concentrations in 30 cm (12 inch) White Bass Over Time in Lake Erie Block 1

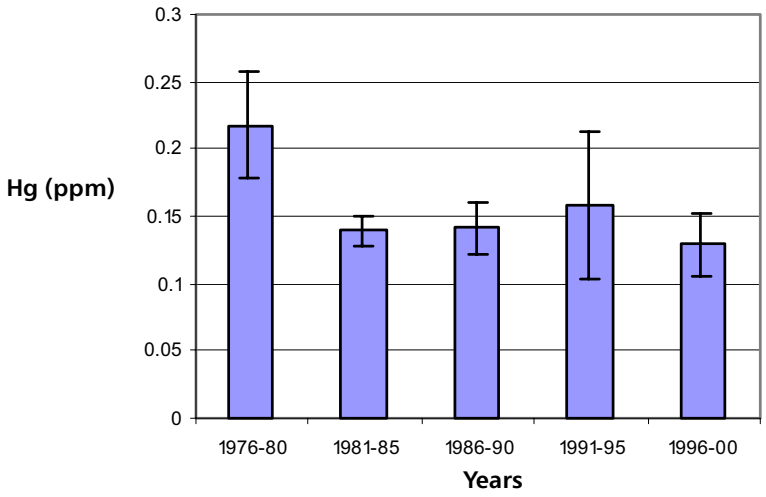


Figure 9: Mercury Concentrations in 45 cm (18 inch) Walleye Over Time in Lake Erie Block 1

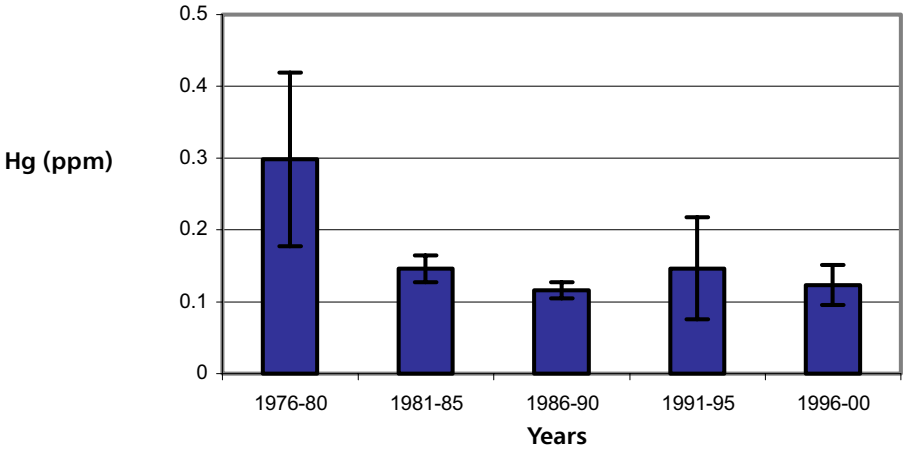


Figure 10: Mercury Concentration vs. Length in Walleye and Bass from Lake Erie Block 1

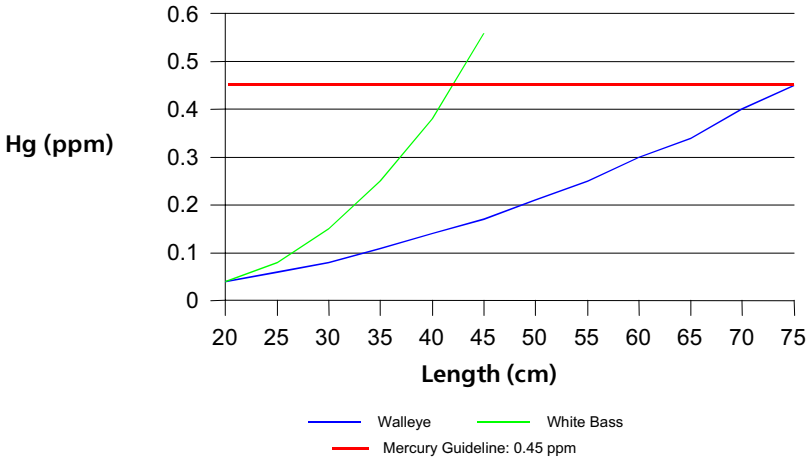


Figure 11: PCB Concentrations in 30 cm (12 inch) White Bass Across Lake Erie 1990 - 2000

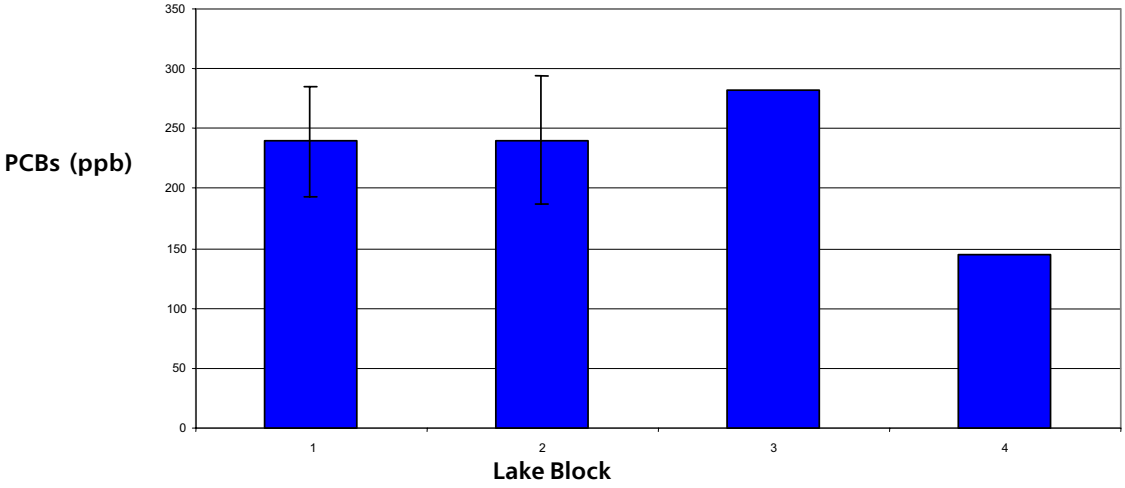


Figure 12: PCB Concentrations in 30 cm (12 inch) White Bass Over Time in Lake Erie Block 1

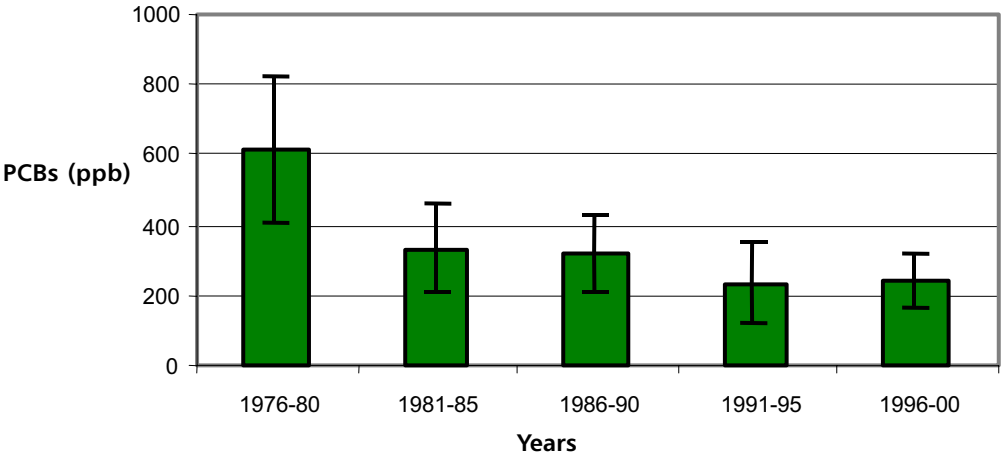


Figure 13: PCB Concentrations in 45 cm (18 inch) Channel Catfish in Lake Erie Block 1

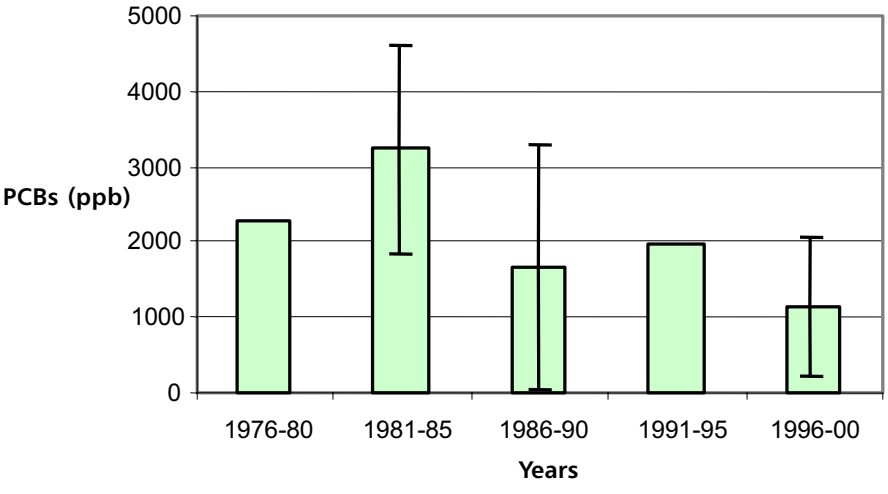


Figure 14: PCB Concentrations in 65 cm (25 inch) Carp in Lake Erie Block 1

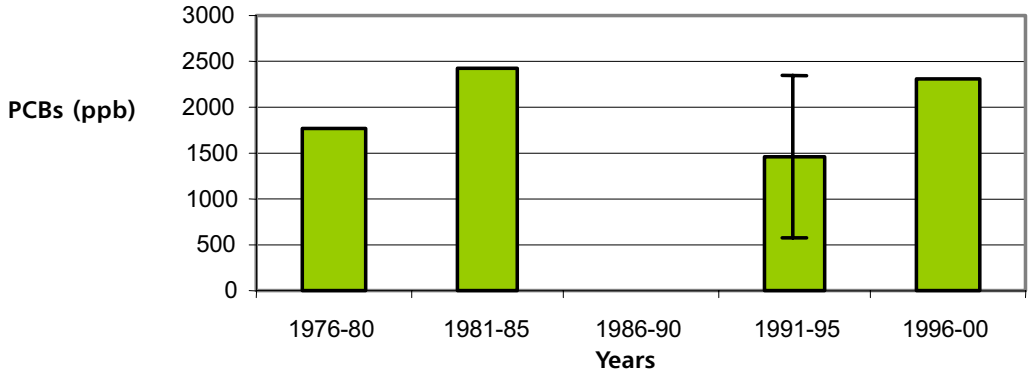
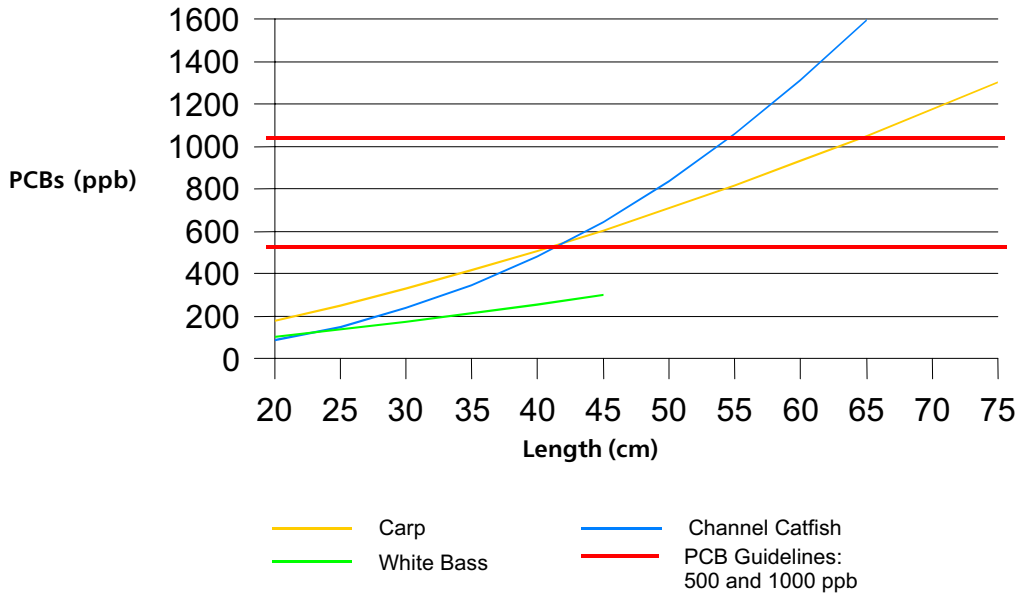


Figure 15: PCB Concentration vs. Length in Fish from Lake Erie Block 1



PCB concentrations in channel catfish appear to have decreased (Figure 13) but lack of replicate data for some periods prevented statistical confirmation. The highest PCB concentrations were found in 1981-1985 (3225 ppb). By the 1996-2000 period mean PCB concentrations had declined to 1143 ppb. PCB concentrations in carp do not appear to have declined over the period of sampling and in the most recent period (1996-2000) were still in excess of 2000 ppb (Figure 14). Differences among species may be due to the residual effects of sediment-bound PCBs. Pelagic species such as white bass would be less affected by sediment-bound PCBs than benthic-feeding species such as carp. Although PCB concentrations are low in most Lake Erie sport fish, high lipid species such as channel catfish and carp exceed the consumption guideline of 500 ppb even in relatively small individuals (Figure 15).

The Ontario Ministry of the Environment, through the Sport Fish Contaminant Monitoring Program, continues to monitor Lake Erie sport fish for trends in contaminant concentrations and provides consumption advice to anglers.

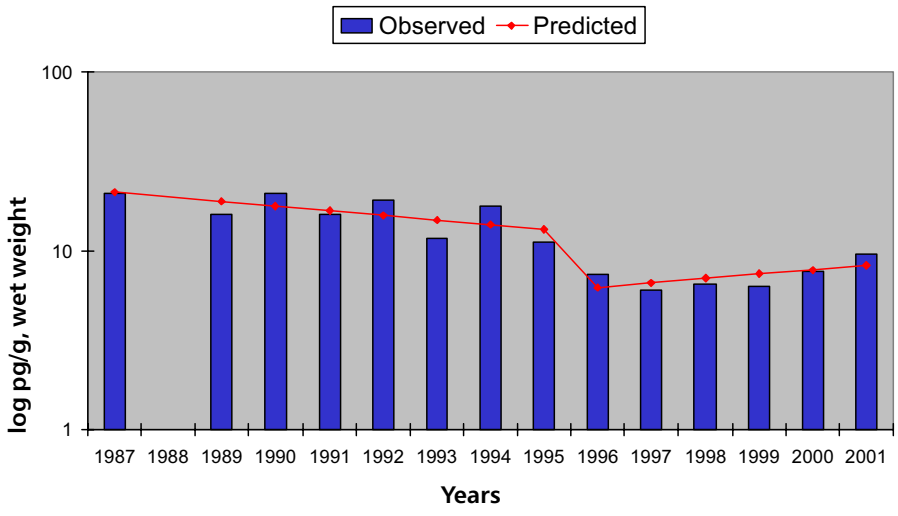
8.5 Trends in Contaminant and Population Levels of Colonial Waterbirds

The Wildlife Toxicology Section of the Canadian Wildlife Service (Ontario Region) maintains two wildlife-monitoring programs on the Great Lakes: contaminants in herring gull eggs and population levels of breeding colonial waterbirds. The former program was last reported on for the two Lake Erie sites, Middle Island and Port Colborne Breakwall, in 1999. The latter program is only conducted in its entirety once every decade and the most recent report is now available.

Contaminant levels in herring gull eggs do not change very much from year to year, and year-to-year changes do not necessarily have much meaning in long-term trends. Significant changes in long-term trends are usually only seen over several years. For example, Figure 16 illustrates an increase in 2,3,7,8 TCDD (dioxin) in herring gull eggs at Middle Island over the last three years, but compared to longer-term observations, there is not an increasing or decreasing trend. Figure 17 likewise shows an increase in PCB in herring gull eggs at the Port Colborne site in 2001, but the overall long-term trend is downward. The overall changes in concentrations of the other contaminants measured under this monitoring program (DDE, hexachlorobenzene, mirex, heptachlor epoxide and dieldrin) were variable over the last three years, but the overall trend is significantly downward.

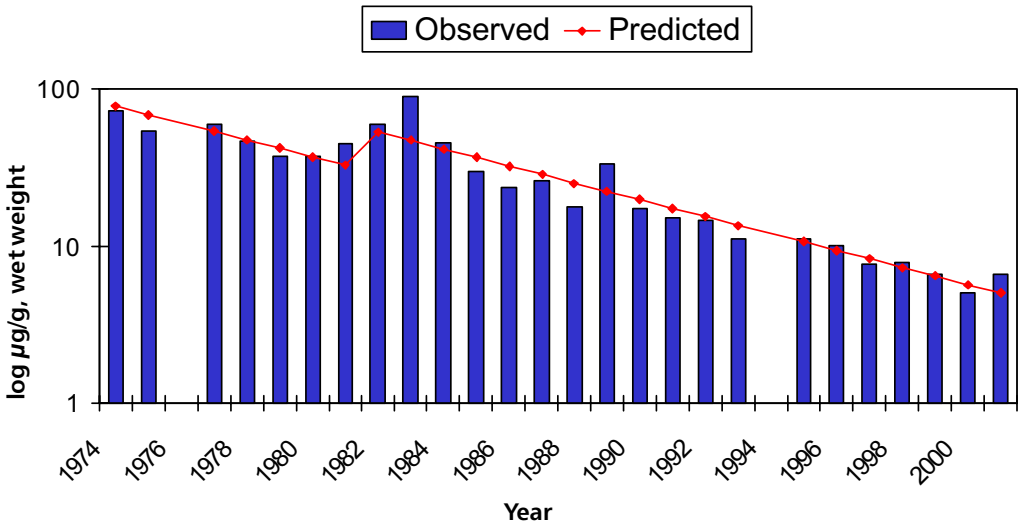
Breeding populations of colonial waterbirds on Lake Erie were surveyed in the late 1970s, 1980s and the 1990s. During the last two decades, populations of herring and ring-billed gulls and common terns have declined from 14.7 to 18.3%. This is consistent with similar patterns for these species in the other Great Lakes. The number of breeding gulls has declined probably as a result of artificially high population levels in the 1980s, when forage fish populations were larger. Common terns have declined probably as a result of ongoing nest-site competition with ring-billed gulls. Double-crested cormorant populations in Lake Erie have increased 211% since the late 1980s. Their populations have been increasing in each of the Great Lakes since the late 1970s. Great black-backed gulls and Caspian terns have just started nesting in Lake Erie (at Mohawk Island at the mouth of the Grand River) and have not yet established themselves there on an annual basis.

Figure 16: 2378-TCDD in Herring Gull Eggs - Middle I., 1987-2001



Model shows a significant decline before the change point year in 1996 and a non-significant trend after the change point.

Figure 17: PCB 1:1 in Herring Gull Eggs - Port Colborne, 1974-2001



Model shows the same significant rate of decline before and after the change point in 1982.

Photo: National Parks Service

8.6 Ohio Lake Erie Quality Index

In 1998, the Ohio Lake Erie Commission released the Lake Erie Quality Index Report. For this report ten indicators were developed to measure environmental, economic and recreational conditions as related to the quality of life enjoyed by those living near or utilizing the Ohio waters of Lake Erie. Each indicator is composed of several metrics that were selected because they were measurable goals or endpoints against which progress could be established and, in most cases, some regular monitoring was already being done. The Lake Erie Quality Index will be updated every five years, and work is currently underway to develop or refine metrics to be reported out on in 2003. In 2000, the Ohio Lake Erie Commission released the Ohio Lake Erie Protection and Restoration Plan, a long-term strategy of what the State of Ohio and its partners need to do to achieve the goals set by the Lake Erie Quality Index. The indicators selected for use in the Lake Erie Quality Index are presented in Table 8 along with the ratings assigned to them in the 1998 Lake Erie Quality Index Report.

Table 8: Ohio Lake Erie Quality Index Indicators

Indicator	Rating		
	Excellent	Good	Fair
Water Quality		Good	
Pollution Sources			Fair
Habitat			Fair
Biological		Good	
Coastal Recreation		Good	
Boating		Good	
Fishing	Excellent		
Beaches		Good	
Tourism	Excellent		
Shipping			Fair

8.7 U.S. EPA LaMP Project Tracking Database

The U.S. EPA has recently developed a computer database to track U.S. progress of U.S. projects identified in LaMP documents. Initially, this database consists of information on projects listed in the Lake Erie LaMP 2000 document. For example, projects listed in the PCB and mercury action plans are included in this database. Information on these projects is to be periodically updated. In addition, new projects described in future LaMP documents could be listed as well. Accessing this database allows interested parties, as well as agency staff, to review progress of LaMP projects without waiting for the publication of LaMP documents. This database will be available at the following web address: http://epa.gov/glnpo/lakes.html.

8.8 U.S. EPA GIS Tool to Characterize Landscapes Based on Ecosystem Health

The Critical Ecosystems Team from U.S. EPA Region 5 has developed a GIS based tool that can characterize landscapes based on three criteria: 1) ecological diversity; 2) sustainability; and 3) rare species or land cover types. The combination of these three criteria identifies the ecosystems with the highest quality or health. The tool is in the process of being peer reviewed, and should be ready for general application by the end of 2002. Teams and programs within the U.S. EPA can use the tool in a number of ways. For example, areas of highest quality can be located and mapped with the boundaries of state and federal protected areas. This will highlight ecosystems that are not currently under management or protection. Areas of highest diversity can be mapped against areas of lowest sustainability to highlight the richest ecosystems that are currently being threatened by chemical, biological or physical stresses. Once these ecosystems are identified, partners can use this information to assist in prioritizing remedial actions.

8.9 State of the Lakes Ecosystem Conference (SOLEC)

In response to a reporting requirement of the Great Lakes Water Quality Agreement, in 1994 U.S. EPA and Environment Canada initiated the State of the Lakes Ecosystem Conference, more universally known as SOLEC. It provides a forum for the exchange of information on the ecological condition of the Great Lakes and surrounding lands. SOLEC focuses on the state of the Great Lakes ecosystem and the major factors impacting it, rather than on the status of programs needed for protection and restoration, which is more of the LaMPs' role. In 1998, SOLEC began an effort to develop standard indicators that could be used to better report out on the status of the Great Lakes in a more consistent manner. SOLEC reviewed a number of possible indicators and is currently refining a list of 80 for their potential utility in measuring conditions across the Great Lakes. The work of the SOLEC team will be utilized wherever possible as the Lake Erie LaMP develops the indicators that it will use to track Lake Erie LaMP progress. In 2002, SOLEC will focus on indicators of biological integrity.

Remedial Action Plan Updates

Section 9

Section 9: Remedial Action Plan Updates

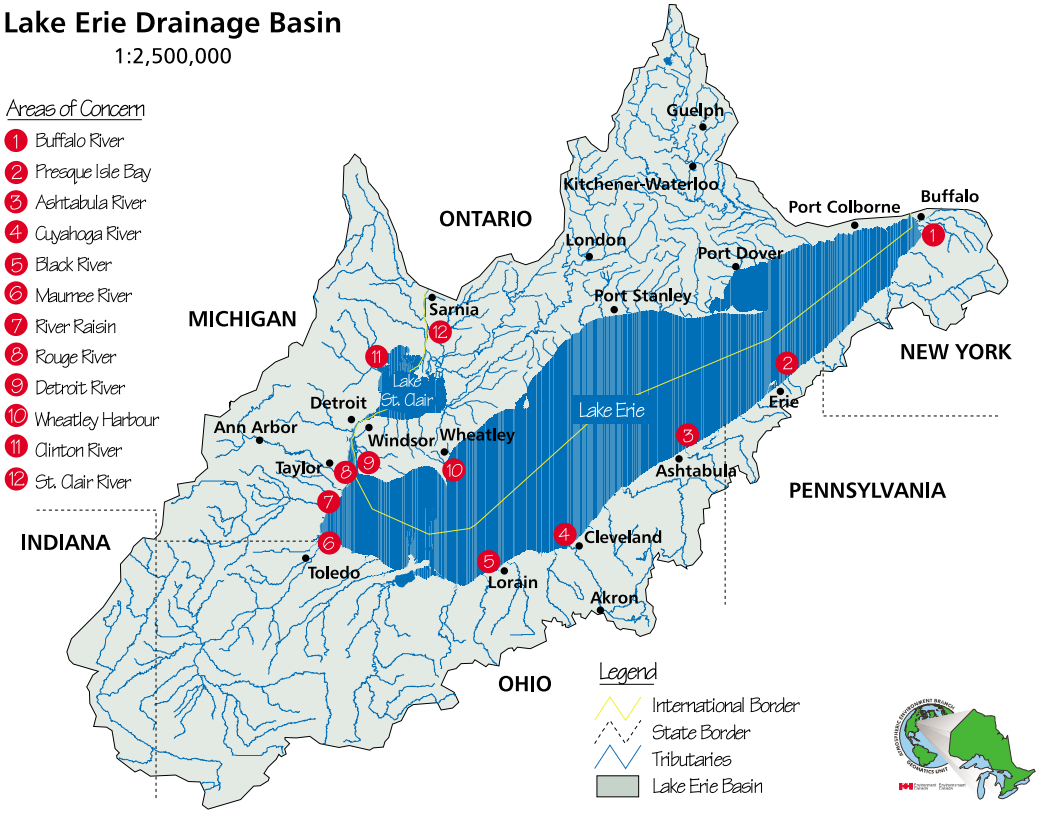
9.1 Introduction

In addition to the development of LaMPs, Annex 2 of the Great Lakes Water Quality Agreement called for the development of Remedial Action Plans (RAPs) for the most environmentally degraded Areas of Concern around the Great Lakes. There are 12 Areas of Concern in the Lake Erie basin: two binational RAPs, one Canadian and nine U.S. The RAPs have a much smaller geographic focus than the LaMP, but they have the same goals – to restore beneficial uses using an ecosystem approach. Implementation of remedial actions has been underway in most RAPs for over ten years, using a combination of federal, state, provincial and local resources. The results of these remedial efforts are much more visible and measurable locally, and will ultimately help to improve Lake Erie.

There is a strong potential that source track-down for many of the stressors affecting Lake Erie will point toward the RAPs. It is likely that many of the management decisions made to restore Lake Erie will need to be implemented in the Areas of Concern. There is also the potential that certain management decisions made for the lake itself will benefit the RAPs. It is essential for the Lake Erie LaMP to continue to cultivate communication with the RAPs and to benefit from the successful partnerships and programs that the RAPs have already created. In many ways, the success of the LaMPs depends on the success of the RAPs.

Appendix A of the Lake Erie LaMP 2000 document provided a brief history of each of the Lake Erie RAPs along with major milestones, projects underway, projects pending and future needs. The following sections highlight the major activities completed or underway in the Lake Erie RAPs since the 2000 report. Note that these activities are only a small representation of the work initiated and accomplished under the RAP program.

Figure 18: Map of Areas of Concern Around the Lake Erie Basin



9.2 Buffalo River RAP, New York

(http://www.epa.gov/glnpo/aoc/buffalo/)

NOTE: The Buffalo River actually discharges to the headwaters of the Niagara River, not Lake Erie. As a result, the Buffalo River is not really part of the Lake Erie ecosystem. However, because of its unique geography, we list the Buffalo River with Lake Erie LaMP.

- The Buffalo River RAP process was developed as a working partnership between the New York State Department of Environmental Conservation (NYSDEC) staff and the Buffalo River Citizens' Committee and its work groups. A Remedial Advisory Committee continues to assist NYSDEC in RAP implementation. Remedial activity efforts are focused in six major areas: stream water quality monitoring, river bottom sediments, inactive hazardous waste sites, municipal and industrial wastewater treatment facilities, combined sewer overflows, and fish and wildlife habitat. RAP strategies and remedial activity progress are updated in the most current Buffalo River RAP Status Report dated June 1999.
- Ongoing assessment activities include the evaluation of remedial options through the modeling of scour and deposition characteristics.
- Needs include further sampling, treatment assessment, and sediment criteria guidance development to assist the decision making process in addressing contaminated sediments.
- Three habitat improvement projects have been constructed to address habitat impairments with funding provided through U.S. EPA. Habitat project plans were developed by Erie County in cooperation the City of Buffalo, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and NYSDEC. These habitat projects have been completed.
- The Buffalo Sewer Authority has received Bond Act funding to address sewer overflows.
- Currently working to develop a feasibility study to address contaminated sediments with the U. S. Army Corps of Engineers.

9.3 Presque Isle Bay RAP, Pennsylvania

(http://www.epa.gov/glnpo/aoc/presque.html)

Presque Isle Bay is located in the northwestern corner of Pennsylvania on the southern shore of Lake Erie. Most of the watershed comprises urban (80%) and industrial areas within the City of Erie and Millcreek Township. Being a relatively closed system with a flushing time of 2.5 years, the bay has suffered from the accumulation and degradation of wastes discharged by point and nonpoint sources.

In January 1991, the U.S. State Department and the International Joint Commission (IJC) designated Presque Isle Bay as the 43rd Great Lakes Area Of Concern (AOC). The AOC received priority attention from the Pennsylvania Department of Environmental Protection (Department), which formed the Presque Isle Bay Public Advisory Committee, a multi-stakeholder group, to assist in developing a Remedial Action Plan (RAP).

The Stage 1 RAP Report identified *restrictions on dredging* and *fish tumors or other deformities* as the two beneficial use impairments. Both are directly related and have been linked to elevated levels of nitrosamines and Polycyclic Aromatic Hydrocarbons (PAH) in the sediments.

- Since 1992, more than 3,200 brown bullheads have been captured, tagged and released, or necropsied. The earlier studies revealed that 64% had developed skin tumors and 22% had liver tumors. Follow-up studies conducted in 1999 by

Penn State University and the Department showed these numbers have since decreased to 19% and 1%, respectively. The subcommittee, tasked with developing objectives for this BUI, will deliver their recommendations to the Public Advisory Committee in February 2002.

- The U.S. EPA and Gannon University conducted a sediment study in 2000 as a follow-up to their 1994 investigation. Ten sites were revisited and core samples were taken. Toxicity tests and macroinvertebrate analysis were performed to further characterize the sediments. At the request of the Public Advisory Committee, dioxin levels were also examined to complete the chemical investigation and determine their impacts, if any, to the system. Results of the study supported earlier findings of widespread, low-level contaminants throughout the bay without any identifiable hot spots requiring active remediation. To complete the findings, the Department, with the support of U.S. EPA, collected five species of fish resident to the bay for dioxin analysis of the tissue to determine if additional fish consumption advisories are warranted. Results of the study will be available in February 2002.
- A milestone for the RAP occurred in December 2001, as the City of Erie completed its obligations under a 1989 Consent Decree with the Department and U.S. EPA to spend an estimated $100 million to upgrade and double the capacity of the sewage treatment plant and eliminate the combined sewer overflows that discharged to the bay. These efforts, along with additional non-point source control measures in the watershed, should allow for natural recovery of the system. This natural recovery option for sediment management has been presented to the Public Advisory Committee and is currently under consideration.
- Based upon objectives currently being developed and proposed for adoption, the Public Advisory Committee will decide the appropriate next steps to take in the RAP process in early 2002. These options include: 1) delisting as an AOC; 2) re-designation to the newly adopted "Recovery Stage;" or 3) continuing under Annex 2 of the Agreement until all beneficial uses have been completely restored.

9.4 Ashtabula River RAP, Ohio

(www.epa.gov/glnpo/aoc/ashtabula.html)

The goal of the Ashtabula River Partnership is to look beyond traditional approaches to determine a comprehensive solution for the impairment of beneficial uses posed by the contaminated sediments in the lower Ashtabula River and Harbor. Over the past two years the following major accomplishments are noted.

- Revised and updated Ashtabula River Comprehensive Management Plan and Environmental Impact Statement. The final draft was released for public comment in December 2001. A public meeting was held on January 3, 2002.
- Completed additional radionuclide testing and prepared radiological risk assessment for river sediments.
- Prepared landfill design criteria report and conducted evaluation of alternative landfill sites and dewatering/transfer sites.
- Completed Value Engineering Study, a report required by the USACE for projects in excess of $2 million.
- Ashtabula City Port Authority signed on as the local sponsor for the disposal facility.
- Prepared six restoration project proposals, including economic and ecological valuations, in support of a Natural Resource Damage Assessment claim.
- A contractor is currently conducting pilot studies to determine dewatering criteria.

- o Engineering design and a Project Cooperative Agreement are currently in progress.
- o Construction of the landfill and dewatering facility are expected to begin in 2004, with dredging scheduled for 2005.

9.5 Cuyahoga River RAP, Ohio

(www.epa.gov/glnpo/aoc/cuyahoga.html)

The Cuyahoga Coordinating Committee works in coordination with the Cuyahoga River Community Planning Organization (CRCPO) to design and implement the RAP. The priorities in the Cuyahoga River area of concern over the past two years have been to update the RAP action agenda and extend stream stewardship projects, continue the phased TMDL on the ship channel, support of funding/plans to reduce/eliminate combined sewer overflows and sanitary sewer overflows, and continue habitat and wetland restoration and protection projects. Accomplishments include:

- o All committees have established additional goals.
- o Big Creek and Yellow Creek stream stewardship programs held many public and educational events, and continue to develop and implement comprehensive watershed plans.
- o A workshop for public officials was held on "Legal Issues and Economic Benefits of Wetland Protection."
- o Four stream bank rehabilitation/habitat restoration projects were completed as funded under a grant from U.S. EPA/GLNPO and matched by local funds.
- o Three workshops were held on streamside management, targeting decision makers and those working specifically in streamside maintenance positions.
- o Produced a document entitled "Life at the Water's Edge – Living in Harmony with Your Backyard Stream." A total of 30,000 copies were printed and it has been widely distributed.
- o Over 100 sites were sampled in an intensive survey of the lower river to be used in preparation of a Total Maximum Daily Load (TMDL) report for that area in 2002.
- o The Northeast Ohio Regional Sewer District initiated construction of the Mill Creek Tunnel that will significantly reduce combined sewer overflow discharge.
- o Final work on the larval fish project in the lower river as part of the phased TMDL for the ship channel was completed.
- o A State of the Cuyahoga River Symposium was held in October 2001 and an updated beneficial use impairment status report was drafted.
- o Working on a $110,000 grant from U.S. EPA/GLNPO to investigate the extent and causes of fish tumors and contaminated sediment in the old navigation channel of the Cuyahoga River.
- o Working on an Ohio Lake Erie Protection Fund project to inventory wetlands and potential sites for wetland restoration.

9.6 Black River RAP, Ohio

(www.epa.gov/glnpo/aoc/blackriver.html)

The priorities of the Black River RAP over the past two years have been to investigate low dissolved oxygen levels in the lacustuary/river mouth area, continue to investigate major source areas of non-point source pollution, continue to implement education programs, and promote Lake Erie Buffer and Conservation Reserve Enhancement programs throughout the watershed to preserve and restore riparian habitat and reduce sediment load to the river. Accomplishments include:

- Coordinated beginning of a two-year comprehensive dissolved oxygen modeling effort of the lower river with several state and federal agencies as well as the four major dischargers to that segment of the river. Intensive field sampling was conducted in 2001.
- Continued implementation of a 319-funded project to demonstrate the use of precision farming in lessening the impacts of agricultural non-point source pollution impacts, and to identify areas of failed and failing home sewage disposal systems to assist local health departments in developing and implementing a Home Sewage Disposal System maintenance and inspection program.
- Continued to work with the Lorain Port Authority on the Grove Site brownfield redevelopment site at the mouth of the river. Much effort has gone into protection of natural shoreline and establishment of additional habitat.
- Working with the U.S. Army Corps of Engineers and the Lorain County General Health District to develop:
  - A countywide operation and inspection system of Home Sewage Disposal Systems.
  - A watershed inventory of the French Creek sub-basin.

Failed or failing home sewage disposal systems and land use around French Creek have been identified as possible contributors to the lower Black River dissolved oxygen problem. French Creek is a major tributary to the lower Black River and is being impacted by urban sprawl as Greater Cleveland spreads westward. The French Creek inventory is being planned to include a "French Creek specific" watershed owner's manual for landowners and decision makers; and the identification of unexplained periodic toxicity within the basin.

Fish tumor incidence in brown bullhead has declined significantly and removal of the beneficial use impairment for fish tumors is under consideration. The Ohio Department of Health is also considering the removal of a PAH-related contact advisory in the lower river that has been in place since 1983.

9.7 Maumee River RAP, Ohio

(www.maumeerap.org)

The Maumee RAP is a community effort to restore the health and beauty of the Maumee River ecosystem for the benefit of all who live there. The priorities over the last two years have been to continue to implement Ohio Lake Erie Buffer and CREP programs to reduce non-point source pollution, continue a very active public outreach and education program, continue efforts to remediate dumps and landfills, and continue to focus concentrated efforts on the Ottawa River and Swan Creek. Accomplishments include:

- Drafted a 10-year activities and accomplishments report to be completed in 2002.
- Continued highly successful Toussaint River Improvement Incentive Program to promote implementation of set-asides, filter and buffer strips and conservation tillage to reduce impacts from agricultural runoff.
- Assisted in establishing Duck and Otter Creek Partnership as a nonprofit organization.
- Initiated project to identify wetlands in AOC to be protected, enhanced or expanded when mitigation is needed for other projects in the AOC.
- Completed floodplain-mapping project for Swan Creek.
- Continued efforts to establish Maumee River Regional Storm Water Management District.
- Held numerous public events and educational workshops.

- o Continued to participate in multi-agency effort to determine long term management plan for Toledo Harbor sediments removed under navigation channel maintenance dredging.
- o Continued to coordinate with the Ottawa River Remediation Team in a concentrated effort to remediate degraded environmental conditions and dredge a recreational navigation channel in the lower Ottawa River.

9.8 River Raisin RAP, Michigan

(http://www.epa.gov/glnpo/aoc/rvraisin.html)

At the April 2001 meeting of the River Raisin Watershed Council, the RAP's Public Advisory Committee (PAC) was accepted as a standing committee of the council. This action provides the PAC with a nonprofit designation and will enhance both groups' status for grant eligibility.

- o $4 million was secured in 2001 for PCB remediation on a portion of the Consolidated Paper Co. site. This only starts the removal of contaminants from the Consolidated site. Future funding is needed to remediate the highly contaminated PCB lagoons (estimated at $20 million).
- o In May 2001 it was announced that a $12 million rehabilitation project would be started at Sterling State Park. The Ford Motor lagoon area, which is included in the State Park project, will result in miles of wetland walking paths accessible in an area that has been closed to the public since the early 1900s.
- o Harding ESE Inc. announced in March 2001 that they were ready to proceed with the final work plan for the River Raisin. The plan includes identifying gaps in existing data, collecting river sediment samples, evaluating PCBs and heavy metals, evaluating permitting issues, conducting two public meetings, determining sediment volumes to be removed, and developing alternatives for remediation of sediments. Results from the sedimentation testing are expected in early 2002.
- o The PAC endorsed a U.S. EPA grant to the Monroe Public Schools to continue the school's environmental outreach program. The program utilizes students to collect fish for analysis to determine levels of contaminants, especially PCBs. Other water quality testing projects for students are included.

9.9 Rouge River RAP, Michigan

(http://www.epa.gov/glnpo/aoc/rougriv/)

Below is a summary of recent and ongoing projects in the Rouge River AOC:

- o Work on the status of most of the impaired beneficial uses is under review and a final draft is expected in mid-2002. Draft delisting criteria for the Rouge River AOC are in production and will be finalized in 2002.
- o Work continues on the voluntary permit to reduce or eliminate the adverse effects of storm water runoff from the watershed communities. Watershed management plans and storm water pollution prevention initiatives have been completed and submitted to Michigan Department of Environmental Quality (MDEQ) for comment. Both identified excessive flow variation, high bacteria counts, low dissolved oxygen and high nutrient concentrations as the major factors degrading the Rouge River.
- o The Rouge Gateway Project continues to focus on the environmental restoration of the lower several miles of the river. Ongoing projects include pilot demonstrations of phyto-remediation of PAH-contaminated soils, the effectiveness of porous pavement for reducing storm water runoff from parking

lots, and the reconnection and restoration of a small oxbow lake to a channelized portion of the river. Future projects are expected to include a fish passageway around a historic dam, and "softening" the edge of the channelized concrete channel using bioengineering techniques.

- The Friends of the Rouge (FOTR) trained several hundred volunteers to conduct frog and toad surveys this spring. A volunteer macroinvertebrate monitoring program began this year. The Friends of the Rouge continue to organize a school-based water quality monitoring program, which this year included 79 schools.
- Several citizen "creek groups" have organized and are addressing issues ranging from river-friendly lawn care practices to streambank restoration. The Rouge Program Office hosted two workshops in 2001 to provide the groups with technical resources and opportunities to network.
- MDEQ staff continued a multi-year survey of mussel populations in the watershed. Five species have been found with significant beds in the headwaters of the main branch of the river.
- MDEQ and the Michigan Department of Natural Resources sampled resident fish near the Newburgh Lake remediation site this fall to investigate the effectiveness of the contaminated sediment cleanup. It is hoped that fish PCB concentrations will be low enough to remove the fish consumption advisory in the river's middle branch.

9.10 Detroit River RAP (U.S. and Canada)

The Detroit River RAP is a binational program implemented through separate Canadian and American RAP committees working toward completing local implementation actions. Regular communication is ensured by the four responsible agencies: Environment Canada, U.S. EPA, Ontario Ministry of the Environment, and Michigan Department of Environmental Quality.

Jointly, the Detroit River Remedial Action Team and the Canadian Clean Up Committee are developing the delisting criteria for impaired beneficial uses within the Detroit River AOC.

U.S.

(http://www.epa.gov/glnpo/aoc/detroit.html)

The Detroit River Remedial Action Team has been busy coordinating and contributing to several projects underway simultaneously.

- Initiated steps to organize the Detroit River Remedial Action Team as a nonprofit watershed organization to oversee the implementation of the RAP.
- Mercury and PCB contamination activities included a downriver community thermometer exchange, and a program to remove PCB contamination at small and medium-sized companies in the City of Detroit.
- Initiated a habitat visioning process and completed an inventory of possible natural habitats along the Detroit River Shoreline. The habitat visioning process and inventory serve as the basis for a habitat management and non-point source pollution plan for the U.S. side of the area of concern.
- The U.S. passed legislation (H.R. 1230) in December 2001, authored by Representative John Dingell (MI-16), to establish an International Wildlife Refuge along the Detroit River. The 18-mile wildlife refuge will stretch from Zug Island south to Sterling State Park in Monroe County. A binational vision has been created for the refuge.
- A comprehensive rehabilitation plan for Detroit River lake sturgeon was initiated in 2000 to understand population dynamics and habitat requirements at all life stages. Their life cycle makes them a potential indicator species for monitoring tissue contaminant levels and fish habitat.

- The City of Detroit Water and Sewerage Department began completion of the Water Works Park II Treatment Plant with: a water museum and learning center; replacement of aging water mains in Detroit; department-wide instrumentation and systems upgrades to 52 water and wastewater facilities; implementation of program management at the Wastewater Treatment Plant; and construction of additional combined sewer overflow facilities.
- Brownfield redevelopment activity was initiated on several riverfront sites including: 35 acres in Southwest Detroit as expanded and enhanced marine terminal operations; the Pleasant Avenue site in the City of River Rouge west of Zug Island; and a 16.5 acre site on the Trenton channel of the Detroit River.

Canada

(http://www.on.ec.gc.ca/glimr/raps/connecting/detroit/intro.html)

The Detroit River Canadian Cleanup Committee (DRCCC) was established in 1998, and represents a restructuring of previous Remedial Action Plan activities. Projects underway and/or completed include:

- Rural Non-point Source Pollution Remediation Program, through the Essex Region Conservation Authority, offers incentive grants to individual landowners to implement agricultural best management practices. In the last two years there have been 40 tree planting, 27 buffer strip, 19 soil erosion reduction structure, 16 septic system upgrade, and four no-till planter projects implemented.
- Biodiversity Conservation Strategy Implementation Program, through the Essex Region Conservation Authority, has implemented five large-scale projects totaling 54 hectares (134 ac) to restore upland and wetland habitats in the area of concern.
- Led by the University of Windsor's Great Lakes Institute for Environmental Research (GLIER), the Detroit River Management and Modeling Framework computer model has been developed to predict the transport and fate of contaminants in the Detroit River. Related food web modeling has also occurred.
- U.S. EPA and GLIER completed a comprehensive annotated bibliography of research on the Detroit River at www.uwindsor.ca/dreams (choose DR Bibliography).
- The City of Windsor led the Combined Sewer Overflow Retention Treatment Basin Study that assessed the performance of various factors in achieving high-rate treatment of particles from combined sewer overflows.
- Building on the programs already in place, the focus of the DRCCC over the next two years is to finalize binational delisting criteria for the area of concern, and fine tune implementation activities to achieve these criteria.

9.11 Wheatley Harbour RAP, Ontario

(no specific web site is available)

This Canadian RAP operates through an informal communication between government and the local community. The focus has been on implementation-oriented projects with the following remediation projects completed:

- The Rural Non-point Source Pollution Remediation Program, administered through the Essex Region Conservation Authority, offers incentive grants to individual landowners to implement agricultural best management practices. In the last two years the following projects have been completed: 25 tree plantings, 14 buffer strips, 10 soil erosion control reduction structures, and 2 septic system upgrades.

Photo: Lake Erie Management Unit, OMNR

- The Biodiversity Conservation Strategy Implementation Program, also offered through the Essex Region Conservation Authority, focuses on implementation of large-scale habitat restoration projects throughout the region. The program is only one year old and, to date, one 2.4 ha (6 ac) project incorporating forest and wetland restoration has been completed.

9.12 Clinton River RAP, Michigan

(http://www.epa.gov/glnpo/aoc/clintriv/)

The Clinton River Watershed Council (Council) has resumed its role as administrator of the Public Advisory Council. The Council will gather information on actions recommended in the RAP, review new technologies for monitoring and mitigation, reorganize the Public Advisory Council in preparation for the 2002 RAP update and promote critical recommended actions.

- Over 2,000 students participated in a student-monitoring program in 2001 collecting physical, biological and chemical data across the watershed.
- More than 30 events were held in the Clinton River watershed as part of the fourth annual River Day held in June 2001. Notable was a fish habitat enhancement project on Paint Creek in the Village of Lake Orion made possible by donations and volunteers from General Motors, Boy Scouts, Village of Lake Orion, Oakland County Drain Commissioner and local businesses.
- In November 2001, a new river cleanup event, “Clean the Clinton,” drew over 150 volunteers to a stretch of river between Rochester Hills and Shelby Township. An estimated three to four tons of debris were removed from the riverbanks.
- The U.S. Coast Guard committed to creating a single database for consolidating U.S. and Canadian federal and state/provincial data on spills and discharges.
- The Macomb County Commission announced that they had agreed to work together with the Oakland County Drain Commission to coordinate county efforts to reduce pollution in the Clinton River.
- A recent study of the sources of fecal contamination at Blossom Heath Beach in Saint Clair Shores identified bird droppings as the major contributor to beach closings.

9.13 St. Clair River RAP (U.S. and Canada)

(http://www.on.ec.gc.ca/glimr/raps/connecting/st-clair/intro.html or http://www.epa.gov/glnpo/aoc/st-clair.html)

Activities in the St. Clair River Area of Concern have focused on several key areas in the past two years. These include maintaining incremental progress towards the achievement of habitat and non-point source goals and characterizing and recommending actions for managing contaminated sediments. These are summarized below.

- Ongoing monitoring to assess improvements in environmental conditions as they relate to RAP implementation activities and delisting targets. This has permitted the RAP and Binational Public Advisory Council to establish that several delisting criteria have been met and determine gaps for those that remain.
- Significant commitments have been secured in the area of municipal infrastructure improvements. The City of Port Huron is currently engaged in a 15 year $180 million (U.S.) sewer separation project. Five combined sewer overflows were eliminated in 2001, reducing overflows by 162 million gallons per year. More than 50% of annual average combined sewer overflows have been eliminated, only one-third of the way into the program. The City of Sarnia recently brought its newly upgraded sewage treatment plant online at a cost of $30 million (Cdn.). This plant now utilizes secondary treatment with ultraviolet disinfection and employs a state-of-the-art sludge management system.
- A key accomplishment in 2001 was the commitment by Dow Chemical Canada Inc. to remediate contaminated sediments adjacent to their St. Clair River manufacturing facility in Sarnia. This announcement came about as a result of proactive efforts by Dow to work with the Ontario Ministry of the Environment and Environment Canada and is a key milestone in achieving RAP goals. Efforts are ongoing to evaluate two additional areas of priority sediments in the upper St. Clair River.
- Habitat and non-point source control efforts have been occurring in St. Clair County, Michigan and Lambton/Kent Counties in Ontario due in large part to efforts by the Blue Water Task Force (now known as the St. Clair County Water Quality Board) and the Rural Lambton Stewardship Network. Collectively, these organizations have successfully obtained grants from the U.S. EPA and Environment Canada to engage interested landowners in habitat and non-point source improvement projects that have leveraged more than $1Million in local matching funds in the past 2 years.
- Through the efforts of the Friends of the St. Clair River (Ontario), and funding from the Ontario Ministry of the Environment, a newly upgraded web site, www.friendsofstclair.ca, came online in October 2001, which serves as a helpful resource to interested citizens and students of all ages looking for information on the St. Clair River.
- A number of key accomplishments have already been realized and reflect a significant effort to address ongoing sources of contamination and spills. Much of the remaining work deals with addressing concerns from past practices such as remediation of historically contaminated sediments and loss of habitat.

Significant Ongoing and Emerging Issues

Section 10

Section 10: Significant Ongoing and Emerging Issues

10.1 Introduction

The dynamic nature of Lake Erie means that things change, often unpredictably. Section 2 in the Lake Erie LaMP 2000 document described how the issues of concern in the lake had changed over time. Some of the issues were resolved through management actions over a short period of time, while others required long-term and ongoing management plans. Some goals, such as phosphorus concentrations in the lake, were considered achieved until zebra mussels invaded and concentrations began fluctuating again. The invasion of a host of new exotic species has created much alteration in the biological community. The ecosystem objectives for Lake Erie attempt to set goals for management actions in the areas of land use, nutrient management, contaminants and exploitation. It may be necessary to continually revisit these goals as new unexpected situations arise. This section provides some insight into issues that are currently important in the lake, as well as those that may be emerging as important future issues. The adaptive management approach of the LaMP process accepts the fact that change is inevitable. The challenge to the LaMP is to keep abreast of lake conditions, identify and encourage research in areas needed to make the appropriate management decisions, and modify management goals and actions when needed.

10.2 Update on Non-indigenous Invasive Species in Lake Erie

Section 11 of the Lake Erie LaMP 2000 document presented a detailed overview of the history of non-indigenous invasive species (exotics) in the lake. Since 2000, several more exotics have entered. Rarely can ecologists predict the effects of a non-indigenous invasive species in a new place. One has better luck in predicting which species may invade next by comparing the characteristics of species that have been successful invaders with those that have failed to become established. For example, ecologists have summarized features that have enhanced invasions including descriptions of successful colonizers (high fecundity, wide tolerance of abiotic factors), impact (economic and ecological), and habitats prone to invasion (i.e., accessible corridors between habitats, climatically matched regions, and disturbed or vacant niches) (Elton 1958, Lodge 1993, Ricciardi and MacIsaac 2000). Successful invaders produce many offspring, are quick to disperse, can tolerate a wide range of a given environmental factor, and invade an area that matches the climate of its home. But even if an invader becomes established, what is the chance that it will pose a problem?

The Lake Erie LaMP has identified exotic species as one of the key problems impairing Lake Erie ecosystems. Five of the 14 beneficial use impairments are due at least partially to exotic species: degradation of plankton, fish and wildlife populations; degradation of aesthetics; and loss of fish and wildlife habitat. The species that are of most concern in Lake Erie include: dreissenid mussels (zebra and quagga), round goby, spiny water flea, *Phragmites*, sea lamprey, Eurasian watermilfoil, and purple loosestrife.

Since the publication of the Lake Erie LaMP 2000 document, there have been reports on effects of exotic species on native species, documentation of new invaders, evidence of avian botulism (with the possible link to invasive fishes), and the development of a Canadian "National Code on the Introductions and Transfers of Aquatic Organisms." This section highlights the changes since the 2000 report.

Blooms of the toxic colonial cyanobacteria, *Microcystis aeruginosa*, have been linked to the feeding habits of the zebra mussel (*Dreissena polymorpha*) (Vanderploeg

et al. 2001). *Microcystis* blooms, typically caused by excessive phosphorus loading, were common in the formerly eutrophic western basin of Lake Erie. The subsequent trophic changes in Lake Erie in response to phosphorus abatement programs initiated under the Great Lakes Water Quality Agreement of 1972, resulted in the decline of *Microcystis* blooms (Makarewicz and Bertram 1991). However, *Microcystis* blooms were recently reported from satellite observations in western Lake Erie and Saginaw Bay (Lake Huron), where zebra mussels are established (Budd et al. 2001). Vanderploeg et al. (2001) hypothesized that zebra mussels induced a shift in algal abundance by ingesting all algae except *Microcystis*. Zebra mussels selectively feed on algal competitors of *Microcystis* and at the same time spit back *Microcystis* into the water column. This behaviour results in the dominance of *Microcystis* and a reduction in other algal species, explaining the paradox of the association between *Microcystis* blooms and filter-feeding dreissenids. The extensive and surprising *Microcystis* blooms of 1998 have not been repeated to that extent in the three years since. However, *Microcystis* is being documented in plankton samples collected throughout the lake. Forecasting future blooms remains unpredictable (Culver, personal communication 2002).

Researchers forecasted that two exotic zooplankton species, *Cercopagis pengoi* (present in Lake Ontario in 2000) and *Daphnia lumholtzi* (inhabiting reservoirs in Ohio and Michigan in 2000) were likely to invade Lake Erie (Lake Erie LaMP 2000). Drs. Igor Grigorovich and Hugh MacIsaac (University of Windsor) have confirmed that both species are well established in the western basin of Lake Erie near the inflow of the Detroit River. The presence of *Cercopagis pengoi*, the fishhook waterflea, represents a significant range expansion, suggesting that the most likely vector is ballast water discharge (MacIsaac, personal communication). *Cercopagis pengoi* reproduces parthenogenically, enabling the species to establish quickly. Owing to its large size, it likely will affect both phytoplankton and zooplankton populations, and might even compete with young-of-the-year-fish for prey (www.epa.gov/glnpo/monitoring/exotics/cercopagis.html).

Daphnia lumholtzi, native to Australia, Africa and southwest Asia, is thought to have arrived in reservoirs in the United States when the Nile perch was introduced to Texas to enhance the sport fishery (Havel, personal communication). The species, which was reported in Missouri and Texas in the early 1990s (Havel and Herbert 1993; Havel et al. 1995), has quickly spread north. Muzinic (2000) published the first record of *D. lumholtzi* in the Great Lakes in specimens collected from East Harbor State Park, in Ohio (western Lake Erie) using vertical plankton net tows. *Daphnia lumholtzi* likely will become a successful invader because of its ability to avoid predation, not because it is a better competitor for the available food supply (Goulden et al. 1995).

The invasion of the zebra mussel (*Dreissena polymorpha*) in the Great Lakes has resulted in "catastrophic" declines of native mussels in infested waters, and severely restricted the range of the northern riffleshell in Canada. Analyses of the diversity and composition of freshwater mussel communities in the lower Great Lakes basin has revealed a pattern of species loss and changing community composition throughout the basin, particularly in the formerly species-rich Lake Erie and Lake St. Clair drainages (Metcalfe-Smith et al., 1998a). Coastal wetland areas, such as Metzger's Marsh (a diked wetland) and tributaries in the Lake Erie watershed now act as "refuges" for many species of native unionids. Native unionid species occurring in the Canadian waters of the lower Great Lakes drainage basin were ranked by their vulnerability to zebra mussels. Under this ranking scheme, nine out of 35 native unionids were ranked as highly vulnerable to zebra mussels (Metcalfe-Smith et al., 1998b). Species most at risk from impact of zebra mussels occur mainly in the Great Lakes themselves or in the lower reaches of the larger tributaries, while headwater species are less likely to cohabit with zebra mussels throughout most of their ranges.

Lake Erie, excluding tributaries, has 34 exotic fish species. Nineteen species are established and 15 others are reported (Lake Erie LaMP 2000). As an example of the increasing impact of exotic species on Lake Erie, non-indigenous species now comprise 75% of the commercial fish catch in Lake Erie (Corkum et al. 2001a).

Aquarium, water garden and bait fish introductions are a global problem and an important vector of non-indigenous invasive species. Although one in every four fish species introductions in the United States results from the aquarium trade, little effort is directed toward public awareness of aquarium releases in the Great Lakes basin (Dextrase and Paleczny 2000). Of nine fish species associated with aquarium and water garden release in Ontario, three species have been reported in Lake Erie: goldfish (*Carassius auratus*), pacu (*Colossoma* sp.), and suckermouth catfish (*Panaque* sp.) (Dextrase and Paleczny 2000). The Ontario Federation of Anglers and Hunters has established a "Fish Rescue Program and Awareness Initiative." The organization has established a network to hold unwanted pets until a new owner is found (toll free hot line: 1-800-563-7711). Unfortunately no regulations exist to control aquaria and pond water release.

Photo: Lake Erie Management Unit, OMNR

In 2000, there were unusual sightings of the Chinese bighead carp, *Hypophthalmichthys nobilis*. On 16 October 2000, the third specimen ever of Chinese bighead carp was caught in a trapnet on the west side of Point Pelee in the western basin of Lake Erie (T. Johnson, personal communication). The fish is native to eastern China and introduced into the United States in 1973. The October sighting was probably the result of fish escape from aquaculture ponds in Ohio (T. Johnson, personal communication). The Chinese bighead carp is a filter feeder and if ever established, the species may compete with native fishes for plankton.

Of all the exotic fishes in Lake Erie, the one most troublesome is the recently established round goby, *Neogobius melanostomus*. Concerns about the round goby include:

- Their ability to transfer contaminants through the food web;
- Their detrimental effect on native species;
- Their ability to proliferate owing to their multiple spawning habitats;
- The potential expansion of gobies by anglers using bait buckets; and,
- Economic costs of gobies as bycatch in nets of commercial fishers (Corkum et al. 2001b).

The extent of the potential impact of the round goby is not yet fully realized because literature from its native range (Black and Caspian seas and associated waters) and invaded areas is limited, and researchers have not yet had sufficient funding to address many of the concerns. A special section on "The Round Goby Invasion", recently published in the Journal of Great Lakes Research (volume 27, issue 3), addresses some of these shortcomings (Charlebois et al. 2001). Janssen and Jude (2001) document the local extinction of mottled sculpins (*Cottus bairdi*) by the round goby in Calumet Harbor, southern Lake Michigan owing to competition for food resources (small fishes), space (medium sized fishes) and spawning sites (large fishes). Recruitment failure of mottled sculpins was attributed to spawning interference by the round goby (Janssen and Jude 2001). Declining populations of mottled sculpins, greenside darters and channel darters around the Lake Erie islands in the western basin are also thought to be associated with the increasing number of round gobies (R. Thoma, personal communication).

Several agencies have monitored movement of the round goby and their contribution to the diet of predators in Lake Erie (T. Johnson and C. Knight, personal communication). The round goby first entered the western basin of Lake Erie in 1993 and by 1999 had spread throughout the lake. The round goby contributes significantly to the diet of smallmouth bass (*Micropterus dolomieu*), stonecats (*Noturus flavus*), burbot (*Lota lota*), and yellow perch (*Perca flavescens*), but is a minor component in the diet of walleye (*Stizostedion vitreum*) and white bass (*Morone chrysops*) (T. Johnson, personal communication). Clearly, the round goby will be influential in transferring energy from the lake bottom up through the food chain. Studies on bioenergetics of the round goby and its effect on the Lake Erie food web are in progress (T. Johnson, personal communication). Additional tools such as species-specific piscicides are being investigated for potential control of the round goby (Schreier et al. 2001).

Fisheries managers are concerned that round goby may move from the Great Lakes basin south to the Mississippi River basin where the goby may adversely affect other native

biota. The La Crosse, Wisconsin, Fisheries Office personnel use baited minnow traps to monitor the movement of the round goby en route to the Mississippi River from Lake Michigan, a distance of 536 km (Steingraeber and Thiel 2000). Annual movement of the round goby along the Calumet Sag Channel between Lake Michigan and the Des Plaines River is about 25 km per year. However, round goby movement in lakes may differ depending on prevailing currents. An electrical barrier is being constructed on the Des Plaines River, Illinois, to reduce the risk of non-indigenous fishes from moving between the Great Lakes and Mississippi basins. Unfortunately, the round goby has moved downstream from the barrier location. However, the structure may eliminate the transfer between basins of other non-indigenous species such as the bighead (*Hypophthalmichthys nobilis*) and silver (*H. molitrix*) carp, which are now in the lower Illinois River and are moving north to the Great Lakes.

The federal policies that relate to exotic species in the Great Lakes include the U.S. Lacey Act, the U.S. National Invasive Species Act, the Canadian Fisheries Act and the Canada-Ontario Agreement. The original U.S. Non-indigenous Aquatic Nuisance Prevention and Control Act (1990) was reauthorized in 1996 as the National Invasive Species Act. The Province of Ontario and the eight U.S. states bordering the Great Lakes all have restrictions on non-indigenous invasive species, but policies are inconsistent. Recently, a draft document has been prepared for a Canadian "National Policy/Code on Introductions and Transfers of Aquatic Organism" that will apply to all intentional introductions for stocking or aquaculture. Environment Canada hosted a national workshop on invasive alien species in November 2001. The objectives of this workshop were to: identify and clarify fundamental issues in the management of invasive alien species; develop a draft framework for a national plan that identifies key policy and management options; and outline a process to develop a draft Canada-wide plan by fall 2002.

Chartered under U.S. federal law, the Great Lakes Panel on Aquatic Nuisance Species is responsible for advancing prevention and control efforts in the Great Lakes-St. Lawrence system. Currently they are pursuing a policy on ballast water management. The recommendations in the policy include: establish criteria for ballast water management practices and treatment technologies; promote a regional (and binational) approach to ballast water management; apply regulations and guidelines to all vessels including those with no ballast on board; and evaluate ballast water management practices and treatment technologies. Several demonstration projects are underway to test ballast water treatment technologies on board freighters.

Photo: Lake Erie Management Unit, OMNR

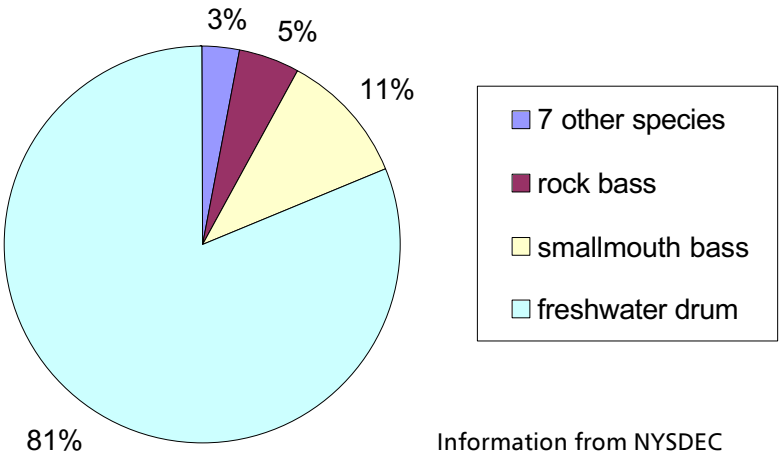
10.3 Botulism E

Researchers have suggested a possible link between the round goby and avian botulism, a disease of wild migratory birds caused by *Clostridium botulinum* (Domske and Obert, personal communication). Birds such as ducks, gulls, and loons are paralyzed or die after exposure to a toxin produced by the botulism bacteria. Fish-eating birds exhibit type E botulism poisoning. In one case, botulism-infected birds in Lake Erie had a higher incidence of round goby in their guts compared with uninfected birds. Low oxygen concentrations combined with temperature inversion may stress round goby inducing them to swim to the surface and drift shoreward, enabling birds to feed on fish that harbor the anaerobic bacteria that contain the toxin. Ward Stone (New York, Department of Environmental Conservation) has identified botulism type E toxin in freshwater drum, smallmouth bass, lake sturgeon and in round gobies retrieved from the guts of smallmouth bass.

The Canadian Wildlife Service reported that the fish die-off (likely caused by temperature inversion) of freshwater drum and the round goby at Wheatley on August 16, 2001 did not result in any unusual bird mortalities. However, after a similar die-off of fish near Port Dover, also on August 16, there were 38 dead birds, one mudpuppy, three shorebirds and a report of a sick great blue heron. On October 29, 2001, the Canadian Wildlife Service reported die-offs of the common loon, ring-billed gulls, red-breasted mergansers, gadwalls, and long-tailed ducks (old squaw) along the northeast shore of Lake Erie between Port Dover and Dunnville. In addition, there were dead fish along the beach including round goby, carp, and catfish as well as a mudpuppy. Specimens were sent to the Canadian Cooperative Wildlife Health Centre at the University of Guelph for assessment.

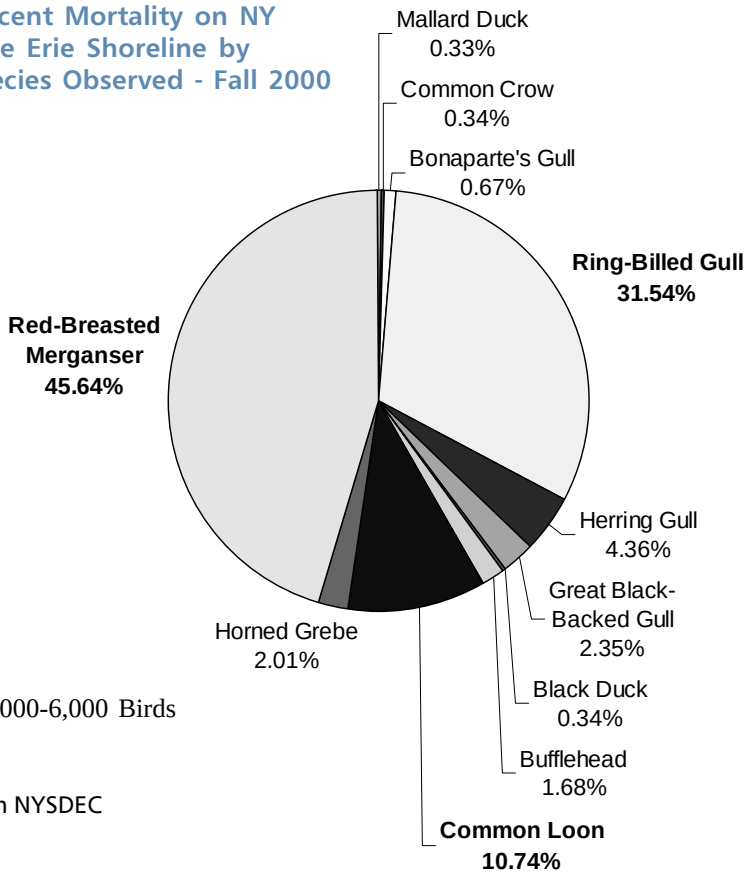
Similar mortalities of fish and birds occurred along the New York shoreline of Lake Erie during the same period. Among fish found dead along the New York shoreline in September 2001, 81% were freshwater drum (Figure 18) with the remainder consisting of nine other species. Bird collections in fall 2000 revealed an estimated 5,000 to 6,000 birds died that year, with red-breasted merganser the most common species (Figure 19). Estimates of dead common loons in New York were over 500 birds in 2000, and over 1000 birds in 2001. In addition, seven dead lake sturgeon (a threatened species in New York) were found in 2000, while 27 individuals were collected in 2001.

Figure 19: Frequency of Dead Fish Species Observed Along NY Lake Erie Beaches, September, 2001



Information from NYSDEC

Figure 20: Percent Mortality on NY Lake Erie Shoreline by Species Observed - Fall 2000



Mortality: 5,000-6,000 Birds

Information from NYSDEC

10.4 Phosphorus Changes in Lake Erie

Since 1965, phosphorus loads to Lake Erie have been reduced by roughly 50% to approximately 11,000 metric tonnes per year, the target goal set in the Great Lakes Water Quality Agreement. Most of the reduction came from better treatment of municipal sewage sources. Over the 30 years since inception of the controls, Environment Canada and U.S. EPA collected water samples for the purpose of following the recovery of the lake. Since the loading target was reached in the mid 1980s, the zebra mussel invasion and other exotic species have changed the biology of the lake and the associated internal nutrient processing. Thus, there is interest in understanding what drives phosphorus concentrations today.

Phosphorus concentrations reached record lows in 1995. Decreases in phosphorus concentrations coincident with the increase in zebra mussel populations were comparable to those caused by nutrient load reductions up to 1985. The largest changes in phosphorus of 5 to 6 ug/l pre zebra mussels and 5 to18 ug/l post zebra mussels occurred in the west central and west basins, respectively. Changes in the central and east basins were 2.5 to 4 ug/l both pre and post zebra mussels. One mechanism for this may have been the actual growth of the zebra mussel organism. For example, as the planktonic mussel larvae grew over a few weeks and then sank to the bottom, they took phosphorus with them. This was a new sedimentation flux that removed phosphorus from the water column.

The low phosphorus concentrations stimulated concerns that existing phosphorus controls were no longer appropriate now that the biology of the lake had changed. Despite ongoing recovery of walleye populations during nutrient controls, loss of productivity for fisheries was feared. Inferred from chlorophyll concentrations (Charlton et al. 1999) though, primary production was reduced much more by nutrient controls prior to the onset of the mussels than after the mussels arrived.

From 1995 to 2000 phosphorus concentrations rebounded in the west, west central,

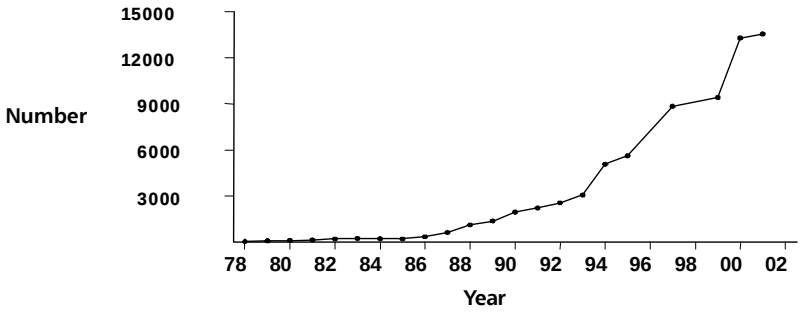
and central basins by almost 10 ug/l. Some of the concentrations in the central basin during 2000 approximated those in the early years of phosphorus controls. Recovery of phosphorus concentrations also occurred in the east basin to a lesser extent. Concentrations are slightly below the recommended 10 ug/l in the east basin but are somewhat above 10 ug/l in the central basin. One explanation for the phosphorus increases may be that the growth rate of mussel populations has slowed and nutrients are now recycling back into the water. On the other hand, increased phosphorus loads may have caused the increases.

Unfortunately, studies of mussels and other exotic species are insufficient to explain their part in the recent phosphorus variations. Furthermore, phosphorus-loading statistics are no longer consistently available so it can't be determined if the concentration variations are simply caused by load variations. Due to loss of resources and discontinuation of research and monitoring efforts, opportunities to learn how the lake functions are being lost and capabilities to make informed management decisions are reduced.

10.5 Double Crested Cormorants in the Great Lakes

Double-crested cormorants are colonial waterbirds that nest on the ground or in trees, often mixed in with other species. They have an extensive range in North America, occurring throughout the interior as well as on both coasts. The first report of cormorant nesting on the Great Lakes occurred between 1913 and 1920, and by 1950 the breeding population was at 900 pairs (Weseloh et al. 1995). Human persecution and environmental contaminants led to the virtual extinction of cormorants on the Great Lakes by the early 1970s. From 1970 to 1991 the Great Lakes cormorant population increased from 89 nests to more than 38,000 nests. The population has increased at an annual rate of 23 percent from 1990 to 1994 (Tyson et al. 1999). Major factors leading to an increase in the Great Lakes population were reduced contaminants and persecution plus an abundance of prey fish (Weseloh et al. 1995, Blokpoel and Tessier 1996). By 1999, there were almost 100,000 nesting pairs in the Great Lakes. On Lake Erie, there has been a dramatic increase in the number of nests. In 1978 there were 58 nests, and by 2001 there were more than 13,000 cormorant nests (Figure 20).

Figure 21: Number of Cormorant Nests on Lake Erie



With the burgeoning cormorant population there has been an increase in conflicts with commercial and sport fisheries in the Great Lakes. The common opinion of many fishers is that cormorants have a negative impact on the fish communities. In response to these concerns, diet and related studies were conducted to identify impacts of cormorant feeding on Great Lakes fisheries. Studies conducted worldwide have repeatedly shown that while cormorants can, and often do, take fish species that are valued in commercial and sport fisheries, those species usually comprise a very small proportion of the birds' diet. One Lake Erie study found that the number of these fish (i.e. yellow perch, smallmouth bass, and walleye) consumed by cormorants was less than five percent of the total diet (Bur et al. 1999). Research has not yet established conclusively

Photo: New York Department of Environmental Conservation, Rodger Klindt

whether cormorants have the ability to deplete local populations of fish.

Cormorants can affect other colonial waterbirds at mixed breeding colonies, both directly (by physical displacement) and indirectly (by altering the vegetation) (Trapp et al. 1999). These birds often inadvertently kill trees and vegetation with their feces. Some of these areas include stands of uncommon or rare floral species. For example, cormorant feces are negatively impacting the rare Kentucky coffee tree, *Gymnocladus dioicus*, on Middle Island and other islands in western Lake Erie. Vegetation alteration may affect the ecological balance of a site, and lower property, recreational, and aesthetic values. Lake Erie's West Sister Island has the largest colonial waterbird population in the Great Lakes.

Since 1972, depredation permits allowing the taking of double-crested cormorants have been authorized on a case-by-case basis, usually when negative impacts on aquaculture operations and habitat have been demonstrated. Most permits were for birds causing depredation problems at aquaculture operations. The U.S. Department of Agriculture's Wildlife Services Division is responsible for documenting economic losses.

The persistence of conflicts associated with double-crested cormorants, widespread public and agency dissatisfaction with the status quo, and the desire to develop a more consistent and effective management strategy for double-crested cormorants led the U.S. Fish & Wildlife Service to prepare a national cormorant management plan for the contiguous United States. The purpose of the draft environmental impact statement on double-crested cormorants is threefold: to reduce resource conflicts associated with double-crested cormorants in the contiguous United States; to enhance the flexibility of natural resource agencies in dealing with cormorant-related resource conflicts; and to ensure the conservation of healthy, viable cormorant populations.

The Double-Crested Cormorant Management Plan describes and evaluates the anticipated environmental effects of six management alternatives: 1) continue current cormorant management practices (no action); 2) implement only non-lethal management techniques; 3) expand current cormorant damage management practices; 4) establish a new Depredation Order to address public resource conflicts; 5) reduce regional cormorant populations; and 6) establish frameworks for a cormorant hunting season. Alternatives were analyzed with regard to their potential impacts on cormorant populations, fish, other birds, vegetation, federally listed threatened and endangered species, water quality and human health, economic impacts, fish hatcheries and environmental justice, property losses, and aesthetic values. Management alternative number 4 is the proposed action.

10.6 Lake Erie Water Levels

Lake Erie water levels have declined from near-record high levels in June 1997 to below-average conditions since May 1999. This is a result of low water supplies from the upper lakes beginning in mid-1997. At the beginning of 2002, Lake Erie was 12 cm (4.7in) below average, but 6 cm (2.4 in) higher than levels experienced one year earlier.

Water levels fluctuate according to the climate of the region. Since it is not possible to accurately forecast weather conditions several months in advance, staff of Environment Canada and the U.S. Army Corps of Engineers prepare a six-month forecast of the probable range of future water levels assuming wet and dry supply conditions. This six-month forecast (Figure 22) is provided in the Monthly Water Level Bulletins published in Canada by the Canadian Hydrographic Service and in the United States by the U.S. Army Corps of Engineers. If dry conditions prevail over the first six months of 2002, by summer the level of Lake Erie could be ten or more centimeters (3.9 in) lower than levels experienced during 2001, but still well above the period-of-record minimum levels recorded in 1934. If, however, wet conditions are experienced, levels could equal or exceed those recorded during 2001 and could climb a few centimetres above average. Please consult the Canadian Hydrographic Service website (http://chswww.bur.dfo.ca/danp/) or the U.S. Army Corps of Engineers website (http://huron.lre.usace.army.mil/levels/bltnhmpg.html) for up-to-date information on current and forecasted water levels.

Photo: Ohio Division of Wildlife

Figure 22: Recent and Historic Lake Erie Water Levels (Source: Canadian Hydrographic Service)

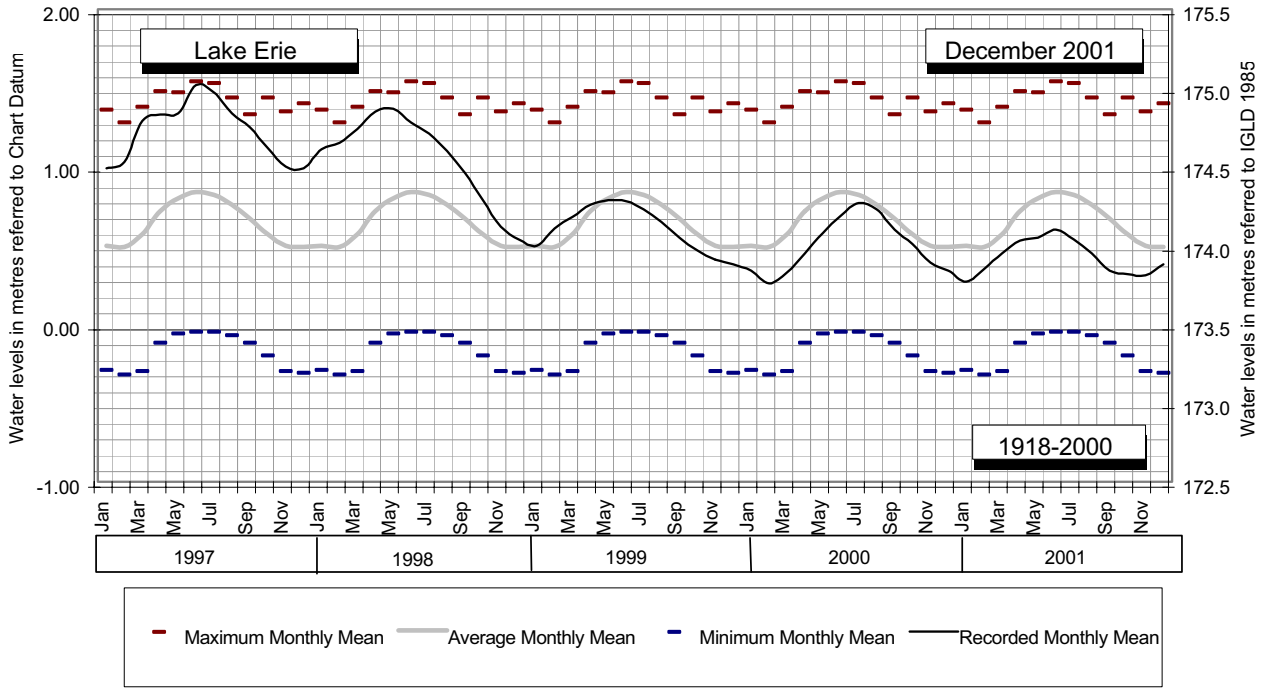
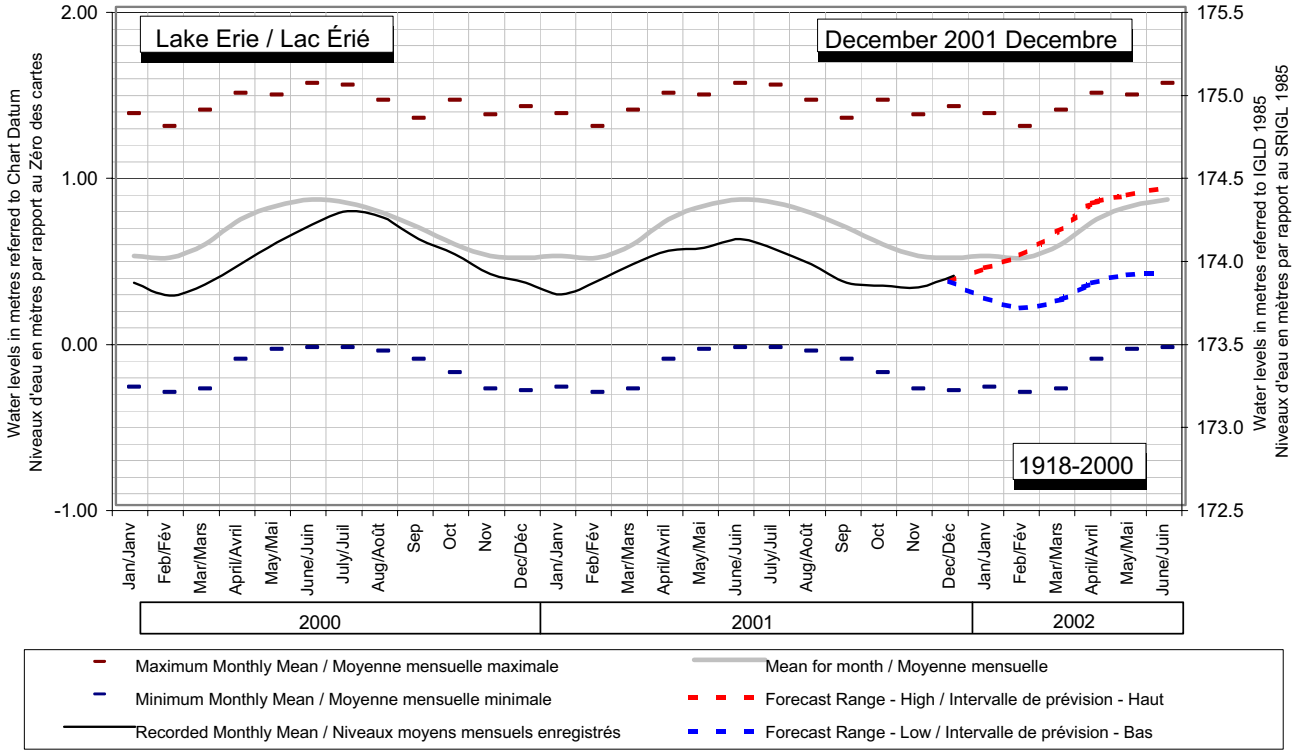


Figure 23: Monthly Water Level Bulletin Including 6 Month Forecast (Source: Canadian Hydrographic Service)



Pathways to Achievements/ Next Steps

Section 11

Section 11: Pathways to Achievements / Next Steps

Photo: Michelle Fletcher

Since the publication of the Lake Erie LaMP 2000 report, significant progress has been made in many areas. Achievements include:

- selecting Ecosystem Alternative 2 as the preferred future state of the lake;
- proposing ecosystem management objectives;
- completing the beneficial use impairment assessment for Degraded Wildlife Populations and Loss of Wildlife Habitat;
- continuing to promote and track reductions in mercury and PCBs to Lake Erie;
- initiating a source track down program for critical pollutants and pollutants of concern to Lake Erie;
- hosting two workshops by the Lake Erie Millennium Plan;
- production of an educational slide show and fish consumption brochure by the Forum; and
- continuing to monitor and follow up on ongoing and emerging issues.

In addition to the projects in this report specifically attributed to the Lake Erie LaMP effort, the Lake Erie LaMP will continue to coordinate with and track the progress of a number of ongoing programs focused on the Great Lakes and/or Lake Erie. Of particular importance will be coordinating with and tracking the progress/successes of the Great Lakes Binational Toxics Strategy, the RAPs, the Lake Erie Millennium Plan, and SOLEC. The LaMP recognizes that an adaptive management approach is paramount to identifying and addressing the most critical needs of Lake Erie as its ecosystem continues to change. Therefore, the LaMP will:

- continue to evaluate the state of the lake;
- be cognizant of emerging issues;
- identify research, monitoring and funding needs; and
- with its partners, facilitate, expand, alter and/or adapt the LaMP work plan to best protect and restore the chemical, physical and biological integrity of Lake Erie.

Outlined in Table 9 are projects and programs that the Lake Erie LaMP plans to pursue over the next two years. The work plan is limited to those projects over which the Lake Erie LaMP has control, and does not include those programs implemented by partner agencies under other program mandates. However, LaMP partner programs are key to the successful implementation of the LaMP, and the LaMP partners are encouraged to develop, implement and track agency-specific work plans in support of LaMP goals.

Table 9: Lake Erie LaMP Work Plan 2002 – 2004

ECOSYSTEM OBJECTIVES AND INDICATORS

- Select candidate suite of ecosystem indicators and define quantifiable endpoints
- With partner agencies and stakeholders, develop regional actions plans in support of ecosystem management objectives and indicators
- Develop monitoring protocol for selected indicators
- Implement monitoring programs in selected watersheds to determine effectiveness of monitoring protocol

BENEFICIAL USES

- Assess the nature and extent of stresses contributing to beneficial use impairments and clearly identify where the use impairment is occurring
- Conduct a gap analysis to determine the adequacy of existing programs to restore beneficial uses
- Update status of Beneficial Uses Impairment Assessments as new information becomes available

HABITAT

- Conduct a binational bioregional planning assessment to promote and implement habitat protection and restoration projects
- Encourage the implementation of ecosystem and habitat restoration projects in tributaries to Lake Erie with a focus on ecological function/habitat quality along with habitat quantity
- Encourage partner agencies to incorporate monitoring of indicators selected for Lake Erie into habitat programs in the Lake Erie basin wherever possible
- Identify and support existing habitat (and fish and wildlife) management objectives for Lake Erie basin through the LaMP and promote the integration of LaMP habitat objectives into existing programs in the basin
- Encourage and promote stronger controls on key stressors impacting habitats in the Lake Erie Basin (e.g., land use and associated sediment/nutrient loadings through Smart Growth or other "sustainable growth" initiatives, control of exotic species)
- Identify fish and wildlife habitat research priorities through the Lake Erie Millennium Plan

SOURCES AND LOADINGS

- Continue to track the progress of the Great Lakes Binational Toxic Strategy in regard to actions that may reduce loadings of the Lake Erie pollutants of concern
- Continue to support implementation of PCB and mercury reduction activities identified in the PCB and mercury action plans in LaMP 2000
- Screen Canadian Lake Erie tributary sediments for critical pollutants, analyze the screening data to identify priorities for confirmatory sampling at tributaries showing elevated levels of the critical pollutants, and initiate track down projects as appropriate
- Ensure track down activities are coordinated with RAP efforts in both the U.S. and Canada

PUBLIC INVOLVEMENT

- Provide support to the Lake Erie Forum to assist in the achievement of their priorities:
  - public education and awareness of mercury in the Lake Erie Ecosystem
  - public education and awareness on the impacts of land use activities on Lake Erie including demonstrations in local communities
- Provide LaMP program and status of Lakes Erie ecosystem updates to the Lake Erie stakeholders through newsletters, brochures, workshops and conferences

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Section 12

Section 12: References

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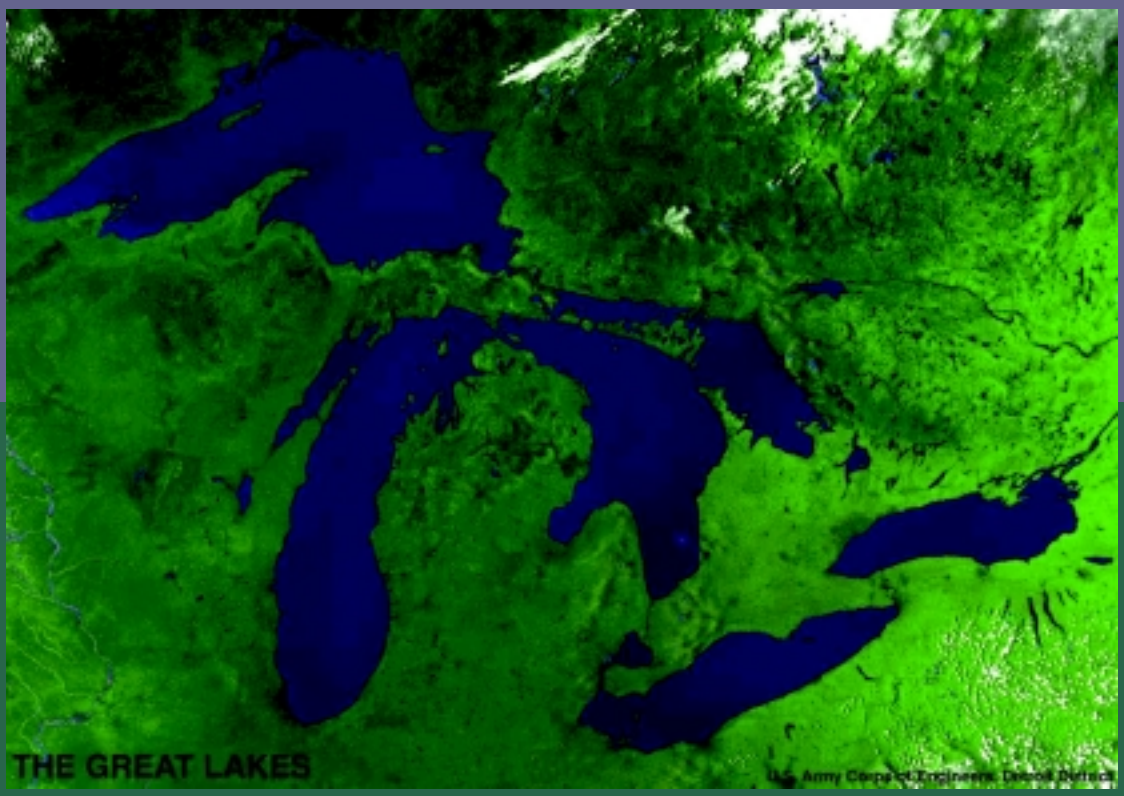

How to Get Involved

The LaMP 2002 report is also available on the Lake Erie LaMP website. Comments on the Lake Erie LaMP 2002 report or on the Lake Erie LaMP process can be submitted on-line. The report and comment form can be accessed at either: www.ec.gc.ca/glimr/lakes/erie/ ; or www.epa.gov/glnpo/lakeerie/ .

If you would like to receive the Lake Erie LaMP Update and other Lake Erie LaMP information as it becomes available, join the Lake Erie Network. Contact:

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