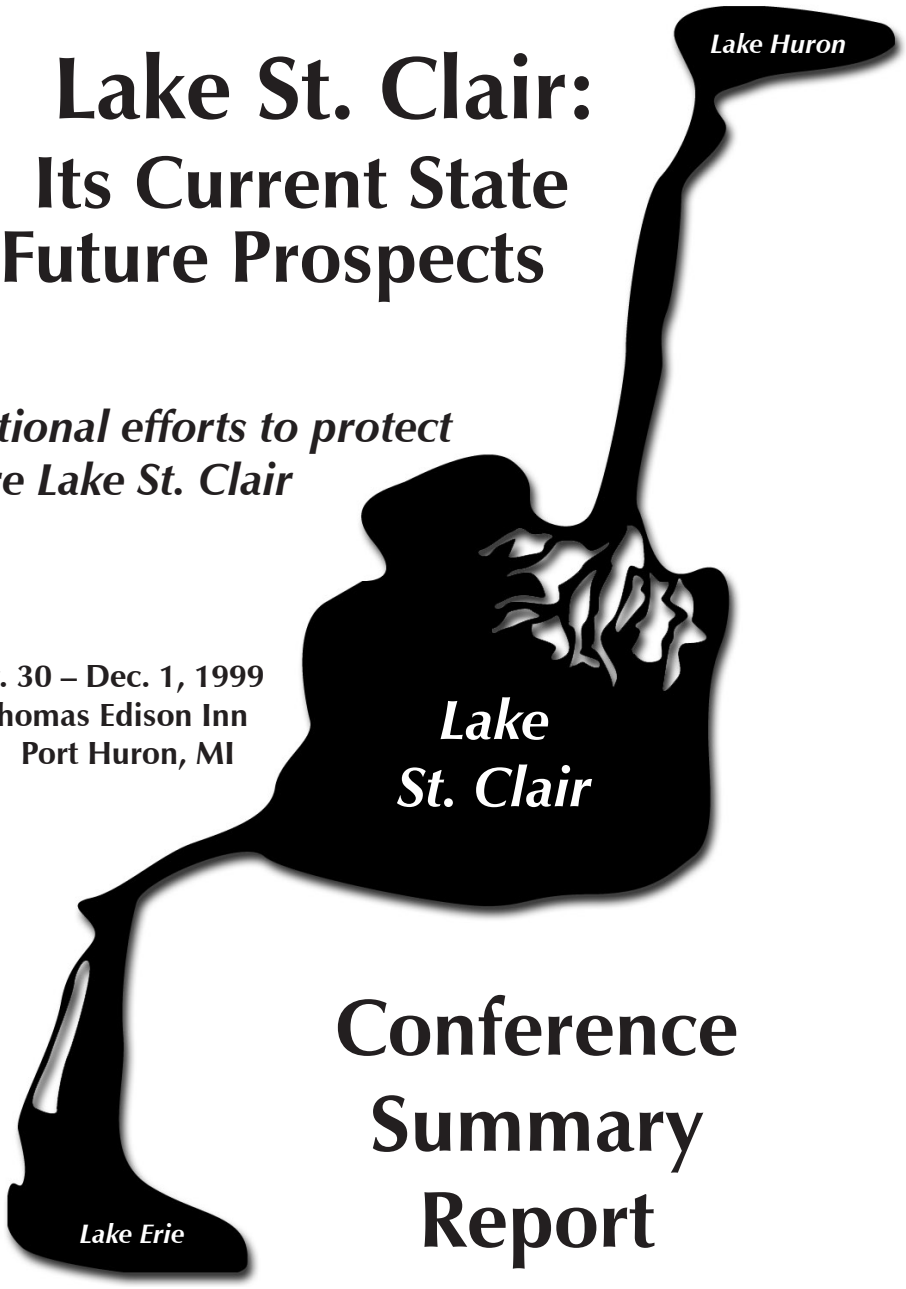
Lake St. Clair:
Its Current State and Future Prospects

Advancing binational efforts to protect and restore Lake St. Clair

Nov. 30 – Dec. 1, 1999
Thomas Edison Inn
Port Huron, MI



Conference Summary Report

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Executive Summary

On Nov. 30 - Dec. 1, 1999 more than 200 agency staff, elected officials, residents and other parties from the United States and Canada participated in a conference titled *Lake St. Clair: Its Current State and Future Prospects.* Held in Port Huron, Mich., the conference goal was to advance efforts to address the problems facing Lake St. Clair. Specific objectives included exchanging information on the state of the lake; discussing critical environmental issues; reviewing programs, policies and institutions responsible for managing the lake; and identifying actions, resources and collaboration needed to implement environmental improvements within the lake and its watershed.

The conference was funded by the U.S. Environmental Protection Agency, Region 5 and U.S. EPA, Great Lakes National Program Office, and coordinated by the Great Lakes Commission. More than two dozen U.S. and Canadian agencies, tribes/First Nations, municipalities, citizens organizations and business groups sponsored the conference and served on the conference steering committee.

The conference program included presentations on the full array of issues impacting Lake St. Clair as well as opportunities for focused input from the attendees. Breakout sessions solicited recommendations on the conference's four major topical areas: *Habitat and Biodiversity*; *Human Health, Beach Closures and Drinking Water*; *Loadings, Toxics, Transport and Sources*; and *Physical Conditions and Processes*.

This summary report was compiled by the Great Lakes Commission and approved by the conference steering committee as an accurate reflection of the conference discussions and a general statement on the principle challenges and opportunities facing the lake. Specific findings and recommendations may not necessarily reflect the views of individual committee members or participating agencies. The following are major findings from the conference:

Monitoring and Data Management: Researchers know what data they require but are concerned about monitoring programs and fragmented or inadequately shared data. More information is required about individual ecosystem components and their interaction with each other in order to develop adequate decisionmaking tools.

Resource Restoration and Protection: Historic and ongoing environmental impacts have substantially altered and degraded the Lake St. Clair ecosystem. These include physical, chemical and biological alterations introduced or exacerbated by human action.

Watershed Planning, Management and Interjurisdictional Coordination: There are initiatives and efforts already underway at all jurisdictional levels on both sides of the border in the Lake St. Clair watershed. In order to be most effective, however, these initiatives require integration both within the Lake St. Clair watershed and the Huron to Erie corridor.

Funding: Researchers and resource managers identified several areas of unmet funding needs. Priority areas included resources for long-term monitoring and data management, habitat restoration, contaminated sediment remediation and information/education efforts.

Source Reduction and Pollution Prevention: Failing urban infrastructure is a significant source of environmental degradation in the Lake St. Clair watershed. Issues of concern include combined sewer overflows, failing septic systems, illicit discharges and inadequate emission controls of mercury, PCBs and other toxic chemicals.

Enforcement and Compliance: Despite current regulations, penalties and enforcement actions, unacceptable pollution discharges and habitat losses continue.

Public Health: Identified pollutants in Lake St. Clair can potentially threaten human health. Primary routes of exposure include drinking water, fish consumption and recreational water contact.

Public Information and Outreach: Despite considerable public interest in Lake St. Clair, information/ education efforts are fragmented and there is a general lack of public understanding of the lake's ecosystem, particularly regarding the value of biodiversity and fish and wildlife habitat. This understanding, and associated public involvement in stewardship initiatives, is crucial to creating and implementing successful management efforts.

Findings and Recommendations

The following findings and recommendations are based on conference presentations and breakout session discussions. These sessions addressed several topics (*Habitat and Biodiversity*; *Human Health, Beach Closures and Drinking Water*; *Loadings, Toxics, Transport and Sources*; and *Physical Conditions and Processes)* and provided participants with an opportunity to identify points of consensus on the following items:

- *What are the issues that must be addressed in any effort to improve the environmental quality of Lake St. Clair and its watershed?*
- *For each issue or category of issues identified, what specific actions might be taken? What timeframe should they be pursued in and what resources and collaborative arrangements are needed?*

The results of these discussions were reported out in plenary session, followed by open discussion among all conference participants. This material was compiled by Great Lakes Commission staff and was subsequently reviewed by the conference steering committee. The findings and recommendations provide a general statement on the principle challenges and opportunities facing Lake St Clair and are offered as guidance to the binational Lake St. Clair management community. While they accurately reflect conference discussions, they may not necessarily reflect the views of individual steering committee members or participating agencies.

Resource Restoration and Protection

Findings: Historic and ongoing environmental impacts have substantially altered and degraded the Lake St. Clair ecosystem. These include physical, chemical and biological alterations introduced or exacerbated by human action.

Recommendations:

1) Prevent introductions of nonindigenous aquatic nuisance species and control those already present;
2) Restore impaired components of the ecosystem, especially wetland habitat; and
3) Mitigate human impacts via best management practices such as storm water control and buffer strips.

Source Reduction and Pollution Prevention

Findings: Failing urban infrastructure is a significant source of environmental degradation in the Lake St. Clair watershed. Issues of concern include combined sewer overflows, failing septic systems, illicit discharges and inadequate emission controls of mercury, PCBs and other toxic chemicals.

Recommendations:

1) Control discharges of airborne and effluent-discharged toxic chemicals at the source; and
2) Address failing septic systems, separate and combined sewers, and illicit discharges.

Enforcement and Compliance

Findings: Despite current regulations, penalties and enforcement actions, unacceptable pollution discharges and habitat losses continue.

Recommendations:

1) Review and assess land use and pollution control regulations to ensure that they are comprehensive and that associated penalties are adequate; and
2) Ensure that regulations are adequate and vigorously enforced.

Monitoring and Data Management

Findings: Researchers know what data they require but are concerned about monitoring programs and fragmented or inadequately shared data. More information is required about individual ecosystem components and their interaction with each other in order to develop adequate decision-making tools.

Recommendations:

1) Develop an integrated geographically and temporally sensitive water quality monitoring strategy to support sound resource management decision-making processes;
2) Assess the range and quality of existing habitat and the potential to restore valuable habitat;
3) Assess biodiversity and develop programs to maintain and enhance existing diversity; and
4) Assess the extent and impact of exotic invaders.

Watershed Planning, Management and Interjurisdictional Coordination

Findings: There are initiatives and efforts already underway at all jurisdictional levels on both sides of the border in the Lake St. Clair watershed. In order to be most effective, however, these initiatives require integration both within the Lake St. Clair watershed and the Huron to Erie corridor.

Recommendations:

1) Develop a management framework involving all U.S., Canadian and tribal/First Nation jurisdictions in the watershed with interests in land use planning, habitat and/or water quality;
2) Adopt common, binational water quality goals and monitoring methods; and
3) Prepare an integrated management plan that is sensitive to biodiversity, habitat quality and quantity, and other desirable environmental attributes.

Funding

Findings: Researchers and resource managers identified several areas of unfunded needs. Priority areas included resources for long-term monitoring and data management, habitat restoration, contaminated sediment remediation and information/education efforts.

Recommendations:

1) Explore the potential for a Lake St. Clair endowment similar to the Great Lakes Protection Fund or Lake Erie Protection Fund that could be funded creatively through licensing/user fees, fines and other sources;
2) Pursue funding for ongoing monitoring and surveillance efforts;
3) Pursue funding for land conservation and restoration; and
4) Restore or enhance funding to rural nonpoint source programs.

Public Health

Findings: Identified pollutants in Lake St. Clair can potentially threaten human health. Primary routes of exposure include drinking water, fish consumption and recreational water contact.

Recommendations:

1) Develop technology and identify the costs associated with removing toxic chemicals in drinking water treatment plants;
2) Establish guidelines, consistent on a binational basis, for consumption of sport-caught fish and commercially available fish;
3) Establish a binational risk assessment for fish consumption advisories;
4) Recommend purchasing practices for commercial fish;

5) Improve engineering and associated analyses related to the siting and design of drinking water intakes;
6) Enhance the quality and make better use of meteorological data in assessing sources and impacts of bacteria in Lake St. Clair and its tributaries;
7) Improve testing methods for bacteria, particularly in relation to the timeliness of the results and their utility in identifying threats to public health at beaches and other locations.
8) Enhance the public's understanding of the connection between drinking water quality and uses of water; and
9) Conduct epidemiological studies to track the numbers and causes of water-related illness in the Lake St. Clair watershed.

Public Information and Outreach

Findings: Despite considerable public interest in Lake St. Clair, information/education efforts are fragmented. There is a general lack of public understanding of the Lake St. Clair ecosystem, particularly in relation to the value of biodiversity and fish and wildlife habitat. This understanding, and associated public involvement in stewardship initiatives, is crucial to creating and implementing successful management efforts.

Recommendations:
1) Develop a targeted public education program to promote understanding of watershed/ecosystem processes and to highlight linkages between land use, water quality and public health;
2) Increase public awareness of fish consumption advisories through alternative dissemination methods for public information materials, including distribution in non-traditional areas, such as boat launch sites;
3) Develop a web site that brings together information on the range of Lake St. Clair issues and the resources available to address them; and
4) Develop a biodiversity atlas for Lake St. Clair;
5) Develop an environmental education curriculum for primary, middle and secondary educators, including resources such as a professional video, teacher brochures, classroom presentations, seedling labs, biodiversity information, and opportunities for volunteer monitoring; and
6) Develop more and better media coverage of Lake St. Clair in newspapers and television;

Miscellaneous Recommendations:

1) Elevate the profile of and attention to Lake St. Clair via designation as an Area of Concern or through other means; and
2) Adopt and pursue a position on water quantity management that protects the Lake St. Clair ecosystem.

Overview of Lake St. Clair

Lake St. Clair is a vital shared resource between the United States and Canada that provides substantial ecological, recreational and commercial benefits to the binational community. Lake St. Clair is located between Lake Huron to the north and Lake Erie to the south. The St. Clair River flows into the lake from the north and the lake in turn drains into the Detroit River from the southwest, providing a linkage to Lake Erie. The lake is approximately 26 miles long and 24 miles wide, with a surface area of 670 square miles and 62 miles of shoreline. The lake's maximum natural depth is 21.3 feet. The St. Clair River delta covers 240 square miles at the northern end of the lake and is the largest coastal delta in the Great Lakes. Inflow to Lake St. Clair averages approximately 183,000 cubic feet per second, approximately 98 percent of which enters from Lake Huron through the St. Clair River. The remaining inflow stems from the watersheds of five major rivers covering 9,300 square miles: the Clinton, Belle and Black rivers on the U.S. side; and the Sydenham and Thames rivers on the Canadian side. The lake's large inflow relative to its volume of water results in water being exchanged completely every five to seven days.

Lake St. Clair is home to numerous plant and animal species. The St. Clair River delta at the northern end of the lake is particularly important for migrating waterfowl and the Great Lakes fishery. Well over one million waterfowl use the area each year. The lake's fishery resources have changed over time due to impacts from wetland losses, exotic species, pollution discharges and habitat alterations. The lake is considered important from a biodiversity perspective. The lake was identified as a Biodiversity Investment Area in the 1996 State of the Lakes Ecosystem Conference (SOLEC) *Land by the Lakes* background paper. The SOLEC 1998 background paper *Coastal Wetland Ecosystems* identified Lake St. Clair and the adjacent Detroit River as priority "eco-reaches" due to the habitat they provide for a large number of plant and animal species, but especially because there are so few wetlands remaining along these coastal stretches.

From a recreational perspective, Lake St. Clair is among the most heavily utilized portions of the Great Lakes. With nearly one million registered boats, Michigan has more than any other state, and the total is increasing by almost ten percent annually. More than 150,000 of these boats are registered in the three U.S. counties adjacent to Lake St. Clair, which include more than 200 marinas. The annual economic value of boating-related activities in the three-county area is estimated to be more than $260 million. The sport fishery on Lake St. Clair is substantial, with 1.5 million fish taken from the lake annually with an annual value of $30 million. Sport fishing on Lake St. Clair accounts for 33 percent of the total Great Lake fish catch and 48 percent of the *entire* Great Lakes sport fishing effort.

Navigation channels in Lake St. Clair represent a vital link in the Great Lakes-St. Lawrence transportation system. In recent years waterborne commerce on Lake St. Clair has ranged between 60 and 70 million tons spread over an average of 3,000 vessel movements. Less than a third of this traffic is of Canadian origin and destination and about three-quarters of the tonnage is downbound (toward the Detroit River). The principal commodities in order of volume are iron ore, limestone, coal and grain. Finally, Lake St. Clair is the source of drinking water for more than 4.5 million people in southeastern Michigan.

However, just as it provides a wide array of beneficial uses, Lake St. Clair also suffers from a commensurate range of adverse, human-related impacts. Suburban sprawl in the U.S. portion of the Lake St. Clair watershed has contributed to serious problems from nonpoint source pollution, combined sewer overflows and leaking septic systems. Beach closures due to dangerous levels of *E. coli* bacteria are increasingly common. Shoreline modifications, agricultural activities and waterfront development have altered natural habitat and dramatically reduced the acreage of ecologically vital wetlands. The fragmentation and isolation of remaining habitat negatively impact fish and wildlife populations and represent a significant, long-term threat to regional biodiversity. An important resource for understanding these and other impacts to Lake St. Clair is the *Upper Great Lakes Connecting Channels Study*, prepared by the U.S. Environmental Protection Agency and Environment Canada in 1988.

Pollution discharges from industry have also impacted water quality in Lake St. Clair and the health of fish and wildlife caught there. Industry in the Sarnia, Ontario area and in the Clinton River watershed, in particular, has contributed heavy metals, PCBs and other toxic pollutants to the lake and its sediments. Intensive agricultural activity in the Canadian portion of the watershed has led to elevated phosphorus levels and related impacts. Fish consumption advisories are in place for several fish species caught in U.S. and Canadian waters.

Finally, perhaps the most dramatic environmental impacts on Lake St. Clair in recent years have stemmed from nonindigenous aquatic nuisance species, including the zebra mussel, Eurasian watermilfoil, purple loosestrife, round goby and ruffe, to name only the most prominent "exotic species" affecting the lake. In fact, Lake St. Clair has the dubious distinction of being the place where many of these species were first detected. The zebra mussel is generally considered responsible for the extraordinary increase in water clarity over the past decade. This significant change contributed to a 400 percent increase in aquatic vegetation between 1985 and 1995 and a shift in the fishery. Excess aquatic vegetation has caused serious problems for boaters and waterfront property owners. The full impact of exotic species, including more recent arrivals such as the round goby and ruffe, is still becoming apparent.

In short, Lake St. Clair is a very important resource ecologically and economically. It also is a very dynamic system facing a complex array of anthropogenic stresses. Continued population growth and development along the shores of Lake St. Clair and within its watershed promise only greater use of and demands from the resource and a corresponding increase in the intensity of stresses and environmental impacts on the lake.

In recent years, pollution discharges, changing water levels and impacts from exotic species have resulted in substantial local concern over the health of Lake St. Clair and threats to the beneficial uses it provides to residents. Numerous grassroots initiatives are underway to address critical impacts to Lake St. Clair and its watershed. The Macomb County Water Quality Board and St. Clair County's Blue Water Task Force on Water Quality are two notable examples in this regard. On a broader level, the Lake Huron Initiative, coordinated by the Michigan Office of the Great Lakes, and the Lake Erie Lakewide Management Plan, coordinated by Environment Canada and the U.S. Environmental Protection Agency, provide comprehensive structures for identifying environmental problems facing those lakes and coordinating management efforts and remediation activities. The St. Clair, Clinton and Detroit River Remedial Action Plans (RAP) are facilitating similar processes for the localized problems in those areas.

In its *Ninth Biennial Report on Great Lakes Water Quality*, the International Joint Commission, which oversees implementation of the Great Lakes Water Quality Agreement and reviews progress in addressing the Areas of Concern (AOC) designated pursuant to that agreement, recommended that the U.S. and Canadian federal governments review environmental conditions on Lake St. Clair in order to consider its designation as an AOC. This recommendation, and the fact the Lake St. Clair is situated between two designated AOCs but has not itself been designated as such, was noted by many conference participants. In their responses to the IJC report, the U.S. and Canadian governments stated that they did not believe Lake St. Clair warranted designation as an AOC and that the lake could best be addressed through existing programs. However, the agencies have recognized the strong local interest in the lake's problems and, in response, are supporting a research project being undertaken by the Great Lakes Commission to assess management responsibilities for Lake St. Clair and recommend a framework for a binational Lake St. Clair management initiative. Excerpts from the IJC report and the U.S. and Canadian responses are provided in Appendix E.

The 1999 Lake St. Clair conference highlighted the varied issues and challenges facing the lake and its watershed, and the many efforts underway to address them. However, the conference also underscored the lack of a unified and comprehensive management structure designed specifically to assess and coordinate binational efforts to protect, restore and enhance the Lake St. Clair ecosystem. Long-term conference outcomes will likely be directed toward this end.

Conference Background and Next Steps

Conference Background

In June 1999 the U.S. Environmental Protection Agency (U.S. EPA), Region 5 and its Great Lakes National Program Office (GLNPO) proposed a forum to assess the state of Lake St. Clair and identify prospective actions to address environmental problems impacting the lake. The proposed forum stemmed from the agency's recognition of the strong local interest in Lake St. Clair and concern over environmental conditions in the lake and its watershed. A broad array of U.S. and Canadian stakeholders was invited to serve on a steering committee to plan the forum (see Appendix D for a list of steering committee members). The steering committee met for the first time on July 14 and numerous subsequent meetings were convened leading up the final conference.

Staff from U.S. EPA's Southeast Michigan Initiative and Great Lakes National Program Office explained that the agency wished to discuss current environmental concerns and issues facing Lake St. Clair; assess roles and responsibilities for managing the lake; and build consensus on the actions needed to address the problems facing the lake and its watershed. The forum was also intended to build on recommendations made in the 1997 report of the Macomb County Blue Ribbon Commission on Lake St. Clair. Steering committee members voiced strong support for the proposed forum and committed to assisting in planning and coordinating the event. U.S. EPA provided funding to the Great Lakes Commission to coordinate logistical arrangements for the conference.

The steering committee agreed that the overall goal of the conference would be to advance efforts to address the problems facing Lake St. Clair. Specific objectives included exchanging information on the state of the lake; discussing critical environmental issues; reviewing programs, policies and institutions responsible for managing the lake; and identifying actions, resources and collaboration needed to implement environmental improvements within the lake and its watershed. The conference was targeted at U.S. and Canadian resource managers, local officials, elected representatives and other stakeholders involved in implementation efforts to address the environmental problems facing Lake St. Clair.

The conference was held on Nov. 30 and Dec. 1, 1999 at the Thomas Edison Inn in Port Huron, MI. An initial notice was mailed in early October to more than 2,000 individuals involved in environmental/resource management efforts in the Lake St. Clair region. The distribution list included U.S. and Canadian agencies, citizens organizations, business/industry groups, elected officials, tribal authorities/First Nations, university researchers, and public advisory forums. The latter category encompassed members of public advisory councils for the Clinton, Detroit and St. Clair river Areas of Concern and public forums for the Lake Erie Lakewide Management Plan and the Lake Huron Initiative. The complete conference flyer, including the program and registration form, was distributed in early November. The conference was announced via several email lists, including *GLIN-Announce* and the monthly calendar of the Michigan Department of Environmental Quality, and a press release was distributed to media outlets in Michigan and Ontario.

The conference program included presentations on the full array of issues impacting Lake St. Clair as well as opportunities for focused input from the attendees. Following opening remarks, the conference began with a plenary session titled *The State of Lake St. Clair: Historical Perspectives and Existing Conditions*, which provided conference participants with a common "baseline" understanding of Lake St. Clair, including its physical conditions, land use, fisheries, and recreation and economic uses. During the next plenary session, titled *Research Policy and Management Responsibilities for Lake St. Clair*, representatives from agencies involved in managing Lake St. Clair reviewed their mandates and responsibilities and identified priorities, challenges and unmet needs. U.S. Congressman David Bonior provided the luncheon keynote address.

In the afternoon of the conference's first day, four sessions were offered concurrently and repeated, allowing attendees to participate in two of the four sessions. The four sessions provided an overview of the

major issues facing lake St. Clair, including *Habitat and Biodiversity*; *Human Health, Beach Closures and Drinking Water*; *Loadings, Toxics, Transport and Sources*; and *Physical Conditions and Processes*. Within each session, experts addressed discrete topics within the overall issue area.

On the second day of the conference participants convened in breakout sessions aligned with the topical areas from the previous day's concurrent sessions. The purpose of the sessions was to identify outstanding issues, gaps and unmet needs, action items, resources and collaborators and a timeframe for action. Through facilitated discussion, participants identified points of consensus on the following items:

- *What are the issues that must be addressed in any effort to improve the environmental quality of Lake St. Clair and its watershed?*
- *For each issue or category of issues identified, what specific actions might be taken? What timeframe should they be pursued in and what resources and collaborative arrangements are needed?*

The results of these discussions were reported out in plenary session, followed by open discussion among all conference participants. The full conference program is included in Appendix A. Notes taken during the discussion sessions are provided in Appendix B. Abstracts provided by the conference speakers are provided below in section five.

The conference was attended by more than 200 individuals from the U.S. and Canada (the participants list is provided in Appendix C). Elected officials and agency staff from communities adjacent to Lake St. Clair were particularly well represented, attesting to the strong local interest and concern over conditions in the lake. Media coverage of the conference was strong and numerous stories appeared in local newspapers and radio and television stations.

Staff from the Great Lakes Commission compiled input received at the conference and developed the findings and recommendations included above in section two. This material was reviewed and approved by the conference steering committee. The findings and recommendations reflect the major themes that emerged from the conference and a general consensus on priorities based on discussions and input from the conference participants. This material is intended as guidance for the binational Lake St. Clair management community as it addresses the many issues affecting Lake St. Clair and its watershed.

Next Steps

The conference summary report and findings and recommendations will be distributed to all conference participants and other interested parties. It also will be made available online via the Great Lakes Information Network. The steering committee and other participants have suggested that the conference be convened on a biennial basis to review new information on Lake St. Clair, evaluate progress in addressing environmental problems and reassess management priorities. In addition, the organizers of the State of the Lake Ecosystem Conference (SOLEC), a biennial forum for assessing environmental conditions in the Great Lakes, have expressed a desire for Lake St. Clair to be formally considered at the next SOLEC conference, scheduled for October 2000 in Hamilton, Ontario. Together with U.S. EPA and the other steering committee members, the Great Lakes Commission will pursue these opportunities.

Between the conference and the release of this report, a number of major developments have occurred related to Lake St. Clair:

- U.S. EPA, Great Lakes National Program Office has committed to helping support a biennial conference on Lake St. Clair to review environmental conditions and prospective management actions.
- U.S. EPA, Environment Canada, the Ontario Ministry of the Environment and the Michigan Department of Environmental Quality have approved a formal resolution through which they agreed to an undertaking with respect to Lake St. Clair and to address the lake within the existing Four Agency Framework of Roles and Responsibilities for Implementation of the Detroit River, St. Clair

River and St. Marys River Areas of Concern Shared Remedial Action Plans. A copy of this resolution is included in Appendix F.

- The October 2000 SOLEC conference will feature a plenary presentation and breakout session on the St. Clair River-Lake St. Clair-Detroit River corridor that will highlight conditions on, and restoration priorities for, Lake St. Clair.

- The Great Lakes Commission, with support from U.S. EPA, is undertaking a research project to assess management responsibilities for Lake St. Clair for purposes of recommending a framework for a binational Lake St. Clair management initiative.

- Representatives from several municipalities along the U.S. shore of Lake St. Clair are exploring options for developing a forum to coordinate programs, policies and protection efforts related to the lake.

- The Wildlife Habitat Council, through the St. Clair River Waterways For Wildlife Project has been provided a grant from U.S. EPA, Great Lakes National Program Office, to develop a biodiversity atlas for the St. Clair River-Lake St. Clair-Detroit River corridor.

- As part of the Four Agency Framework for the binational Areas of Concern, the U.S. and Canadian federal and state/provincial agencies are assessing monitoring efforts in the St. Clair River-Lake St. Clair-Detroit River corridor to enhance communication, collaboration, consistency, effectiveness and data access related to ecosystem monitoring.

- The Great Lakes Commission has established a web page on the Great Lakes Information Network dedicated to Lake St. Clair (www.great-lakes.net/lakes/stclair.html). The conference summary will be made available on this site and links will be established to other resources and stakeholders related to Lake St. Clair.

- The U.S. Army Corps of Engineers has been provided with funding to prepare a comprehensive management plan for Lake St. Clair and the St. Clair River in coordination with state and local governments and Canadian federal and provincial authorities. As authorized, the plan is to include the identification of the causes and sources of environmental degradation; continuous monitoring of organic, biological, metallic and chemical contamination levels; timely dissemination of information on contamination levels to public authorities, other interested parties and the public; and recommendations for potential restoration measures.

Numerous additional initiatives are undoubtedly underway in the Lake St. Clair watershed.

These efforts represented an important, collective response to the problems facing Lake St. Clair and illustrate the heightened level of concern for the lake's health that has emerged in recent years. A notable consensus of the conference participants was the need for a binational process for integrating the wide array of local, state/provincial, tribal/First Nation and federal management efforts into a rational and collective framework. A Lake St. Clair management initiative, in whatever form it eventually takes, will build on the success of the conference and the substantial momentum it generated while addressing a pronounced unmet need in the binational management regime for the corridor linking Lake Huron and Lake Erie.

Abstracts submitted by the conference speakers are provided below. They appear in the order in which they were listed in the conference agenda. Contact information for the authors is provided following the presentation title. Contact information for speakers who did not submit abstracts is provided at the end of this section.

The State of Lake St. Clair: Historical Perspectives and Existing Conditions

Lake St. Clair: A Geologic and Land Use Introduction

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INTRODUCTION

Lake St. Clair is often referred to as the sixth Great Lake, though it is of relatively small size, and lacks the deep-water characteristics of the five Great Lakes. In terms of size, the lake occupies 1,114 sq km or about 400 sq miles (Bolsenga & Herdendorf 1993), i.e., it is approximately the size of adjacent Macomb County, MI. The lake is shaped like a heart, with the St. Clair River delta located at the northcentral portion of this water body (Figure 1). The finger-like distributaries of the delta distribute the inflow from the St. Clair River mainly to the south and southwest toward the central and western portions of the lake.

View Figure 1: Geographics Setting of Lake St. Clair *(large pdf file)*

Together, the St. Clair River, Lake St. Clair and Detroit River comprise the connecting channels between Lake Huron and Lake Erie. Lake Huron, which is one of the three upper Great Lakes, is of exceptional quality, and this relatively high quality water exerts a strong influence on the ecology of Lake St. Clair (Edsall **et al**. 1986). The St. Clair River, which is actually a strait and not a true river, supplies about 97% of the annual water volume of Lake St. Clair (Schwab **et al**. 1989). However, other river, creek, and drain inputs along the margins of Lake St. Clair do provide some input which does affect the water quality and lake volume which consists of 3.4 cubic kilometers.

Lake St. Clair has an average water depth of 3.3 m (11 feet), with a maximum depth of 6.4 m (21 feet). Bottom scour by wave action tends to be limited to the shorelines areas. As part of the Great Lakes/St. Lawrence Seaway, which was opened in 1959, an 8.23 m (27 foot) deep navigation channel was dredged diagonally through the lake, and this channel trends just west of the International Boundary. The navigation channel extends through the lake from the mouth of South Channel of the St. Clair River to the head of the Detroit River (Coordinating Committee 1988).

GLACIAL ORIGIN

At approximately 9,000 years before present, i.e., following the Lake Chippewa-Lake Stanley low water period, the St. Clair River was scoured and the St. Clair River Delta was deposited in what is now Lake St. Clair (Dorr & Eschman 1970). As water levels in the connecting corridor between ancestral Lake Huron and Lake Erie rose, the hydrologic connection between the two bodies was established and the delta was created (Raphael & Jaworski 1982). This delta is now part of the wetland complex that provides primary production and ecosystem support to Lake St. Clair.

Lake St. Clair is located on the lake plain of the modern Great Lakes. Lake plain sediments are characterized by lacustrine silts and blue clay deposits which are overlain by surficial sand sediments. The distributaries of the St. Clair River delta are entrenched in the silty clays, and hence channel migration or shifting is difficult. The lake plain soils near the lake supported agricultural development along the lake, but on the United States' side agriculture has given way to residential development. Conversely, on the Canadian side agricultural land use has continued, and the water quality of Thames and Sydenham Rivers reflects that land usage.

FLOW-THROUGH SYSTEM

The residence time of water in Lake St. Clair averages 7 days (Schloesser **et al**. 1996), but can vary from 2 to 30 days, depending on wind direction and circulation patterns (Schwab **et al**. 1989). If the water flows through the navigation channel, which is maintained by the U.S. Army Corps of Engineers, the time the water remains in the lake is perhaps just 2 days. However, this residence time increases along the shorelines when there is ice cover or dense beds of submersed aquatics. Such a flow-through ecosystem favors filtering organisms such as the invasive (i.e., adventive) zebra mussel.

Wind-generated currents affect the residence time of the water in the lake and establish gyres. Winds from the west, along with the dominance of flow in the navigation channel, set up a clockwise gyre on the United States' side of the lake, while a counter clockwise pattern prevails on the Canadian side (Ibrahim & McCorquodale 1985). These changing water circulation patterns provide for the mixing of water masses in the lake, and can increase the residence time of the water therein.

WATER QUALITY OF THE LAKE

As evidenced by Table 1, the water quality of Lake St. Clair is representative of a mesotrophic lake system. The pH of the water averages about 8.27, and the dissolved oxygen is near saturation. Total phosphorus is somewhat high, i.e., at 0.044 mg/l. Though no data for nitrate nitrogen are present in the table, other data sources indicate levels in the water column probably range between 0.360 and 0.533 mg/l (Edsall 1996 Unpub.). Secchi disk depths have also increased since 1986 due to zebra mussel filtering activity. Thus, except at the shorelines where rivers outfall, or where there are drains, pumping stations, and combined sewer overflows (CSOs), the water quality in Lake St. Clair is generally regarded as very acceptable.

AQUATIC PLANT ACCUMULATION IN 1994

During the month of July 1994 large, floating mats of submersed aquatic plants and algae began to appear along the western shoreline of Lake St. Clair. Waterweed (*Eloedea canadensis*) and green algae were especially abundant in the rafted plant material (U.S. Army Corps of Engineers 1996). On southern and southeastern shorelines of the lake, balls of plant material were commonly seen at that time (Pers. Commo. Ronald Griffiths). Aerial photographs taken by the Army Corps of Engineers show the linear rafts of plant material as well as long booms that marina operators brought out in an attempt to prevent blockage of marina entrances and boat slips.

By August 1994 these rafts of floating plant masses began to turn black and decompose. The U.S. Army Corps of Engineers was eventually called in to help remove the rafts of material from the shorelines, especially at the Metropolitan Beach of the Huron-Clinton Metropolitan Park Authority (HCMA). Research by Edsall 1996 as well as by Wilcox & French 1996 revealed that plant nutrients in the water column and in the sediments were high enough to produce the growth of the plant material. Other research by Fox (1995) indicated that storms during the early summer could have caused the detachment of the submersed plants, and using a drift model, showed the possibility of rafting on the western shorelines.

Another potential cause for the 1994 accumulation of floating plant mats were the discharges of the combined sewer overflows (CSOs) along the Red Run and near the mouth of the Clinton River. As a result of the Section

208 water quality studies in the 1970s, which focused on stormwater impacts, the U.S. Environmental Protection Agency (U.S. EPA) encouraged the City of Detroit and other nearby municipalities to connect their stormwater pipes to the sanitary sewer interceptors. In addition, at selected locations, CSOs were installed to relieve excessive flows during wet weather when the Detroit Waste Water Treatment Plant (DWWTP) was unable to keep up with the processing of the inflows (Manny **et al**. 1988).

Table 1. Water Quality of Lake St. Clair

Parameter	Units	St. Clair	Lake	Detroit	Western	Central	Eastern
Water Temperature	C	11.88E	18.85E	14.58E	17.27E	14.85E	14.71E
Secchi depth	m	0.4	1.5	1.0	0.8	3.0	4.3
Dissolved oxygen (D.O.)	ppm	10.4	9.5	9.3	9.8	9.4	9.9
D.O. percent saturation	%	97.4	102.0	91.9	98.1	90.6	96.6
Conductivity at 25 C	umhos/cm	329	224	256	282	298	304
Dissolved solids	ppm	142.7	134.6	140.3	193.7	211.2	197.6
Suspended solids	mg/l	21.62	12.14	15.42	19.86	6.63	5.32
Alkalinity, total	mg/l	91.6	81.6	83.4	82.3	89.8	103.9
Alkalinity,	mg/l	-------	-------	-------	4.2	3.7	-------
pH	SU	8.09	8.27	8.03	8.42	8.23	8.26
Calcium, total	mg/l	51.2	29.1	29.8	34.4	39.7	31.3
Magnesium, total	mg/l	18.2	7.6	7.5	7.6	9.5	8.8
Potassium, total	mg/l	3.2	1.0	1.0	1.2	1.4	1.3
Sodium, total	mg/l	47.4	4.9	6.1	8.9	10.1	9.2
Chlorides, total	mg/l	20.1	8.1	17.2	-------	24.4	21.6
Sulfates, total	mg/l	16.6	16.7	16.1	32.7	25.7	25.5
Fluoride, total	mg/l	0.12	0.12	0.11	0.24	0.16	0.20
Silica, total	ug/l	1.11	0.72	0.83	-------	-------	0.32
Ammonia, dissolved	ug/l	0.018	-------	0.047	0.061	0.023	0.017
Nitrate + nitrite, diss.	ug/l	0.290	-------	0.300	0.325	0.165	0.263
Phosphorus, total	ug/l	-------	44.5	-------	-------	29.1	20.7
Phosphorus, dissolved	ug/l	11.9	8.1	33.8	29.3	11.8	8.1
Phosphorus, ortho	ug/l	12.2	-------	12.1	9.2	5.8	3.4
Chlorophyll a	ug/l	11.9	4.7	3.4	13.5	5.6	3.1

Source: Bolsenga & Herdendorf 1993.

Another potential cause for the 1994 accumulation of floating plant mats were the discharges of the combined sewer overflows (CSOs) along the Red Run and near the mouth of the Clinton River. As a result of the Section 208 water quality studies in the 1970s, which focused on stormwater impacts, the U.S. Environmental Protection Agency (U.S. EPA) encouraged the City of Detroit and other nearby municipalities to connect their stormwater pipes to the sanitary sewer interceptors. In addition, at selected locations, CSOs were installed to relieve excessive flows during wet weather when the Detroit Waste Water Treatment Plant (DWWTP) was unable to keep up with the processing of the inflows (Manny **et al**. 1988).

Macomb County was utilizing five CSO basins that discharged a mixture of stormwater and sewage water into Lake St. Clair. These CSO facilities are known as the Chapatron, Martin, Milk River, St. Clair Shores, and Twelve Towns Basins. During the spring of 1994, it was reported that an estimated 500 million gallons

of improperly treated stormwater and sewage were discharged into Lake St. Clair from these five basins (Jaski 1994). These wet weather CSO discharges, along with illegal sewer connections to storm drains and failing private septic systems, all contribute to the nutrient loading of the lake. However, the current CSO concern appears to be in regard to fecal coliforms, low dissolved oxygen and other water quality degradation problems, as opposed to the fertilization of the bottom sediments in regard to rooted aquatic plant growth.

COMMERCIAL SHIPPING AND ZEBRA MUSSELS

The navigation channel, which trends through Lake St. Clair, is the commercial shipping channel that connects the upper Great Lakes with the lower Great Lakes of the Great Lakes/St. Lawrence Seaway System. In 1986 an ocean-going ship from the Black Sea discharged some ballast water in order to move through the 8.2 to 8.8 m deep navigation channel of Lake St. Clair (Pers. Commo. Ronald Griffiths). This ballast water probably contained larvae of the zebra mussel, and once introduced, this filter-feeding mollusk spread rapidly in Lake St. Clair. By 1994 the mussels had crossed the navigation channel and invaded the waters of western Lake St. Clair. Colonization of the lake by this invasive, exotic species has increased the transparency of the water body, and decreased the chlorophyll a content as well (Leach 1993).

LAND USE IMPACTS

It was in Lake St. Clair that the concern for wetland loss was accentuated in Michigan. St. John's Marsh, in the St. Clair River Delta, and the Blue Water development near the Clinton River, were two wetland areas that caused great controversy and legal action during the 1970s. The U.S. Army Corps of Engineers and the Michigan Department of Natural Resources (now MDEQ) both denied the venetian blind type dredging of wetlands for residential development that was taking place in St. John's Marsh. Moreover, that type of dredge and fill was causing huge wetland losses along the inland lakes and streams all over Michigan. At present, Michigan is only one of two states in the United States with a state-wide wetland protection statute.

View Figure 2: Infrared image of Lake St. Clair *(large pdf file)*

On the Canadian side, agricultural land use adversely affects the lake, particularly the nearshore environments, via drainage from the agricultural fields. See Figure 2 (Infrared Image of Lake St. Clair). This image shows that farm fields in western Ontario, which border Lake St. Clair, are being intensively cultivated for the production of corn, tobacco, tomatoes and other crops. Some of the land near the St. Clair River delta has been drained for crop land, and pumping stations are needed to de-water the fields. During rain events, suspended sediments, farm fertilizers, and herbicides drain into the lake per the Syndenham River and Thames River. Agricultural drainage in the Thames River is important in that this stream was formerly a most important Walleye spawning stream. In addition, a large area of dense submersed aquatic plant growth occurs south of the Canadian side of the delta, and this growth area may reflect the nutrient loading from the nearby agricultural fields in Ontario.

View Figure 3: Increase of residential development along Lake St. Clair *(large pdf file)*

On the United States' side of Lake St. Clair, the land use concern is in regard to fairly rapid residential development in Macomb County that is spreading into St. Clair County (Figure 3). In response to suburban development, the Drain Commission of Macomb County has been deepening the drains in order to provide increased detention in these watercourses. By excavating a double trapezoid shape in the drains, these watercourses facilitate local drainage and detain a larger volume of stormwater than on-site stormwater detention basins.

Without drain improvements and pumping stations, the lake plain could not be developed for residential use as fully or with basements. Pumping stations along Jefferson Highway and other roadways near the lakeshore provide for the needed stormwater removal. This stormwater drainage severely degrades the local creeks and drains as well as the nearshore area of Lake St. Clair, particularly Anchor Bay. Also, the Health

Department of Macomb County has been sampling the drains in order to identify failing on-site private septic systems that are causing fecal coliform outbreaks and nutrient loading of local watercourses and county-designated drains.

IMPORTANCE OF THE ST. CLAIR RIVER DELTA WETLANDS

The wetlands of the delta are an essential part of the Lake St. Clair ecosystem. The delta, with its distributaries, distributes the inflow water from the St. Clair River in several directions, particularly to the United States' portion of the lake. In spring the water of the wetlands warms up more quickly than the water mass of the open lake. As the phytoplankton and zooplankton populations grow, fish are drawn not only to the warmer waters, but to the increased food production in the deep water marshes. Local cuts in the distributary channels allow for the hydrological connections to the bays and marshes, which further increases the significance of the deltaic wetlands to the ecology of Lake St. Clair.

Muscamoot Bay on Harsens Island is recognized as an important fish spawning and fish nursery area. However, unlike Dickinson Island, much of Harsens Island is diked and managed by the Michigan DNR for waterfowl hunting, and not for the fishery of Lake St. Clair. Also, Harsens Island is currently being subjected to continuing development threats due to its current zoning for residential use and the undermapping of the wetlands therein. On the Canadian side, augmentation of the flows down old distributary channels, including Chematogan Channel, could perhaps increase the connectivity of those important wetlands.

SUMMARY

Lake St. Clair is a mesotrophic lake that is relatively productive. Its flow-through waters, which derive from Lake Huron, along with the deltaic wetlands, help explain its productivity. Other speakers at this workshop will discuss, in detail, the fisheries value and other qualities of the lake. However, there are land use concerns that include residential expansion and drain deepening on the western side, and intensive agricultural usages on the eastern side of the lake.

This small lake within the connecting channel between Lake Huron and Lake Erie can remain productive, providing the adjacent land uses are managed properly. This proper management includes the protection of the St. Clair River delta wetlands, including those on Harsens Island, along with improved stormwater and agricultural runoff control. At present, it is uncertain whether the existing policies and regulations of both countries can maintain the current ecological conditions of this small, but valuable lake.

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Lake St. Clair – A Review of its Habitat, Fish Community, Fisheries and Current Issues

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Lake St. Clair is a very important system, both ecologically and economically. It is also a very dynamic system, undergoing dramatic change in the last 10 years, with many issues confronting it including contaminants, introduced species, and changes in the habitat and fish community.

The habitat of Lake St. Clair includes delta marshes and wetlands which fringe its shores. They are among the most productive in the Great Lakes and provide vital habitats for migratory waterfowl, furbearers, and fish and important hydrological and ecological functions, such as fish spawning and nursery habit. The fish community is largely coolwater species: walleye, yellow perch, white bass, sturgeon and muskellunge, and warmwater species: small- and largemouth bass and sunfish. Some species, e.g. walleye, are migratory and intermingle with stocks in the St. Clair River, Lake Huron, the Detroit River and Lake Erie.

The recreational fishery on Lake St. Clair has become the most intensive in south-western Ontario and south-eastern Michigan. In the 1980's the combined Michigan and Ontario summer and winter fisheries provided nearly 2.5 million hours of fishing annually and nearly 5.0 million hours when the St. Clair and Detroit River fisheries were included. The combined Michigan and Ontario average annual harvest was 1.5 million fish. Walleye, perch, bass and muskellunge were the most preferred species. The muskellunge fishery on Lake St. Clair is world class and boasts annual catches in excess of 5,000 fish in the Ontario waters alone. The value of the recreational fishery in the mid 1970's was in excess of $10 million annually in the Michigan waters of the St. Clair system and $8 million annually for Ontario. In today's dollars, the combined value of the fishery likely exceeds $30 million.

Lake St. Clair has supported commercial fishing from the days of the first settlers. Around the late 1800's, total annual catches approached 2 million pounds then reduced to between 1.3 and 0.7 million pounds with walleye, yellow perch, lake sturgeon, and a variety of panfish and coursefish species comprising the fishery. The commercial fishery was closed in the Michigan waters in 1909 and in the Ontario waters in 1970 when high levels of mercury were discovered. In 1980, the Ontario fishery was re-opened under a rigid quota management system with total annual catches of yellow perch, sturgeon, panfish and course fish of approximately 140,000 pounds in the 1980's and less than 20,000 in the 1990's.

There are five native sustenance fisheries utilizing fish from Lake St. Clair. They include the Walpole Island Indian Reservation (north Lake St. Clair), the Moravian, Oneida, and Muncey Indian reservations on the Thames River and the Sarnia Indian Reservation on the St. Clair River. Annual historic harvests exceeded 100,000 pounds, but are estimated to be considerably less now.

Contaminants and toxins from manufacturing and petrochemical industries bordering the St. Clair River, Lake St. Clair and the Detroit River are an issue affecting the ecosystem, and its use. High levels of mercury closed the fisheries on Lake St. Clair in 1970 with consumption guidelines being issued that remain in place today despite good progress being made to reduce or eliminate source loadings. Ecological effects include impacts on the benthic community and fish diseases such as liver tumors and lip papilomas. The Great Lakes Water Quality Agreement of 1978, identified the Clinton River on Lake St. Clair and a number of areas in the St. Clair and Detroit rivers as geographic Areas of Concern (AOC) for which remedial action planning (RAP) processes were established over the 1980's and 90's to restore impaired beneficial uses. Recently, problems with combined municipal sanitary and storm sewer overflows have lead to elevated levels of *E. coli* bacteria and beach closings, particularly in 1994.

At least 136 exotic aquatic organisms of all types have invaded the Great Lakes since the 1800's, with a third being introduced in the last 30 years. For Lake St. Clair they include the plants (Eurasian watermilfoil and purple loosestrife); crustaceans (spiny water flea and the rusty crayfish); molluscs (zebra mussel in 1988); and fish introductions (carp, alewife, and smelt historically and white perch in mid 1980's, the round and tubenose gobies in 1993, and possibly the ruffe in the future). Lake St. Clair has the dubious distinction of being the location where many of the exotic species introductions in the Great Lakes were first detected. These many exotic species have imposed mostly negative impacts and may have irreversibly modified the Lake St. Clair ecosystem.

The habitat of Lake St. Clair has undergone significant change in the last 10 years. The most dramatic has been an increase in water transparency, a result of the introduction of zebra mussel and to some extent lowering water levels after 1988. Water transparency has radically increased 2-3 fold in many areas, with areas showing greatest increase having the highest zebra mussel densities, implicating zebra mussel as the principle cause. In association with these changes, Chlorophyll decreased to half representing a reduction in pelagic productivity and a transfer of energy from the pelagic to benthic community. The increase in water transparency promoted over a 4 fold increase in aquatic vegetation between 1985/6 and 1995. The Michigan waters of Lake St. Clair haven't shown as large a change, possibly due to the moderating influence of the high volume of Lake Huron water moving through that side. These habitat changes have had significant implications for the fish community and meant Lake St. Clair was no longer ideal for walleye, but favors bass and muskellunge, a historic condition.

The fish community has also undergone dramatic change over the last 10 years. Exotic species, such as white perch and gobies, have recently appeared as significant components of the fish community with unknown effects. Walleye abundance has declined to less than half over the 1990's with a review ruling out exploitation and suggesting environmental factors have lowered walleye reproduction and prompted emigration. Habitat changes in the 1990's that disfavor walleye while supporting muskellunge and bass have resulted in changes in the fish community as dramatically seen in angler surveys. In the 1970' and 80's most anglers fished for walleye (70%), followed by bass anglers (11%), perch (9%) and finally muskellunge (9%). A recent survey in 1999 found most anglers now fished for muskellunge (29%), followed by bass (24%), perch (24%) and finally walleye (20%). Similar changes were seen in index netting surveys and indicate a very significant change in the fish community and fishery have taken place over a relatively short period of time.

In conclusion, we see Lake St. Clair is a very ecologically and economically important system that has undergone dramatic change in last 10 years. It has many issues confronting it including contaminants and water quality problems and exotic species introductions that have promoted significant habitat and fish community change. The shear magnitude of the human population in the Lake St. Clair watershed imposes not only great resource use demands on the system, but with much of this population in large metropolitan centers with industrial-based activities, there are great environmental demands also placed on the system. As researchers, managers, politicians, and public, we not only need to be aware of just how important this system is, but, we also need to recognize that man-induced changes, like the introduction of exotics, have brought about natural changes such as increased aquatic vegetation and fish community changes in a background of other natural influences like water level changes in a complex system. We therefore need to understand how the past changes in this dynamic and complex system may modify or constrain our scope for future man-induced remediation, and challenge our efforts to bring stability and predictability to this important system.

The Economic Impact of Boating in Wayne, St. Clair and Macomb Counties

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Before specifically pinpointing the economic impact of boating in Wayne, St. Clair and Macomb Counties, it is important to have an overall perspective of the size and scope of recreational boating in Michigan. There are more registered boats in Michigan than any other state, approximately 960,000. Michigan ranks second in the nation in the overall combined sale of boats, motors, trailers and accessories. Florida is the only state that exceeds Michigan's boating related retail sales. Fishing comprises over 52% of the boat use and therefore, there is a strong link between boat sales, boat use and recreational sportfishing. Overall, it is estimated that boating has an economic impact of $3 billion on the state's economy.

It is also worth noting that Michigan State University in their 1994/95 research indicates that there were 626 coastal marinas in the state and a significant number, 34%, were identified marinas in Wayne, Macomb, and

St. Clair Counties; 64, 75 and 72 marinas respectively. Wayne, Macomb and St. Clair Counties represent the shoreline counties to Lake St. Clair.

In terms of environmental regulations affecting marina operations and boat use, Michigan became a "no discharge zone" for all recreational vessels in 1970. During 1994/95, Michigan State University extensively evaluated vessel use patterns and marina pump-out inventories as a result of the federal Clean Vessel Act. Michigan has an extensive and effective marina pump-out program and inventory of facilities. Marinas are regulated by the Michigan Department of Environmental Quality and require marina operating permits and, based on the types of activities in the facilities, must be permitted through the National Pollution Discharge Elimination System administered by the state's general permitting authority.

In addition to the marina inventory mentioned above, there are approximately 153,000 boats registered in the three counties–Wayne, Macomb and St. Clair. This number is significant when noting this number is more than each of these following states have in their entirety: Colorado, Connecticut, Maine, and Massachusetts. Of the approximately 94,000 boats registered to residents of the three counties, the largest concentration of boats is in the 16' to 20' range–approximately 30,000. It is also worth noting that of those vessels owned by residents of the three counties, 19,000 are stored at waterfront primary homes and over 17,000 are stored in marinas. Most significant is the fact that over 29,000 are stored at non-waterfront homes which indicates the importance of providing water access, such as boat launching facilities. A further analysis indicates that many of the boats registered to residents in the three county areas are stored outside of these counties–41,000 outside versus approximately 52,000.

Analysis of boat days indicates that boats registered to residents are not only being used within the three counties but also are being used outside the three county area. Boat days are defined as one boat being used during one day, regardless of the length of time. Trip and annual craft-related spending for Macomb, St. Clair and Wayne Counties was $149.9 million in 1998, including $60.7 million in Macomb County, $38.4 million in St. Clair County and $50.8 million in Wayne County. During 1999 83% of the 16,476 marina slips in the three counties was occupied.

Using a multiplier of 1.75, the economic value of direct spending by recreational boaters in the three county area is estimated at $262.5 million. Boating not only benefits the boating businesses providing product, service, and access, but dollars spread throughout the community. Boaters buy groceries, eat in restaurants, use motels, etc.

When planning for the future of Lake St. Clair, our communities and leaders must consider not only sound and practical environmental practices and stewardship when crafting future policy but also consider the important role that water-based recreation plays in the well-being of our citizens and the economic viability of the recreational based industry in the Lake St. Clair region.

Research, Policy and Management Responsibilities for Lake St. Clair

Tribal/First Nations Issues and Concerns

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Boozhoo, I bring you greetings from Chief Joseph Gilbert and the Walpole Island First Nation.

I am glad to have this opportunity to contribute to a conference on Lake St. Clair. Especially, since the 'current state and future prospects' for that lake affect the twenty-two hundred of us who live in the Walpole Island First Nation more directly than is probably the case for virtually all of the participants in this conference. For many of you it may be a place of recreation and pleasure; for others a main focus of your

research or professional careers. For a few of you, I can believe that it has become your life's work. As I will try to show in the next few minutes, however, Lake St. Clair is not merely my First Nation's home; it is the focus of our economic, social and spiritual life.

I should warn you of two things at the outset. First, despite what was suggested in the title proposed for my talk by the conference organizers, I cannot talk about the issues and concerns that may face other aboriginal groups; I can only speak from a Walpole Island perspective. Other First Nation's have their own stories. Secondly, it may be that Walpole Island's view of these issues and concerns is rather bleaker than those of the majority of other contributors.

As is well-known and mentioned previously several times this morning, Lake St. Clair is the only Great Lakes connecting channel, all the way from the mouth of Lake Superior to the St. Lawrence River, that was not made an Area of Concern under the Great Lakes Water Quality Agreement. Of course, this could be regarded as rather 'faint praise' but let's be glad about it nevertheless.

If we ask, however, why has the lake tended to be less polluted than the St. Clair River, which provides 98% of its inflow, then a good part of the answer, especially over the decades, has been the delta on which our First Nation lives. The transporting power of a river varies as something like the fourth power of its velocity: where a fast-moving river encounters relatively still water, most of the sediment that it is carrying is deposited and a delta is created. If those sediments are contaminated by chemicals or other pollutants, the pollutants remain. The delta area is hence a filter, and while we at Walpole Island are glad that the filtering protects Lake St. Clair, we are also very much aware that we live on the filter. Nowadays, it is true, the volume of pollutants coming down the St. Clair River has been substantially reduced, and most of the delta formation that is taking place at present is on the western (U.S.) side of the river. But, as I shall show later, this is of little comfort to my First Nation.

It is also well known that 'The St. Clair system contains one of the largest coastal wetlands in the Great Lakes.'[1] A very large proportion of that wetland is contained in the unceded territory of the Walpole Island First Nation. Why is this so? One superficial answer is simply that deltas tend to be wetlands by their very nature. But that is very superficial, because our wetlands are in many respects the surviving vestiges of what used to be huge areas of wetlands. There are about 13,000 hectares of wetland remaining in the St.Clair system, but on the Ontario side alone, '... over 400,000 ha of wetlands in three contiguous counties have been converted [to agriculture] since the late 1800s.'[2]

If you are inclined to say that attitudes have changed, and that such conversion of wetlands is now discouraged, allow us on Walpole to be rather skeptical, on the strength of the following:

> In Ontario, wetlands are currently being lost to agriculture. The wetlands from the Thames River north to Chenal Ecarte dwindled from 3,574 ha in 1965 to 2,510 ha in 1984. . . Draining for agriculture accounted for 89% of the wetland loss, whereas marina and cottage development consumed the remaining 11%.[3]

In such a context, Walpole Island First Nation finds it both ironical and thoughtless - one might even say, insulting - that suggestions have been made that our wetlands should be designated for protection under the Ramsar Convention. They would undoubtedly qualify as 'wetlands of international importance' but consider the situation from our point of view. The Ramsar Convention is essentially an agreement among nations, including Canada and the USA, that they have not done a good job of protecting wetlands in the past. They therefore agree to try to do a better job in the future. Very good, but not, I suggest, relevant to Walpole Island First Nation. We have done a good job in the past, and we have every intention of continuing in the future, for all sorts of reasons. As just one example, this is duck hunting season, and we draw hunters from a wide area. We have long-standing agreements with several clubs, who have built lodges on our wetlands because they have confidence that we will continue to maintain our wetlands. More specifically, one

agreement that we have is with the St. Clair Flats Shooting Club which began in 1876, over a century ago. I submit, a resource management and conservation tool that has survived the test of time and serves us well today. With this sort of track record, why should anyone suppose that our wetlands need the 'protection' of an international convention?

The Walpole Island wetlands are also recognized as a valuable, and perhaps a vital nursery for the fish that make Lake St. Clair so important as a recreation site.

> Of the more than 70 species recorded as native [to Lake St. Clair] or migrants, 34 use the lake for spawning. . . Most of the 28 native species spawn in shallow water along the delta . . . or other shoreline areas or in tributaries to the lake.[4]

The more that other wetland areas around the lake are converted to agriculture — or to sites for cottages for people who wish to fish the lake — the greater the dependence on the Walpole Island marshes as spawning sites. We value the fish of Lake St. Clair at least as much as others who live around the lake or come to fish there for recreation. We also fish for sport; we fish for food; and we derive a significant source of our First Nation income, as with duck hunting, from licensing, guiding and other services to visitors based on the fish resource.

So far, so good. But consider what happened nearly 30 years ago, when the threat of mercury pollution caused a ban on commercial fishing in Lake St. Clair in 1970. We in the First Nation were no part of the pollution that caused the ban, but there were many in our community whose livelihood in the commercial fishery was drastically affected by the ban.[5] Given the danger, those fishermen, and the Walpole Island community, could accept the need for the ban, and the consequent disruption of their lives.

What was not easy to accept was that this ban was then used by the Government of Ontario as a policy instrument to remove commercial fishing permanently from the lake. When the ban was lifted in 1980, only one Walpole Island community member was able to obtain a commercial fishing license. Pressure from sport fishery interests led to a situation such that, by 1986, according to Ontario Ministry of Natural Resources:

> …no-one will be allowed to establish a livelihood through commercial fishing on Lake St. Clair again.[6]

As we on Walpole Island see it, of course, 'sport fishing' is just as 'commercial' as 'commercial fishing.' Indeed, it is *because* it involves more money, more potential revenue, and more voters than 'commercial fishing' that the latter is being deliberately forced out, regardless of the impact on the people affected. And, as an environmental audit of Walpole Island First Nation noted a few years ago:

> If one is to judge from the *Chatham District Fisheries Management Plan, 1987-2000*, published by the Ontario Ministry of Natural Resources in 1990, the Government of Ontario would prefer to ignore native fishing completely. One of the maps that it contains does show a 'native fishing area' in the vicinity of Walpole Island, but the Management Plan does not otherwise mention native concerns, even in the context of a discussion of real and perceived conflicts between different fishing interests.[7]

I said earlier that the reduction in the volume and character of pollutants coming down the St. Clair River has been of little comfort to us on Walpole Island. There are several reasons for this, but as this is a conference about Lake St. Clair, I want to focus on what happened ten years ago in regard to dredging.

As many of you will know, our First Nation agreed to surrender part of our Territory to enable a straight Seaway channel to be cut through the delta. We also provided a location for Canada to create a confined

disposal facility for dredged materials, similar to the facility at Dickinson Island used by similar navigational dredging by the United States. Ten years ago, however, the Canadian Government and its dredging contractor were anxious to save money. They therefore did a limited analysis of the sediments in the area to be dredged, concluded that the sediments were not contaminated, and therefore announced that the material would not be placed in the confined disposal facility, but would instead be dumped in the open waters of Lake St. Clair.

We took the Government of Canada to court over that one. We initially failed in our bid to get an injunction to prevent the dredging and dumping, but we did, after the fact, get a commitment that nothing like it would happen again. This was helped by the fact that more detailed sampling of the sediments showed the presence of such persistent toxic chemicals as hexachlorobenzene (HCB) and octachlorostyrene (OCS), neither of which had been looked for in the first set of analyses.

There are several conclusions that we draw from that experience, and that I hope you will endorse. The first is that, as environmental conditions improve, the tendency is to assume that fewer precautions need to be taken, and saving a buck looks more attractive than saving the environment. A second, and less obvious, conclusion is that big organizations, like national, provincial or state governments, are all too often examples of the left hand not knowing what the right hand is doing. What made the dredging situation more glaring was the fact that, less than 12 months earlier, a major study of the St. Clair River and Lake St. Clair had been completed and published, under the imprint of *eight* government agencies: U.S. Fish and Wildlife, Environment Ontario, NOAA, U.S. Army Corps of Engineers, Detroit Water and Sewerage Department, Michigan Department of Natural Resources, U.S. EPA, and Environment Canada.

That is how we, on Walpole Island, knew that the sediments were likely to be contaminated by HCB and OCS, and other pollutants. Was it too much to expect that Public Works Canada and the Canadian Coast Guard should have looked at the same book before making their proposals for open-lake dumping? And why did Environment Canada go along with their proposals?

The final conclusion, I regret, is that we at Walpole Island First Nation simply cannot trust other jurisdictions to have the same care for our environment, including Lake St. Clair, that we have maintained for generations. It is not pleasant to live in such an atmosphere of distrust, and we remain ready and eager to cooperate with others whenever there seems to be a real opportunity to improve the situation. But we have had too many negative experiences for us to be ready, any time soon, to substitute trust for our own vigilance and our conviction that we are better protectors of the environment than those who would like to do so on our behalf.

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State and Provincial Perspectives–Ontario Ministry of the Environment

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The vision of the Ministry of the Environment is "*where a convergence of healthy well-being, recreation, commerce, and industry are sustained in surroundings of clean air, water and land*." To fulfill this vision, the ministry sets clear policies, standards, and rules to protect the environment and to encourage conservation activities. Along with monitoring and enforcing these rules, the Ministry looks for innovative approaches to complement regulations. This includes building partnerships with communities, industries and organizations to find flexible, practical, cost-effective ways to strengthen environmental protection and conservation efforts.

In Southwestern Ontario the Ministry has responsibilities for several policy areas relating to Lake St. Clair. These include:

< Implementation of RAPs;
< Prevention and Control of Pollution;
< Four Agency Letter of Commitment;
< Technology transfer and cooperative monitoring efforts.

The Operations Division is the operations and program delivery arm of the Ministry. It is responsible for delivering programs to protect air quality, to protect surface and ground water quality and quantity, to manage the disposal of wastes, to ensure an adequate quality of drinking water and to control the use of pesticides. In addition, the division is responsible for administering the ministry's approvals and licensing programs as well as an investigative and enforcement program to ensure compliance with environmental laws.

The division has a province-wide network of regional, district and area offices. As well, it includes the Approvals Branch, the Investigations and Enforcement Branch and the Spills Action Centre. The Southwestern Region administers a source Monitoring program which encompasses audit and inspection, spill response, non-compliance reporting and enforcement (orders, charges, tickets etc.).

Along with other Divisions within the Ministry and external partners such as the Ministry of Natural Resources and others, several ongoing monitoring programs are conducted on Lake St. Clair. These include annual index netting and fish tagging, sport fish contaminant monitoring, contaminant fate and transport modeling, drinking water monitoring and tributary monitoring of the Thames River watershed. Lake St. Clair and its watershed are also the subject of extensive research in areas such as contaminant fate and transport modeling, sediment research (resuspension and settling) and distribution and dispersal of Zebra mussels.

The St. Clair River RAP has tracked improvements in water quality since 1988 and conducts a comprehensive monitoring and source control program. The RAP has met with a number of successes due in large part to voluntary and legislated improvements at petro-chemical facilities in the Sarnia area. The reduction in the size and frequency of industrial spills has been a significant achievement. Closure of down river water treatment plants as a result of a spill has not occurred since late 1994.

The control of Inputs remains a key priority of the Ministry and this will continue to be achieved through control of point and non-point sources to the St. Clair River and Thames River watersheds. It is anticipated that the significant progress in source control and spill prevention already observed will be complemented by programs designed to deal with ongoing and historical problems resulting in continuous improvements in water quality and biological systems.

State and Provincial Perspectives–Michigan Department of Environmental Quality

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The Michigan Department of Environmental Quality (DEQ) is composed of ten divisions each with its own set of unique environmental protection responsibilities and mandates, including the administration of over 100 state and federal laws and regulations. Its mission is "to drive improvements in environmental quality for the protection of public health and natural resources to benefit current and future generations. This will be accomplished through effective administration of agency programs, providing for the use of innovative strategies, while helping to foster a strong and sustainable economy." Our programs and strategies now include traditional "command and control" regulations, and voluntary strategies.

The regulations that were developed in the early 1970s were designed to the more visible end-of-pipe or top-of-stack point source discharges to the water or air. These programs have proven to be very successful in improving the environmental quality over the past (almost) thirty years as shown by the following examples. The DEQ is committed to ensuring future environmental gains from these programs.

- The federal Clean Air Act requires states to prepare and maintain emission inventories of major pollution sources. Since 1974, emissions have continually decreased for the six pollutants tracked.
- The Pollutant Standards Index was developed by the U.S. EPA to provide a simple, uniform way to report daily air pollution concentrations. The index allows the air quality levels in a given area to be classified as good, moderate, unhealthful, very unhealthful, or hazardous. Eight large Michigan metropolitan areas are required to report the index. In general, all eight areas have shown improvement since 1987 with the greatest reduction occurring in the Detroit and Grand Rapids metropolitan areas.
- Discharges to water have also been dramatically reduced. The DEQ has monitored water quality trends on the Detroit River since 1969. While the greatest improvement occurred in the 1980s, most parameters continue to show a decreasing trend in both concentration and loadings.

Despite the success of these programs, more obscure and diffuse environmental problems remain. It is these problems that the state must now address. The same regulatory approach used 20 years ago will not work in the next millennium. The DEQ has already begun to shift its emphasis from just regulating or cleaning up environmental problems to trying to prevent them in the first place. Pollution prevention and other voluntary initiatives hold great promise and provide a more economical way to protect our environment. In addition, the DEQ has begun to set priorities for environmental protection based on scientifically-based comparative risk methodologies to address the most serious environmental problems first and wisely allocate its limited funds.

Environmental Monitoring is also an important function of the DEQ. DEQ's water quality monitoring for this area was recently enhanced. The head and mouth of the St. Clair River are now monitored along with the Detroit River and additional parameters and lowering detection limits have been added. In addition, the Clinton River, as part of the DEQ Tributary Monitoring Program is now sampled biennially. The Clean Water Fund of the CMI (described below) will further enhance these efforts.

The citizens of Michigan have shown their support for environmental progress by passing the $675 Million Clean Michigan Initiative (CMI). The CMI includes the following sections:

- Brownfield Cleanup and Redevelopment - $335 Million
- Clean Water Fund (CWF) - $90 Million
- Nonpoint Source Pollution Prevention - $50 Million
- Waterfront Redevelopment - $50 Million
- Pollution Prevention Programs - $20 Million
- Contaminated Sediment Cleanup - $25 Million

The CMI will ensure progress in the protection and restoration of Michigan's natural resources into the next millennium.

Local Institutions and Perspectives from the Canadian Side

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The main institutional body responsible for resource management at the regional and local level in Ontario are the Conservation Authorities. Created by the provincial *Conservation Authorities Act* in the 1950s, 38 watershed based Conservation Authorities have been formed, the majority in southern Ontario. Each Conservation Authority receives core funding from its member municipalities and is governed by a municipally appointed Board of Directors. They therefore represent a unique institutional response to resource management in that they are locally driven, implementation oriented, watershed based resource management agencies.

Four Conservation Authorities have regard for the Lake St. Clair watershed. Although the main program areas of each is a little different depending on local conditions and issues and the directions set by the various Boards of Directors, they generally correspond. The core program area of most Authorities relates to regulation of shoreline and floodplain areas, and providing input to development applications received by municipalities and plans prepared by municipalities. Additionally, Conservation Authorities are active in managing biological resources through tree planting programs, rural non-point source pollution remediation programs, water quality monitoring and water quality improvement programs, and preparation of strategies to protect and enhance each watershed's biodiversity. Conservation Authorities have also taken on important roles in the provision of recreational and environmental education opportunities in the form of Conservation Areas which support day use or overnight camping, birdwatching, interpretive displays and events, fishing and other experiences, and environmental education programs.

A number of aspects are expanded upon in the presentation. Ongoing challenges include obtaining project funding to maintain and expand existing services, greening the south shore watersheds of Lake St. Clair, better understanding local ecosystems, further developing the connection between environmental, human health and economic health, and continuing to serve our customers well.

Luncheon Keynote Speaker

Honorable David E. Bonior, Member of Congress, 2207 Rayburn House Office Building, Washington, D.C., 202-225-2106, 202-226-1169, david.bonior@mail.house.gov.

This is a special gathering of people who understand and care about our water. And I believe that this conference will bring our progress with lake St. Clair and the St. Clair River to the next level.

In fact our efforts remind me of the story of a stone-cutter who was in his basement one day working when his son came down to watch him. The stone-cutter hit the rock time and time again, and finally, on the 200th try, the stone finally broke. The son looked at his father and said: "Father, I don't understand. If the 200th try broke the rock open, why didn't you just hit it that hard in the first place? The father responded: "It wasn't the 200th try that broke the rock, it was the 199 that came before it."

When it comes to protecting the health of our water it is the constant attention to detail and hundreds of little steps that bring us success. Clean water is the most simple necessity of our lives. Fortunately, so many talented and dedicated people are committed to rolling up their sleeves, doing the hard work and ensuring that we progress with respect to our lake. This is about more than a natural resource. This is about the fabric of life itself.

The Great Lakes and connecting waterways are the greatest natural resource in this area; they are our Yellowstone. They are our Grand Canyon. They are our Great Barrier Reef. They are the reason many

people come here and the reason many people stay. The Great Lakes have a profound effect on who we are as a people and how we live our lives.

Most of us have been swimming at these beaches and boating on these waters since our earliest memories. As someone who has lived along the Great Lakes all my life, I learned at a very early age how much water is a part of everything we experience. During the summer, my friends and I would go to Jefferson Beach for a swim. During the winter, we'd watch the ice fishermen set up their equipment on the frozen water. As I grew older, I'd join my friends and we'd spend our weekends out on their boat enjoying the water. These are experiences we all share. They remind us that clean water is essential to our way of life. This is a lesson I learned early - and it is a part of the values I continue to carry.

But events at Lake St. Clair and the St. Clair River taught many of us how important our environment is for our quality of life and for our economy. Without clean water, thousands of jobs evaporate. Sport fishing in the lake alone generates $140 million annually. Boaters and beach goers spend more than $1 billion each year on boats, accessories, marina slips and fuel. Burt when the beaches close, profits at local marinas go down. Business losses mount. And the risk to the public health weighs heavy on our minds.

Some of you in this room may actually remember our early struggles to protect our water when the environmental movement was in its infancy. In 1972 – the same year Congress first passed the Clear Water Act – I was serving Macomb County in the State House. We were facing our own challenges here in Michigan with Polychlorinated biphenyls – PCBs. PCBs are dangerous carcinogens that were poisoning the state's fish and contaminating the water. They can pass through the skin and accumulate in the body. They can cause birth defects in children. So we fought to ban PCBs – and we were successful. This was ground-breaking legislation at the time and eventually led to Congress banning the manufacture of PCBs and PCB-containing products.

Some of you may remember the hearings we held in 1985 on the chemical spill. The spill consisted of deposits of drycleaning fluid that were heavier than water. It formed a black tarry substance that was non-water soluble on the bottom of the St. Clair River. The hearing was an unprecedented meeting of representatives from the public and private sectors, from Canada and the United States, and from national, state and local governments. Thanks to that meeting, the spill was cleaned up. And just as importantly – government officials improved their alert and notification systems regarding spills.

Some of you may have been present five years ago when we held a public hearing in Macomb County to discuss sewage-related bacteria that forced a swimming ban and the closure of public beaches. At the hearing, we were able to educate the public on the importance of monitoring our water. We brought to light that in some instances permits for sewage discharges hadn't been renewed for 20 years. We underscored that there was a lot we needed to do and that we all have a role to play.

Thanks to that gathering, we in the community forced the State of Michigan to reevaluate permits. Community groups got involved. We raised awareness and changed people's attitudes about downspouts, sewer upgrades and nonpoint source pollution. It was a change of heart formalized in a conference, but it was carried out by many of you...and many of our friends and neighbors.

Many of you were also present at our water summit in the spring of this year when we discussed comprehensive monitoring. Right now, no main entity, no central institution ensures that the lake and river are properly monitored. But with over 2,300 miles of shoreline, limited resources, and multiple governments, we understand the necessity and the magnitude of this task. It is a discussion we are continuing today.

Many of you in this room are active and are making a difference. But many of you also feel like you are working in isolation. How can you possibly solve the problem if you are just one concerned citizen? Just one elected official? Just one agency? Or just one task force? There is a saying that one determined person

can make a significant difference, but that a group of determined people can change the course of history. By working together, we can do much more.

We all know instinctively that we need a comprehensive approach to water quality – one which brings together all levels of government, and all concerned members of our communities. We need to share ideas, pool resources and develop a comprehensive strategy to safeguarding our water. That is why were are here today to bring us all up to speed and help us focus on one united vision. We know that the best ideas do not come from Washington or Ottawa, Toronto or Lansing, but from the communities that are confronting these challenges every day. So we seek input and opinion and guidance from all of you.

And just as we need to view the river and lake as one united system, we need to view our efforts as one united system. We can increase our progress tenfold if we make the most of our resources, complement each other's efforts and communicate with one another.

We're talking about 95% of this nation's fresh water. We're talking about lakes that provide 23 million people with their drinking water. We're talking about a multibillion dollar economic resource. We're talking about a national treasure.

Our efforts to clean up our water should not stop at the county line, the state line or even the borders of our own country. Polluted water does not know regional or international boundaries. The true key to our success is cooperation. And we, as community leaders, can help provide the tools for families and communities to address some of our challenges.

I am committed to ensuring that the federal government pitches in and fulfills its role in conserving this important international waterway. I am willing to go back to the table year after year, for as long as it takes, to do my part. This year, I was able to secure $1.9 million in seed money for separating our storm and sanitary sewers right here in Port Huron. We increased the funding for the Environmental Protection Agency's water programs. And over the years, with federal money we cleaned sewer systems along the river and lake in Marysville and Marine City. I have fought for clean water bills, funding for drains and sewer systems and the State Revolving Loan Fund. We can protect our lake and river step by step, pipe by pipe. No one piece is a total solution, but together the pieces help us more forward.

As we move ahead and watch our water improve, we should never forget that our action didn't come from some far-off planner in Washington or Ottawa. Our action didn't spring from some thick report or national study. It began right here in the Blue Water Region. And even though our progress involves just about every organization imaginable, we know that our success lies with the people of Ontario and Michigan. I know that by pooling our efforts, we can ensure that our drinking water is safe, that our water is not a health risk and that our children will enjoy this treasure.

I think each of us who has grown up near our Great Lakes has a special respect and reverence for the water. This is why we are here today. A beautiful lake or river can inspire us. Thoreau once wrote, "A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature." Let us continue to keep our lakes and rivers beautiful and expressive. Let us not tire in the depth of our commitment. An we will each enjoy measures of rewards.

Concurrent Sessions

Habitat and Biodiversity

Fish Community Composition and Change

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Lake St. Clair continues to support a valuable fish community and fishery in spite of heavy commercial fishing in the mid-to-late 1800's, ensuing loss of most valuable wetland habitat, and colonization by exotic organisms. Some of our concerns for fish management in Lake St. Clair are 1) Restoration of wetland habitats and native fish populations; 2) User conflicts and impact of boats on sensitive habitats; 3) Chemical contaminants in the system; 4) Impacts of exotic species. Zebra mussels and round gobies are the latest invaders which have found a suitable home completely colonizing the St. Clair system. We recommend that Lake St. Clair management activities focus on restoring wetland habitat, reestablishing valuable native species, and preventing damage from exotic species.

Historical publications provide some insight into the original fish community of Lake St. Clair and its productivity, written because of a concern in the 1870's that fishing was depleting valuable species. These reports show us that 1) the majority of commercial catch was lake herring, yellow perch, and suckers; 2) The St. Clair River catch was predominately lake herring with lesser amounts of northern pike and walleye; 3) The Detroit River produced primarily lake whitefish and lake herring, 4) Combination of Ontario and Michigan catch during late 1800's reached nearly 4 million pounds at peak, 5) Michigan harvest post-1909 was harvest of "rough" fish under special permit, continuing at very low levels until about 1970, 6) Commercial records show that herring and whitefish were heavily exploited by the fishery in the late 1880's, mainly during fall spawning migrations into Lake St. Clair from Lake Erie, 7) obvious decline in these populations and loss of valuable food fish, prompted a biological investigation of Lake St. Clair.

Dr. Reighard, a prominent zoologist at the University of Michigan, conducted a study of Lake St. Clair's plants and animals in 1898. He thoroughly investigated Michigan's waters of the lake, sampling plants and aquatic animals. He thought that young lake whitefish would do well in Lake St. Clair and recommended that large numbers of eggs be planted over the dense Chara beds scattered throughout the lake. Chara is a macro-algae that forms dense, sturdy mats covering the lake bottom throughout the year providing excellent cover and food resources for eggs and fry. It is easy to imagine that lake herring and whitefish once spawned in Lake St. Clair on Chara during fall. There eggs would hatch in the early spring with many of the fry being swept downstream into Lake Erie where plankton was more abundant. Since Chara has returned to its former abundance (over 50% of plant biomass) and lake whitefish and lake herring are considered to be valuable members of the fish community, we recommend that attempts be made to reestablish populations in Lake St. Clair by planting eggs.

We used Michigan creel survey data in the 1940's and 1980's to estimate angling harvest from Lake St. Clair. In the 1940's it appeared to be slightly under 1 million pounds and in the 1980's was probably around 3 million equaling commercial yield. I also compared commercial yields on a per unit area basis from all Great Lakes for the period 1914-1970 and found that Lake St. Clair had the second highest productivity, following only Lake Erie.

Lake St. Clair probably contains the most diverse fish community of any of the Great Lakes with the top three of mimic shiner, rainbow smelt, and yellow perch making up 68% of the total trawl catch of 45 different species. Many of the species and individuals are transitory migrants and the lake is one of major Great Lakes sites for colonization by exotic organisms.

The fish community of Lake St. Clair includes several fishes currently listed by Michigan Department of Natural Resources as species of special concern. These include river darter, channel darter, eastern sand darter, lake sturgeon, and mooneye. Populations of sturgeon and mooneye are relatively healthy but the three darter species are quite rare and the condition of their populations remains unknown.

Sport fishing on Lake St. Clair has been good since the early 1900's and has improved dramatically for many species, such as muskellunge, smallmouth bass, and yellow perch since the late 1980's. Many fish species

have responded positively to better environmental conditions following pollution abatement and dramatic clearing of the water. We also know from tagging that millions of Lake Erie walleye migrate through Lake St. Clair each year where they contribute significantly to angling harvest. Improved environmental conditions in Lake Erie have appreciably benefitted fish abundance and the fishery in Lake St. Clair.

Aquatic Macrophytes and Wetlands

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Fluctuations in water-levels are a prominent feature of the Great Lakes. They also serve as the driving force that dictates the health and diversity of Great Lakes wetland plant communities and the habitat those wetlands provide for fish and wildlife. Plant communities in wetlands respond to changes in water depth, both in terms of species composition and vegetation patterns, but how does that response relate to lake-level behavior? Following the high lake levels of 1986, Lake St. Clair water levels dropped about one-half meter by 1988. We took advantage of that opportunity to initiate studies of the wetland plant communities of Dickinson Island, a river-delta wetland at the mouth of the St. Clair River.

In one study, we sampled randomly placed quadrats on transects that followed topographic contours with different histories of flooding and dewatering. The transect at the lowest elevation was one-half meter under water in 1988 and represented the depth experienced by the 1988 shoreline during the 1986 high; it had been flooded continuously for 21 years. The next transect was the just below the 1988 shoreline and had been flooded for 5 years. A transect 5 cm higher in elevation had been flooded for 4 years but was being periodically flooded and dewatered by seiches in 1988. The next transect landward, 20 cm above the 1988 shoreline, was dewatered throughout the 1988 growing season following 4 years of flooding. The two remaining transects were at low and high elevations further landward; their water-level histories were similar to the 1988-shoreline and 1988-dewatered transects, but their landward position protected them from direct wave attack during flooding years.

Ordination of the transect data by detrended correspondence analysis showed strong similarities among plant communities with similar water-level histories and clear differences between those at different altitudes. Species richness was greatest in areas that had been flooded and then dewatered. Forty-five of the fifty taxa present in the drawdown area were unique to that area, and they represented 73% of the total taxa of the wetland.

In the second study, we sampled aboveground plant biomass for all taxa present in 35 quadrats randomly placed in a dewatered area where past high water levels had killed the dominant emergent plants (mostly cattails). We also sampled 10 quadrats on a nearby mound at a higher elevation where flooding had not killed the emergent plants. We resampled those areas in 1989, 1990, 1991, and 1996 to evaluate changes in plant dominance as the flooding/dewatering cycle progressed.

Few changes occurred between years in the area where 1986 flooding had not killed the emergent vegetation. Hybrid cattail (*Typha* x *glauca*) accounted for greater than 85% of aboveground plant biomass in all years. Buttonbush (*Cephalanthus occidentalis*) and arrowhead (*Sagittaria latifolia*) were the next most prominent species but in far smaller quantities. In the area cleared of emergent vegetation by the high water in 1986, biomass of narrow-leaf cattail (*Typha angustifolia*) increased from about 50 to over 300 g/m^2 from 1988 to 1996. Other species with increases in biomass through time, but in smaller quantities, included common reed (*Phragmites australis*), blue-joint grass *(Calamagrostis canadensis*), giant bur-reed (*Sparganium eurycarpum*), and hardstem bulrush (*Scirpus acutus*). Canada rush (*Juncus canadensis*), arrowhead, switchgrass (*Panicum virgatum*), nodding smartweed (*Polygonum lapathifolium*), blunt spikerush (*Eleocharis obtusa*), and numerous other species decreased in biomass through time. The mean number of taxa present in the flooded/dewatered area increased from 38 to 41 and then decreased to 39, 19, and 20 in

the successive years sampled. The latter two figures coincide with the mean of 20 taxa found in the cattail-dominated area that had not been affected by high water in 1986.

Together, these studies demonstrate that the composition of wetland plant communities of Dickinson Island is determined by water-level history as related to elevation and that alternating flooded and dewatered conditions serve to maintain a greater number of plant taxa in the species pool. High water years cause a die-back of dominant species, and succeeding low water years allow a more diverse plant community to emerge from the seed bank. Although the species that develop the greatest canopy will likely regain dominance, the other species have had an opportunity to complete a life cycle and replenish the seed bank, thus setting the stage for the cycle to be repeated.

Exotic Species and Lake St. Clair

Trends in the Zebra Mussel Population of Lake St. Clair between 1988 and 1997

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We have been documenting trends in the zebra mussel population of Lake St. Clair since the first mussel was discovered in the southeastern portion of the lake in 1988. Population surveys were conducted by SCUBA divers at 29 sites located throughout the lake in 1990, 1992, and 1994. In addition, an abbreviated survey was conducted at 5 sites along the Michigan shoreline in 1997. Divers placed a 0.5 m^2 frame on the bottom at each site and collected all mussels within the frame area. Ten replicate samples were collected at each site with divers moving about 2-3 m between replicates. Back in the laboratory, all mussels were counted and measured (shell length).

Over the 1988-94 period, the population increased rapidly in the southeast and then expanded to the northwest. This systematic pattern of expansion was attributed to the high volume of water flowing through the shipping channel; mussel larvae from populations in the southeast were swept out of the lake via the Detroit River and this hindered colonization in the northwest. Between 1992 and 1994, population densities in the southeast apparently stabilized, and biomass (shell-free dry weight) actually declined 3-fold. The decline in biomass can be attributed to both a decline in the average size of individuals in the population, and to a decline in the amount of soft tissue per unit shell length. Over the same period, densities in the northwest increased over 100-fold, and biomass increased 60-fold. The abbreviated survey conducted in 1997 at just a few sites along the Michigan shoreline indicated that densities (biomass not measured) apparently stabilized in the northwest portion between 1994 and 1997.

The introduction of the zebra mussel has caused large-scale ecosystem changes within the lake. Based on literature-derived filtering rates, the filtering capacity of the zebra mussel population in 1994 was 12 times greater-then the filtering capacity of the native mussel population in 1986. This increase in filtering capacity has led to a 2-fold increase in water clarity, and a 3-fold decline in chlorophyll concentrations. Subsequently, the increase in water clarity has led to increased light penetration to the bottom and stimulated the growth of aquatic macrophytes.

While the zebra mussel population in Lake St. Clair no longer seems to be expanding within the lake, it is not clear if the population will begin to decline, or remain at present levels. Further surveys are needed to determine any future trends, and this information will be useful to prepare lake managers for ecosystem changes that may result.

Round Gobies: Ten Years With the Latest Great Lakes Phantom Menace

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Round and tubenose gobies were found in the St. Clair River 10 years ago in 1990, having been transported in ballast water from the Black and Caspian Seas. Within 5 years round gobies were transported to all five Great Lakes via ballast water transfer, had moved into two inland rivers in Michigan via bait bucket transfer, are now found in two inland lakes, and are heading toward the Mississippi River from southern Lake Michigan through the Chicago Sanitary and Ship Canal. The tubenose goby has been found throughout the St. Clair River, Lake St. Clair, Detroit River, and western Lake Erie corridor. Round gobies have not penetrated far up the tributaries in these areas and appear to be limited by eutrophic, predator-filled rivers, while the tubenose goby has traveled long distances up some rivers studied. Round gobies in optimal habitat reach surprisingly high densities, irritating fishermen and dominating fish catches. Round gobies have decimated mottled sculpin populations wherever they overlapped with this species, by aggressively eliminating spawners from prime spawning habitat (underside of rocks or other structures) which is required by both species. Round gobies eat mostly benthos at small sizes, while a few fish and eggs were eaten by larger individuals. Fish >100 mm eat large quantities of zebra mussels, which funnels some energy from a formerly ecologically dead-end food source into prey fish, which are being eaten by many piscivorous fishes, including walleyes, smallmouth bass, and lake sturgeon. However, because zebra mussels accumulate large quantities of PCBs, the potential for bioaccumulation into top predators exists. They are known to eat lake trout eggs and have now been found on artificial reefs used by spawning lake trout in southern Lake Michigan. They have also been found at 30 m offshore during winter and have the potential to affect other sculpin species there, such as slimy and deepwater sculpins. Round gobies will continue to expand their distribution throughout the Great Lakes and connecting waterbodies and represent an unstudied potential threat to lake and stream species, as they expand into these new habitats.

Biodiversity Conservation Strategy for the South Shore of Lake St. Clair

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Since the time of European settlement in the 1830's, much of the original natural resources of the Essex region have either been totally destroyed or have become extremely degraded as a direct or indirect result of clearing and drainage for timber, agriculture, and urban development. The overall loss of approximately 97% of the original wetland area and 95% of the original forest area has resulted in a highly fragmented and degraded ecosystem. The remaining small, isolated remnants of natural habitats constitute the lowest percentage of any region in all of Ontario. It has long been realized that the cumulative loss and alteration of the region's natural resources has had profound consequences on the region’s sustainability and ecosystem health, necessitating the need to significantly increase the extent and quality of remaining natural habitats.

Environment Canada, in partnership with other government agencies, has developed "*A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern*" which provides a methodology to establish habitat restoration guidelines and priorities for degraded ecosystems utilizing geographical information systems (GIS) technology. The purpose of the Biodiversity Conservation Strategy is to produce a spatial database of all natural areas in the Essex region and, utilizing the Environment Canada framework, conduct an analysis of the terrestrial, wetland, and riparian habitats to identify the extent of existing natural vegetation and prioritize opportunities for habitat rehabilitation and enhancement. The objective is to increase the size, extent, and quality of key natural heritage features, natural corridors, and greenway linkages, thereby improving the ecosystem diversity and ecological functions of the Essex region. In addition, by applying the framework to the Detroit River and Wheatley Harbour Areas of Concern the Strategy will assist in addressing the delisting the impaired beneficial use - *loss of fish and wildlife habitat*, for these ongoing Remedial Action Plans.

Current habitat conditions in all of the study areas examined to date reveal that the remaining natural ecosystems of the Essex region are not only far below an amount to be considered healthy and sustainable, but are highly fragmented and degraded and hence, in need of extensive rehabilitation and restoration. The results from this report provide an overall framework to guide where habitat rehabilitation and restoration might be required before the individual sub-watershed ecosystems can be considered healthy and self-sustaining. The high priority restoration opportunity areas mapped in this report are to be used as a guide to concentrate future potential habitat restoration and enhancement works.

Complete restoration of all high priority opportunity areas would lead to an "ideal" ecological condition for our remaining natural resources. It is crucial to implement as much restoration as possible in the areas identified in this report, building upon those few remaining ecosystems in the landscape. Therefore, every effort should be made to apply for funding for those landowners within the high priority areas who are willing to undertake some form of habitat restoration on their property. Only through this logical approach can we justify financial spending versus resulting ecological value.

Human Health, Beach Closures and Drinking Water

Michigan Source Water Assessment Program Activities in Lake St. Clair

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The 1996 amendments reauthorizing the federal Safe Drinking Water Act require states to develop and complete a Source Water Assessment Program (SWAP). This program must identify the areas that supply public drinking water; inventory contaminant sources in these areas; determine source susceptibility to contamination; and inform the public of the results.

The Michigan SWAP was developed through an advisory committee representing numerous agencies and organizations. The program was submitted to the U.S. Environmental Protection Agency in February 1999 and approved in October. The completed document identified 11,970 public water supplies in Michigan with approximately 18,000 sources requiring assessments. About 10,650 of these systems are noncommunity public water supplies on ground water sources. The remaining 1,320 are community, public water supplies. While most of these community supplies rely on groundwater, 70 water treatment plants derive their source from surface waters and provide a source of drinking water to approximately one half of Michigan's residents. Ten of these intakes are on inland rivers while the remaining 60 are on the Great Lakes or connecting channels. The St. Clair River- Lake St. Clair- Detroit River system has 13 public water supply sources with four of these intakes in Lake St. Clair.

The Michigan Department of Environmental Quality (MDEQ) has entered into a partnership with the U. S. Geological Survey (USGS) to develop a flow model for assessing the 13 intakes on the St. Clair - Detroit River system. The Detroit Water and Sewerage Department (DWSD) and U. S. Army Corp of Engineers (USACE) are also contributing to this project. In addition, a contract is pending with the National Atmospheric and Oceanic Administration (NOAA) to obtain current bathymetry data.

The flow model will utilize and enhance a general purpose, two-dimensional, depth-averaged, finite-element hydrodynamic numerical model (Norton, King, and Orlob 1973) referred to as RMA2. The USACE and Environment Canada initiated model development to predict the effects of proposed structures and dredging projects on water levels and currents in the system. The SWAP flow model will assist in identifying source water areas, describe contaminant transport near intakes, and provide real time information for planning and coordinating spill response operations for drinking water sources. The model will be used to provide two dimensional flow information within the system over a range of likely flow scenarios. The direct use of this flow model by cooperating agencies will be supported.

Along with the flow model, MDEQ will utilize "The Great Lakes Protocol" developed through U.S. EPA Region 5 and the Great Lakes states to complete these assessments. This protocol defines procedures for assisting to determine onshore, near-shore and offshore influences. Site visits will be made to each water treatment plant to interview operators regarding raw water trends; review raw water quality records; and initiate a contaminant source inventory. As mandated by Congress, all source water assessments must be completed by May 2003.

Human Health Effects Associated with the Quality of Surface Water

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The bacterial indicator concept has been used for over one hundred years and is today a key element in maintaining the quality of recreational waters. Early use of bacterial indicators was not risk based. The presence of bacterial indicators signaled the presence of fecal material and this alone was considered hazardous enough to disqualify the use of the contaminated water. In the late 1940's indicator bacteria were used quantitatively to measure the quality of recreational water and this data was used to determine if the water quality was related to health effects associated with swimming activity. Health effects were found to be related to contaminated recreational water. These findings were extended and refined by U.S. EPA studies in the 1970's on the relationship between water quality and swimming-associated health effects. These data were used by the U.S. EPA to develop guidelines for maintaining the quality of recreational water. The findings of the U.S. EPA studies have been confirmed in studies around the world and lend credence to the approach used in the United States to protect the health of swimmers.

The establishment of a risk-based approach to protecting the health of swimmers has not, however, solved all of issues related to maintaining high quality recreational waters. The U.S. EPA's Action Plan for Beaches and Recreational Water has discussed a number of these issues, many of which are related to indicator bacteria. Two issues that frequently raise questions from water resource managers involve indicator bacteria. All currently recommended indicator bacteria demonstrate the presence of fecal material from warm-blooded animals without distinguishing whether the source is human or animal. Research findings regarding health effects associated with non-point source of pollution, i.e., animal or bird contamination of water, are equivocal. Data from past research will be used to further define this issue. Another issue which frequently raises questions is whether the risk of swimming in waters that receive discharges from a combined sewer overflow (CSO) is the same as that encountered in waters affected by a treated wastewater from a point source. Health data associated with exposure to CSO discharges that affect recreational waters is not available; however, it is possible to speculate on the risk due to this type of exposure using microbial data from the analysis of wastewaters that pass through sewage treatment plants and data from studies on storm water run-off.

St. Clair and Detroit River Angler Survey

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Between August 1995 and June 1997, researchers from the Sport Fish and Wildlife Consumption Study in Areas of Concern interviewed people who were fishing along the shoreline in five Great Lakes locations

(Metro Toronto, Hamilton Harbour, and the Canadian sides of the Niagara, Detroit and St. Clair Rivers). This paper reports the research results from two locations – the St. Clair and Detroit Rivers, where survey activity was conducted from June 1996 to November 1996, and again from April 1997 to June 1997.

The study was devised to provide detailed information about fishing in each of the water bodies surveyed. Data was collected by research assistants on site, using 3 methods: structured questionnaires, semi-structured tape-recorded conversations and field notes which contained the comments of fishermen and the interpretations of the research team.

This paper presents findings on the proportions of fishers who ate fish from these locations, how much fish they ate, and what species. We also report the reasons 'non-eaters' gave for not eating their catch and the 'concerns' that eaters had about their catch. We also examine how frequently those shoreline fishers who eat their catch reported using the *Guide to Eating Ontario Sport Fish*.

Relying particularly on tape-recorded interviews and field notes, we asked participants for their perspective on the risks and benefits of fish and aquatic wildlife consumption and their opinions about a wide range of related issues, including the state of the local fishery and the aquatic environment. This paper briefly summarizes some of the more important observations and insights shared by participants regarding the benefits of fishing and eating fish from these water bodies, and the meaning/value of the local fishery.

We conclude with some observations regarding the importance of the local fishery on the St. Clair and Detroit Rivers, ways the fishing population in each region could be much more fully engaged as stewards of these resources and measures which could be taken to more effectively communicate consumption advisory information.

Macomb County Health Dept. Efforts to Protect Recreational Users of Lake St. Clair

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The Macomb County Surface Water Improvement and Monitoring (SWIM) Team, a Blue Ribbon Commission Report recommendation, was created in the latter part of 1997 with funds committed by the Macomb County Board of Commissioners. Its mission is monitoring, educational, investigatory and enforcement activities toward achieving the goal of all Macomb County surface waters being in compliance with full body contact standards. This mission is accomplished through systematic monitoring, investigation to locate sources of sewage pollution and enforcement of corrective actions. Sewage complaints and referrals are also investigated.

The Macomb County Health Department (MCHD) has developed a working relationship with the Water Quality Unit of the Macomb County Prosecuting Attorney's Office in dealing with enforcement actions where compliance cannot be achieved cooperatively. Enforcement actions consist of the issuance of a citation pursuant to the Macomb County Health Department Regulations for Monetary Civil Penalties/Citations. The MCHD also has the ability to seek criminal charges if deemed appropriate.

The MCHD conducts a bathing beach monitoring program at four beaches on Lake St. Clair in accordance with established procedures. The program runs from mid-April through late September and utilizes *Escherichia coli (E. Coli)* bacteria as an indicator of the presence of sewage or other wastewater. If bathing beach water contains more than 300 *E. coli* colonies per 100 milliliters of water on a single day or more than 130 *E. coli* colonies per 100 milliliters of water as a 30-day average, a beach is closed until the standards are met.

Watershed monitoring is also conducted at 52 sampling sites where *E. coli* samples are collected once per week. Samples are also collected at selected sites in response to rainfall events, especially in areas where

combined sewer overflows have occurred or are anticipated. The data are reviewed closely for changes from previous weeks, for trends that might indicate problems requiring investigation and for reduction in pollution levels that result from corrective efforts.

Additionally, Lake St. Clair has been the focus of monitoring programs conducted during the summers of 1998 and 1999. Water and sediments in nearshore and offshore areas have been monitored for *E. coli,* nutrients, heavy metals and water quality parameters. Several spatial, temporal and weather-related relationships have been found in the data. The State of Michigan, the Macomb County Board of Commissioners and the United States Army Corps of Engineers funded these studies.

The MCHD conducts several additional programs in the area of surface water quality protection. These include On-Site Sewage Disposal Regulation, Environmental Management and Risk Assessment Program (EMRAP), Household Hazardous Waste (HHW) collection and marina Pollution Prevention. Also the MCHD recently opened a collection site for the Michigan Department of Agriculture Clean Sweep Pesticide Disposal Program.

Loadings, Toxics, Transport and Sources

Urban Runoff in the Clinton River Watershed

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In 1991, the U.S. Geological Survey (USGS) initiated a full-scale program to assess water-quality conditions for a large part of the stream and aquifer systems in the U.S. The long-term goals of the National Water Quality Assessment (NAWQA) Program are to (1) describe the current water quality, (2) identify trends in water-quality, and (3) understand factors that affect the water-quality of U.S. surface- and ground-water resources. Sites in the Clinton River watershed have been included in the Lake Erie-Lake St. Clair NAWQA Study Unit. Data have been collected on the quality of bed sediments, surface and ground water, habitat, and fish and invertebrate communities as part of the NAWQA study design. This presentation depicts the Clinton River watershed in comparison to other watersheds in the Lake Erie-Lake St. Clair NAWQA Study Unit. Among ten river systems in the Lake Erie-Lake St. Clair basin, the Clinton River exhibits high quality habitat, but impaired fish and invertebrate communities. Fish and invertebrate communities may be most affected by bed sediment quality. Records of the Ohio EPA, U.S. EPA and USGS were summarized for recently-deposited bed sediments (samples collected from the top 10 cm from 1990-1997). Bed sediment contamination with persistent and bioaccumulative chemicals such as chlorinated industrial compounds (PCBs), chlorinated pesticides (chlordane, DDT, dieldrin), polycyclic aromatic hydrocarbons (PAHs) and trace metals, such as mercury, is relatively high in the Clinton River watershed. Surface water quality is less impaired than in other Lake Erie-Lake St. Clair watersheds, but shows evidence of human effects in the form of increased chloride and the presence of urban-use pesticides such as diazinon. Shallow ground water throughout the NAWQA study unit also shows elevated chloride concentrations, most likely a result of human activities. Taken together, the USGS NAWQA results document the effects of urban land use on bed sediment, and surface- and ground-water quality in the Clinton River watershed.

Combined Sewer Overflows and Industrial Discharges in the St. Clair River Watershed

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The St. Clair River watershed is home to approximately 170,000 people. Land use in the watershed is primarily agricultural with 78% of land in Ontario and 68% in Michigan used for agricultural purposes.

Local economies are closely tied to industrial manufacturing, particularly petroleum refineries, chemical manufacturing and power generation.

Discharges and spills from the petrochemical manufacturers and municipalities have typically been the benchmark for environmental quality in the St. Clair River. In the 1980's and prior, industrial spills often numbered well over 100 per year and many were of a significant size.

As a result of voluntary and regulated changes such as improved treatment, spill prevention plans, pollution prevention measures and plant closures, loading reductions of contaminants of concern were reduced 75 to 90% in the mid to late 1980's. Further reductions in the 1990's mean that contaminants can virtually no longer be measured in the water.

Despite being virtually eliminated from discharges, many of these contaminants of concern are persistent and bioaccumulative (e.g. mercury, hexachlorobenzene, octachlorostyrene), and as a result can still be measured in sediments on the bottom of the river and in the food chain. Mercury levels in Walleye in Lake St. Clair have dropped steadily since 1970 when the main source was eliminated; however, sediments contaminated with historical deposits constitute a biologically available source. This is an important area currently being evaluated by the St. Clair River Remedial Action Plan (RAP).

With the reductions in industrial discharges, the City of Sarnia Sewage Treatment Plant (STP) and combined sewer overflows (CSOs) have emerged as an important source of contaminants which need to be addressed. The City of Sarnia has developed a Pollution Control Plan and with Provincial funding assistance is currently upgrading the STP from primary treatment to secondary. In addition, the first of 3 detention basins to capture CSO discharges has been constructed and is anticipated to achieve 90% runoff control. CSO events are expected to decline from 60 per year to 15 or fewer per year once the plan is fully implemented. During 1997, the first detention basin intercepted 17 events and no overflows to the St. Clair River occurred.

An inlet control program and sewerage study are being conducted by the City of Sarnia with a view to minimize overflows and pollutant loadings to the St. Clair River as well as basement flooding.

The St. Clair River Remedial Action Plan has highlighted the need to address pollutant loading issues and is encouraged by the progress achieved to date, particularly by industries. Efforts will continue to ensure that current and historical sources of contaminants will be minimized to the greatest extent possible.

Agricultural Impacts in the Thames River Watershed

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Although the Thames River watershed includes the urban areas of London, Chatham, Woodstock and Stratford, there has been and continues to be a significant focus on the impact of agriculture on water quality through nutrient losses, pathogen discharges and persistent toxic (pesticide) residues.

Historically, there has been a continuum of programs and initiatives which have tried to address these concerns and generally meet targets such as those in the Great Lakes Water Quality Agreement. These programs have included federal, provincial and local government driven attempts to address concerns with soil erosion, pathogen transport, adoption of best management practices and dramatic water quality impacts such as fish-kills.

Government program successes and gains are now being augmented by farm leadership driven initiatives to deliver programs to assist and encourage farmers to develop comprehensive environmental farm plans (Environmental Farm Plan Program -EFP) and consistent, comprehensive nutrient/manure management

planning (Nutrient Management Planning Strategy-NMP) with accompanying publications, training and promotion.

This presentation looks at trends in nutrient levels, pesticides residues, pathogens and manure spills/fish-kills incidents focusing on historical improvements and successes in all these areas,

Perhaps the most emotional agricultural issue at present is the general opposition to large scale livestock operations. Although a Nutrient Management Strategy has been developed to address this issue from the standpoint of efficient, safe and environmentally acceptable manure utilization, concerns persist. The persistent problem of manure spills in livestock dense areas fuel these concerns. The majority of manure spills in Ontario over the past 12 years have taken place in South western Ontario. Almost all the spills (more than 230 in Southwestern Ontario) have involved liquid manure, mostly swine. Approximately 60% of the spills have gained access to an open water-body by means of a tile drain and approximately 42% have been associated with the use of spray irrigation techniques of land application.

In summary, it is anticipated that agricultural/environmental issues will continue to be with us into the millennium and the Ministry of Environment will continue to support sector driven and local partnership initiatives, such as the Environment Farm Plan (EFP) and the Nutrient Management Planning Strategy (NMP), which we feel will produce a strong, sustainable commitment to change that will be longer lasting than though regulatory intervention alone.

Loadings from Contaminated Sediments in the St. Clair River

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Historically, the St. Clair River has transported many of the contaminants that are now found in the sediments of Lake St. Clair. These contaminants include mercury, HCB, HCBD and OCS. The industrial point sources from which these chemicals originated are now effectively controlled; however, there are still significant masses of contaminants stored in the sediments of the St. Clair River. This paper discusses the mobility of in-place pollutants at a site near Sarnia, ON. The contaminants of interest are generally hydrophobic, i.e. they tend to partition strongly to the solid phase rather than the liquid phase. As a result, their fate is tied to the fate of the sediments, especially fine sediments, on which they are sorbed. Field, laboratory and computer modelling studies were conducted to assess the probability of sediment and chemical flux from the selected site. The participants in the study included the Ontario Ministry of the Environment (MOE), the Great Lakes Institute for Environmental Research at the University of Windsor, SUNY at Buffalo, NY, and Environment Canada. The Lambton Industrial Society provided data on toxicology of the sediments and the benthic communities.

The MOE completed extensive coring, chemical and sediment analyses for the site. All of the data were incorporated in a GIS, which permitted a 3-D representation of the contaminated sediments and the associated chemical masses. The GIS was used to map the sediment quality as determined by a Triad score of chemical levels, sediment toxicology and benthic community. This procedure identified approximately 4,500 m^3 of highly impair sediments.

Laboratory studies at CCIW were conducted to establish the resuspension and depositional behavior of the fine sediments found at the site. These studies established site specific relationships between the sediment flux and the shear stress of the river.

A 3-D hydrodynamic-sediment transport model was used to establish the shear stress at the site under various river flows, winds, ice cover and ship passage. This model was used to estimate short term erosion

and depositional responses at the site of the contaminated sediments. The IPX version of WASP5 was applied to establish long term sediment and contaminant fate and transport. HCB was used as a surrogate hydrophobic chemical. The model showed that ship induced shear stress can resuspended fine sediments and sorbed contaminants. This was confirmed by MOE field data.

Under the present conditions, both the model and field measurements showed that the water column concentration at the site is of the order of 2 ng/L and the export from the site is approximately 15 g/day. The half-life of the mass of HCB at the site is about 20 years.

Physical Conditions and Processes

Meteorological Analysis of the Lake St. Clair Region

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During 1994, an unprecedented, large amount of matted aquatic plants drifted toward, and amassed along, the western shores of Lake St. Clair. The State of Michigan and Governor John Engler responded by treating the aquatic situation as a "declared emergency." This prompted the Michigan Department of Environmental Quality to launch a multifaceted investigation of the lake's ecology and physical characteristics.

As part of this overall research effort, a sub-study was conducted to review the meteorological condition leading up to, and during the aquatic plant episode. Attention was focused on identifying and reconstructing meteorological occurrences which might have significantly affected the growth, lifespan and eventual breakoff of the plant stems. A modified particle drift model, developed at the Great Lakes Environmental Research Laboratory (GLERL), was then used to analyze observed wind patterns and their effect on the movement of the floating aquatic plant mats in Lake St. Clair.

It was observed that a relatively calm period, during the height of the 1994 aquatic plant growing season, allowed rooted aquatic plant to grow extensively without the usual "pruning" by storms. Then, in June 1994, several storms ripped the plants from the shallow lake bottom and wind-driven currents deposited the masses along the U.S. shore. The modified GLERL drift model, incorporating Lake St. Clair's current patterns, generated a reasonable depiction of the movement of these masses and corresponded well with observed patterns of deposition.

St. Clair Shores Shoreline Reconfiguration

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Frequent and potentially serious beach closures plague the U.S. shore of Lake St. Clair. Typically, *E. Coli* counts peak during the quiescent summer months after major rain events. The goal of this combined numerical prediction and case study analysis is to understand the physical conditions that result in beach closures and to demonstrate mechanisms to mitigate the adverse impacts of drainage into the lake.

A combined decision support system is proposed and demonstrated for Lake St. Clair that incorporates satellite imagery, real time environmental data, a numerical predictive model, and through data assimilation provides beach closure advisories. This system is exercised for a critical period during the summer of 1999

to demonstrate the nature of beach closures in St. Clair Shores, MI and their relation to County Health Department sampling strategy. Gaps in environmental data are identified.

This model can be exercised in three modes; Hind-cast, Now-cast and Fore-cast. In Hind-cast mode the system uses historical environmental data inputs to show potential dispersal sources and pathways. In Now-cast mode, the model uses the past 24 hours of environmental inputs to show current circulation within the basin and its associated dispersal pathways. In Fore-cast mode, the system uses current as well as forecast environmental inputs to show where future dispersal grounding may occur at least 24 hours in advance. This system is intended to be used to make informed management decisions by identifying potential source areas of effluents, streamlining environmental testing, and minimizing contact by the public during predicted events.

In addition, a coastal engineering analysis and redesign of Memorial Beach at St. Clair Shores, MI has been undertaken in conjunction with this modeling effort. The purpose of this design effort has been to create a beach and park environment that serves to mitigate the collection of unwanted materials. This proposed redesign has been implemented with very promising results, dropping the number of beach closures from 49 (prior to redesign and construction) to only 3 in 1999.

Water Movement and Fecal Coliform Contamination in The Metro Beach Area of Lake St. Clair

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This investigation examined sources of fecal coliform bacteria contaminating the Metro Beach swimming area of Lake St. Clair. The initial hypothesis was that bacterial contamination in the Metro Beach area originated from contaminated Clinton River water transported from the spillway to the beach by water currents. Dye movement studies and measurements of fecal bacteria concentrations were used to identify water movement patterns and bacterial distributions. Dye was injected in several locations between the Clinton River spillway and Metro Beach during the weeks of 1 June, 13 July, 3 August, 24 August, and 7 September 1998. Dye cloud movement was tracked at intervals over a 12 to 24 hour period. In conjunction with water movement studies, concentrations of *E. coli* were measured between the Clinton River spillway and the Metro Beach Area. Winds blowing out of the west and southwest resulted in water circulation that followed an easterly trajectory toward the beach area. During the summer of 1998, westerly winds (i.e., from NW to SW) blew 62% of the time, but movement of water from the spillway to the beach was observed during only one of the dye-movement studies. Bacterial concentrations were below detection limits in nearly all samples. Nearshore samples occasionally exhibited low levels of bacterial contamination, but no significant contamination was detected between the spillway and the beach.

Despite low flows from the Clinton River spillway in 1998 and low bacterial concentrations in the area between the spillway and Metro Beach, *E. coli* concentrations were often elevated in the immediate vicinity of the beach, which resulted in several beach closings. Based on these observations, dye dissipation studies and bacterial sampling were also conducted in the swimming area at Metro Beach during the weeks of 3 and 24 August and 7 September. Bacterial concentrations in the swimming area were measured along a series of transects perpendicular to the shore, beginning at the water's edge and extending out to a depth of three feet. Bacterial concentrations were consistently highest close to shore, suggesting that bacteria were entering the lake directly from the beach. During dye studies, bacterial concentrations were relatively low on the upstream end of the beach and increased toward the downstream end of the beach. This pattern suggests that relatively clean water from the lake was becoming contaminated as it passed the beach. Relatively high concentrations of bacteria were observed in the swimming area, despite a water residence time of approximately one-half hour. The source of bacteria was not positively identified, but large numbers of gulls and geese congregate on the beach at night, and their droppings are the most likely source.

The results of this study provide very strong evidence that bacterial contamination of the beach itself is an important source of bacterial contamination in the Metro Beach swimming area. During years with more frequent summer storms, contamination from the Clinton River spillway might also reach the Metro Beach area, but this was not observed during 1998.

Trends in Lake St. Clair Aquatic Plant Communities

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Over the past forty years, three issues have exerted a significant impact on Lake St. Clair aquatic plant communities, and will continue to impact Lake St. Clair in the near future: changes in water quality (particularly clarity), the introduction on nonindigenous plant species, and changes in Great Lakes water levels. Water clarity, as measured by Secchi Disk depth, increased from an average of 1.5m for the period 1967 to 1982, to an average of 2.8m in 1995. Most investigators attribute this increase in water clarity to the introduction and increased numbers of zebra mussels in Lake St. Clair. Plant distribution in the lake increased dramatically during this time period, from covering 59% of the lake in 1978 to 92% of the lake in 1995, based on USGS surveys. Increased transparency can account for most of this increase, based on empirical models relating maximum depth of occurrence to water transparency. Nonindigenous aquatic plants have also caused changes in the aquatic plant community of Lake St. Clair. In particular, Eurasian watermilfoil (*Myriophyllum spicatum*) has slowly spread throughout the lake. In 1978, the USGS found Eurasian watermilfoil at 20% of sample sites, and 35% of vegetated sites. In 1995, the USGS found Eurasian watermilfoil at 40% of sample sites, and almost 50% of all vegetated sites. While Eurasian watermilfoil has not yet dominated vegetation in the system, it is becoming more common throughout the lake. In addition, studies assessing the probability of other nonindigenous species performing well in Great Lakes states has indicated that monoecious hydrilla (*Hydrilla verticillata*) and egeria (*Egeria densa*) both have high probabilities for surviving in the region around Lake St. Clair. Lastly, the Great Lakes, including Lake St. Clair, have experienced water level reductions. Given that Lake St. Clair is a large shallow system with low slope, even small decreases in water level have the potential for losing significant acreage of submersed aquatic plant and wetland communities, which are vital habitat for fish and food for migrating waterfowl. Given the changes in aquatic plant community and potential for further invasions of nonindigenous aquatic plant species, it is prudent to pursue a master management plan for the lake that includes an aquatic plant component. The aquatic plant component would include prevention of new nonindigenous species invasions, assessment, site-specific management, evaluation, monitoring, and education.

Contact Information for Speakers Who Did Not Submit Presentation Abstracts

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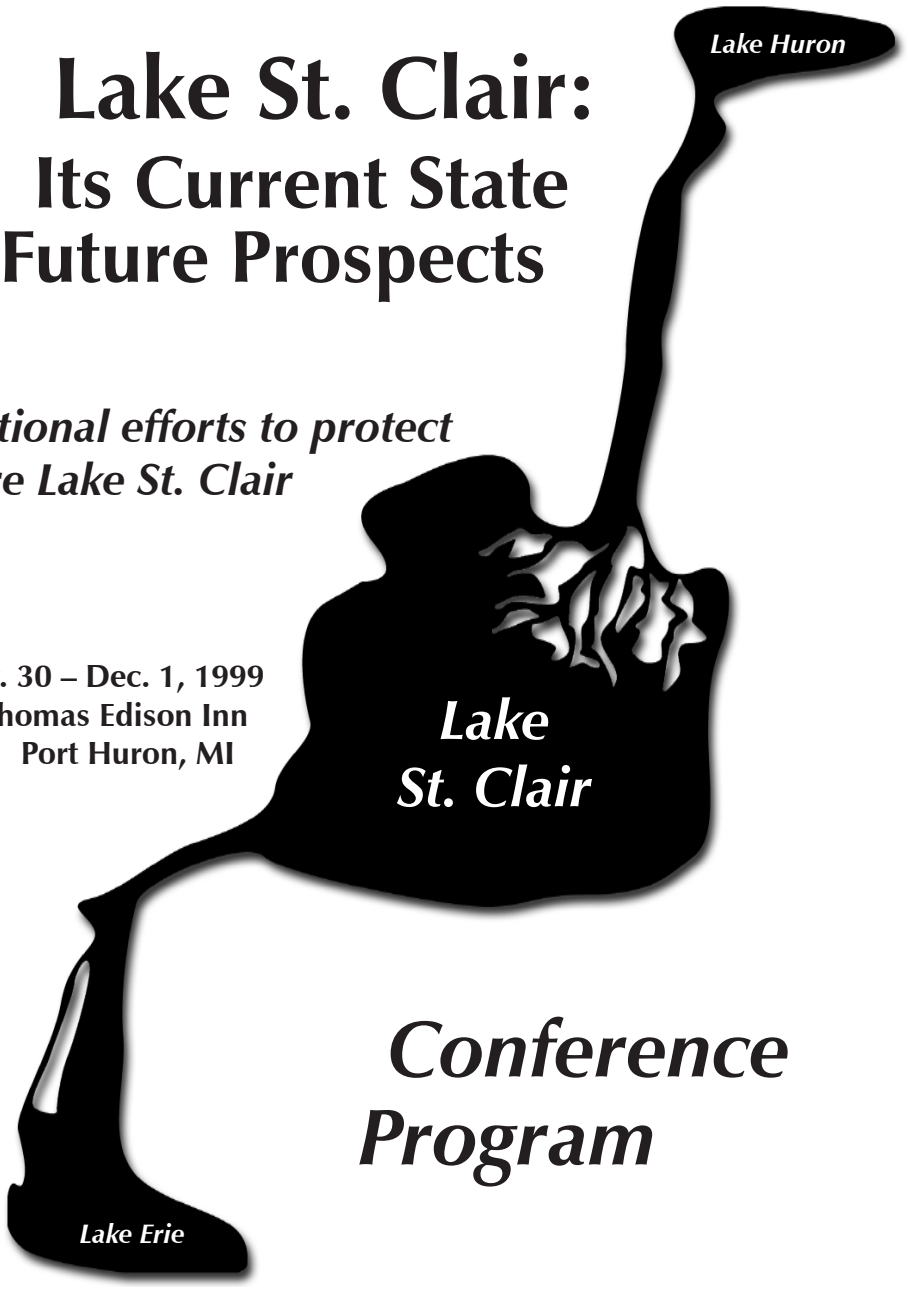
Appendix A

Conference Program

Lake St. Clair:
Its Current State and Future Prospects

Advancing binational efforts to protect and restore Lake St. Clair

Nov. 30 – Dec. 1, 1999
Thomas Edison Inn
Port Huron, MI



Conference Program

Sponsors

U.S. EPA, Great Lakes National Program Office
U.S. EPA, Region 5
Walpole Island First Nation
Great Lakes Commission
International Joint Commission
Environment Canada
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. Coast Guard
U.S. Army Corps of Engineers
Natural Resources Conservation Service
Michigan Dept. of Environmental Quality
Michigan Dept. of Natural Resources
Ontario Ministry of the Environment
Ontario Ministry of Natural Resources
Essex Region Conservation Authority
Macomb County
St. Clair County
Michigan Sea Grant College Program
Clinton River Watershed Council
Clinton River RAP Public Advisory Council
Southeast Michigan Council of Governments
Council of Great Lakes Industries
Lambton Industrial Society

Lake St. Clair: Its Current State and Future Prospects

Conference Overview

The conference will provide a binational forum to exchange information on the state of Lake St. Clair, discuss critical issues, and review programs, policies and institutions responsible for managing the lake. Conference participants will identify actions, resources and collaboration needed to implement environmental improvements within the lake and its watershed. The conference is intended for resource managers, local officials, elected representatives and other stakeholders involved in implementation efforts to address the environmental problems facing Lake St. Clair. The conference offers a valuable opportunity to learn more about Lake St. Clair and help build consensus on the actions needed to protect the lake.

Conference Agenda

Tuesday, November 30

8:30 a.m. **Registration and Continental Breakfast** (Cambridge Ballroom)

9:00 a.m. **Opening Remarks, Introductions and Review of Meeting Agenda and Goals** (Cambridge Ballroom)

Michael J. Donahue, Executive Director, Great Lakes Commission
Tim Henry, Associate Director, Water Division, U.S. Environmental Protection Agency, Region 5
John Hertel, Chairman, Macomb County Board of Commissioners
Pat Acciavatti, Chairman, St. Clair County Board of Commissioners

9:20 a.m. **The State of Lake St. Clair: Historical Perspectives and Existing Conditions**

The purpose of this session is to establish a common, general understanding of the Lake St. Clair resource, including physical conditions, land use, fisheries, recreation and economic uses, patterns of change and past studies and research efforts.

Gene Jaworski, Eastern Michigan University
Don MacLennan, Ontario Ministry of Natural Resources
Van Snider, Michigan Boating Industries Association

10:15 a.m. **Break**

10:30 a.m. **Research, Policy and Management Responsibilities for Lake St. Clair**

Representatives from agencies involved in managing Lake St. Clair will review their mandates and responsibilities and identify priorities, challenges and unmet needs related to the collective management effort.

Moderator: Michael J. Donahue

International Arrangements for Lake St. Clair
Tim Henry, Associate Director, Water Division, U.S. Environmental Protection Agency, Region 5

Tribal/First Nation Issues and Concerns
Dean Jacobs, Director, Walpole Island Heritage Centre

State and Provincial Perspectives
Jim Janse, Director, Southwestern Region, Ontario Ministry of the Environment
Lynn Buhl, Director, Southeast Michigan Office, Michigan Dept. of Environmental Quality

Local Institutions and Perspectives from the U.S. Side
Doug Martz, Chair, Macomb County Water Quality Board

Local Institutions and Perspectives from the Canadian Side
Ken Schmidt, Essex Region Conservation Authority

Questions, comments and discussion.

12:00 Noon **Lunch and Keynote Speaker** (Grand Lobby)

Honorable David Bonior, United States Congressman, District 10, Mt. Clemens

1:30 p.m. **Concurrent Sessions**

The afternoon sessions will provide an overview of the major issues facing Lake St. Clair. Priorities, unmet needs and action items will be recorded for further discussion during breakout sessions on the morning of day two. Four sessions will be held concurrently and repeated at 3:45 p.m. Participants may attend two of the four sessions.

Session One: Habitat and Biodiversity *(Bedford Room)*

Fish Community Composition and Change
Bob Haas, Michigan Dept. of Natural Resources
Mike Thomas, Michigan Dept. of Natural Resources

Aquatic Macrophytes and Wetlands
Doug Wilcox, U.S. Geological Survey

Exotic Species and Lake St. Clair
Tom Nalepa, NOAA, Great Lakes Environmental Research Laboratory
Dave Jude, Center for Great Lakes and Aquatic Sciences
University of Michigan

Biodiversity Conservation Strategy for the South Shore of Lake St. Clair
Dan Lebedyk, Essex Region Conservation Authority

Moderator: Rose Ellison, U.S. Environmental Protection Agency

Session Two: Human Health, Beach Closures and Drinking Water *(Cambridge North)*

Michigan Source Water Assessment Program Activities in Lake St. Clair
Brad Brogren, Michigan Dept. of Environmental Quality

Trends in Fish Contaminant Levels and Bases for Advisories for Lake St. Clair
Bob Sweet, Michigan Dept. of Environmental Quality

Human Health Impacts of Bacteria in Surface Water
Dr. Al Dufour, U.S. Environmental Protection Agency

St. Clair and Detroit River Angler Survey
Jennifer Dawson, McMaster University
David Kraft, Strategic Communications, Toronto

Macomb County Health Dept. Efforts to Protect Recreational Users of Lake St. Clair
Gary White, Macomb County Health Department

Moderator: Sean Morrison, Lambton Health Unit

Session Three: Loadings, Toxics, Transport and Sources *(Cambridge South)*

Urban Runoff in the Clinton River Watershed
Sheridan Haack, U.S. Geological Survey

Combined Sewer Overflows and Industrial Discharges in the St. Clair River Watershed
Roy Schramek, Michigan Dept. of Environmental Quality
Gary Johnson, Ontario Ministry of the Environment

Agricultural Impacts in the Thames River Watershed
Murray Blackie, Ontario Ministry of the Environment

Total Maximum Daily Loads as a Tool for Watershed Management
Tim Henry, Associate Director, Water Division, U.S. Environmental Protection Agency, Region 5

Loadings from Contaminated Sediments in the St. Clair River
Alex McCorquodale, University of New Orleans

Moderator: Jeanna Paluzzi, Clinton River Watershed Council

Session Four: Physical Conditions and Processes *(Lancaster Room)*

Great Lakes Climatology and Water Levels
Frank Quinn, NOAA, Great Lakes Environmental Research Laboratory

Meteorological Analysis of the Lake St. Clair Region
Adam Fox, U.S. Army Corps of Engineers

St. Clair Shores Shoreline Reconfiguration
Dr. Guy Meadows, Cooperative Institute for Limnology and Ecosystems Research, University of Michigan

Water Movement and Fecal Coliform Contamination in the Metro Beach Area of Lake St. Clair
Dr. Craig Smith, Professional Lake Management

Trends in Lake St. Clair Aquatic Plant Communities
Dr. John Madsen, U.S. Army Engineer Research and Development Center

Moderator: Dave Schweiger, U.S. Army Corps of Engineers

3:30 p.m. **Break**

3:45 p.m. **Repeat of Concurrent Sessions**

6:00 p.m. **Reception** (Grand Lobby)

Hors d'Oeuvres and a cash bar will be provided. Displays and informational materials will be arranged around the room from agencies and organizations involved in activities related to Lake St. Clair.

Wednesday, December 1

8:00 a.m. **Registration and Continental Breakfast** (Cambridge Ballroom)

8:30 a.m. **Opening Remarks, Summary of Day One Proceedings and Review of Agenda for Day Two** (Cambridge Ballroom)

Matt Doss, Great Lakes Commission

8:45 a.m. **Breakout Sessions**

Breakout sessions will be convened to identify outstanding issues, gaps and unmet needs, action items, resources and collaborators, and a time frame for the topical areas discussed during day one. Through facilitated discussion, participants will identify points of consensus on the following items:

1) *What are the issues that must be addressed in any effort to improve the environmental quality of Lake St. Clair and its watershed? (Each session will focus on issues in its topical area.)*

2) *For each issue or category of issues identified, what specific actions might be taken? What timeframe should they be pursued in and what resources and collaborative arrangements are needed?*

- *Habitat and Biodiversity (Bedford Room)*
  Facilitator: Richard Hobrla, Michigan Department of Environmental Quality
- *Human Health, Beach Closures and Drinking Water (Cambridge North)*
  Facilitator: Gordon Ruttan, St. Clair County Metropolitan Planning Commission
- *Loadings, Toxics, Transport and Sources (Cambridge South)*
  Facilitator: Roger Nanney, NRCS Liaison to U.S. EPA, Great Lakes National Program Office
- *Physical Conditions and Processes (Lancaster Room)*
  Facilitator: Roger Gauthier, U.S. Army Corps of Engineers

10:30 a.m. **Break**

10:45 a.m. **Reporting Out to Full Group and Open Discussion** (Cambridge Ballroom)

Representatives from each of the breakout sessions will report the results of their session to the full group, followed by open discussion.

Moderator: Michael J. Donahue

12:00 Noon **Wrap Up and Closing Remarks**

Michael J. Donahue, Executive Director, Great Lakes Commission
Laura Lodisio, Regional Team Manager, Southeast Michigan Initiative

A proceedings document will be distributed to all participants following the conference with a summary of input received and abstracts from the presentations.

This conference is made possible through a grant from the U.S. Environmental Protection Agency, Great Lakes National Program Office.

Appendix B

Notes from Discussion Sessions

Lake St. Clair: Its Current State and Future Prospects

Nov. 30 - Dec. 1, 1999
Thomas Edison Inn
Port Huron, MI

Notes from Discussion Sessions

Session One: Habitat and Biodiversity

THEMES

1. Funding
    - Integrated management plan to identify top priorities.
    - Lake St. Clair endowment fund (such as Great Lakes Protection Fund, Lake Erie Protection Fund)
    - One-stop funding website.
    - Use assessment fees.
    - Enforcement fines, natural resource damages.
2. Protecting existing habitat
3. Restore lost, degraded habitat
4. Public education, involvement
    - Biodiversity atlas
    - Environmental education curriculum entrenched
      (professional video, teacher brochure, classroom presentations, seedling labs, supplement to biodiversity atlas, retiree mentoring)
    - Much more media coverage
      (Newspaper series, increase accuracy, website)
    - Volunteer opportunities.
5. Control of exotic species
6. Studies, monitoring, research and data management
7. Land-use management
8. Coordinated, integrated management planning

ISSUES

1. Evaluate wetland protection and restoration potential (especially with lake level issues, climate change forcing more dredging).
2. Dredge spoil placement
3. Diked wetlands on private lands; restore hydrological connections.
4. Lack of public awareness of habitat and biodiversity processes and fns (?).
5. Goby prevention via controls on ships and other mechanisms (bilge monitoring at ingress)
6. Systematic survey of delta biodiversity
7. Purple loosestrife invasions
8. Agricultural buffer strips.
9. Decimation of native mussel species, especially due to the zebra mussel; need to repopulate.
10. Study exotics and fish population interactions.
11. Lake of public understanding of Lake St. Clair habitat and biodiversity values.
12. Storm water impacts due to urbanization.
13. Land use planning; site plans that minimize impacts.
14. Socioeconomic, land cover, biodiversity, data collection and analysis.
15. Prepare an integrated management plan (ACOE rec. in ‘95).
16. Public education: kids, adults.
17. Habitat protection.
18. Funding for land conservation and restoration.
19. Control toxics, pollution.
20. Lake St. Clair watershed protection for water quality and habitat and biodiversity.
21. Soft engineering of shorelines (no seawalls).
22. Environmentally sensitive development techniques.
23. In-lake preserves, including submerged wetlands.
24. Public participation and involvement in stewardship.

25. Hydrological studies on lake levels.
26. Habitat creation in densely developed areas.
27. Local government involvement
28. Better coordination between multiple jurisdictions, international.
29. Mandate urban runoff controls–oils, soil.
30. Onsite storm water management.
31. Recreational, industrial uses in conflict with habitat.
32. Increase understanding of future habitat and biodiversity losses; loss of resiliency, reseeding native mussels.
33. Identify and quantify spawning and nursery areas.
34. Identify equilibrium state as a management goal.
35. AOC designation.
36. Update wetland loss/gain statistics.
37. Involved tribal authorities/First Nations.
38. Expand educational and enforcement of recreational impacts, especially in critical habitats.
39. Increase measurement of human use benefits (creel census, boating use).
40. Assess contribution from spawning stocks.
41. Prevention and control of exotic species.
42. Native seed source, local.
43. Funding for annual study of macrophytes, invertebrates, zooplankton.
44. Internationally compatible monitoring protocols.
45. Why such fish diversity despite insults?
46. Agricultural-to-urban land conversion; losing habitat.

ACTIONS

Funding

1. Communicate priorities to funders
2. Big picture, not small models
3. Mini Lake St. Clair endowment (such as the Great Lakes Protection Fund, Lake Erie Protection Fund)
4. Local funding sources
5. Establish storm water runoff tax
6. Land title transfer fee
7. Pool resources via partnerships
8. Gain public support to influence funding decisions
9. Partnerships to communicate opportunities
10. Change political will to fund environmental programs in the U.S. and Canada
11. One-stop shopping (web site?) To exchange information and ideas.
12. Identify “top dog” to distribute funding.
13. Cultivate foundation support
14. Corporate support
15. Segregate funding actions (e.g., local land acquisition)
16. Natural resource damage fund to fund acquisition/enforcement fines directed to local projects
17. Finance committee to identify sources and match with priorities.
18. Lock fees
19. Integrated management plan to identify priorities
20. Grant manager/writer to coordinate
21. Boat tax, boat gas tax, user assessment fee, toll booth
22. Casinos, steamboat
23. AOC designation
24. Remove restriction on state use of private funds
25. Boat title transfer fee

Public Participation/Education

1. Local stewardship network
2. Media coverage, expand and increase accuracy
3. Biodiversity atlas (such as Chicago Wilderness Atlas), with community foundation and values, stewardship opportunities, etc.
4. Newspaper series
5. Classroom presentation initiative
6. Brochure targeted at teachers
7. Find and communicate success stories
8. Interactive kiosks in schools and public places

9. Retiree mentoring in schools.
10. Integrate messages into RAP communication efforts
11. Public advisory committees with a range of expertise in all major communities.
12. Schools seedling labs.
13. Launch atlas with reference to SOLEC biodiversity investment areas
14. Well maintained web site
15. TV infomercials, more than public service announcements.
16. Volunteer opportunities need coordination, including retirees
17. K-12 environmental education curriculum entrenched (e.g., Project Fish); incorporate into MEAP.
18. What's the message? State of Lake St. Clair ecosystem, critical resources, major threats, research needs.
19. Professional video for classrooms.
20. Local elected official education.
21. Teacher, nature center training (supplement atlas with teacher's manual)
22. Enhance boating community appreciation of habitat and biodiversity values
23. Establish overall committee to coordinate
24. Get people out on tours, boat rides
25. Environmental commodore at all boating facilities.

Session Two: Human Health, Beach Closures and Drinking Water

THEMES

1. Education (E)
2. Monitoring (M)
3. Source reduction (S)

ISSUES

Beaches

1. Lack of hourly environmental/meteorological data (M).
2. Lag time in acquiring results from beach testing–rapid indicators (M).
3. Beach testing in response to weather events and all year round (M)
4. Source control–CSOs, sewage discharges (S).
5. Planing of native vegetation to restore normal habitat (Habitat).
6. Restore funding to rural nonpoint source programs (S).
7. Standardize testing between the U.S. and Canada (M).
8. Epidemiological data on effects of recreation in Lake St. Clair–drinking water, swimming, fishing, relationship of wildlife sources (M).
9. Continue consumer confidence report to water customers–understandable and assessable to the public (E).
10. Develop a system for disseminating information to the public to address the need for public education on issues (E).
11. Links between local health departments and municipal water agencies (E).

Drinking water

1. Education for public on connection between drinking water and uses of water (E).
2. Natural plantings to reduce the need for watering to conserve water (Habitat).
3. Need for more stringent bottled water regulations (S).
4. Better education regarding water treatment systems (E).
5. Need for toxics reduction and source remediation programs (5).
6. Incorporate toxics removal in water treatment plants–develop technology and identify costs (S).
7. Educate the public on the need for monitoring of individual water supplies–review and distribute existing materials and post information on websites (E).
8. Ensure that land application of biosolids is isolated from water supplies (S).
9. Address intake capacity and distribution to the public–maintenance, planning, location of intakes (Infrastructure).
10. Pilot projects–constructed wetlands, BMPs, funding for new technology, monitoring (Funding).
11. Asbestos pipes–identify, locate and eliminate any that exist (S).
12. Controls on ballast water discharges (S).

Fish consumption

1. Consistent guidelines for consumption of sport-caught fish and commercially available fish–toxicity levels stated on containers (E).

2. Relative risk assessment for fish advisories (E).
3. Make fish advisories geo-specific–more broad distribution of fish advisories; increase public awareness through alternative distribution methods for information on fish consumption advisories; and distribute information in non-traditional areas (boat launch sites) (E).
4. Recommended purchasing practices for commercial fish (E).
5. Source control on discharges of mercury and PCB (S).
6. Position on water exports from the Great Lakes (Political Issue).

Miscellaneous comments
1. Inventory existing information/education materials.
2. Web site accessible to all parties–U.S., Canada, First Nation, local communities, school, individuals.

Session Three: Loadings, Toxics, Transport and Sources

SUMMARY

1. Increase regulatory enforcement and compliance.
2. Source control and pollution prevention (e.g., outreach and education).
3. Watershed planning (communication among all stakeholders, data/information sharing).
4. Funding.
5. Load measurement and source identification (monitoring, prioritization, etc.).
6. Process research (BMP effectiveness, sediment dynamics).

THEMES/ISSUES

Urban Runoff
1. Illicit sewer/stormdrain connections.
2. Watershed planning
3. Failing septic systems.
4. Inadequate construction site erosion control.
5. Percolation of storm water.
6. Control quantity and quality.
7. Alternative storm water management (e.g., landscaping).
8. Funding options.
9. Storm water retention.
10. Street sweeping/general maintenance.
11. Alternatives to road salt.
12. Herbicides/pesticides.

Municipal Sources/CSOs
1. Source control/pollution prevention
2. Non-structural BMPs.
3. Exploring alternative manufacturing processes.
4. Programs to separate CSOs.
5. Reviewing permits for discharges to stormdrains.
6. Effluent monitoring.
7. Assessment/changes to industrial pretreatment program.
8. Better land-use planning for urban sprawl.
9. Infrastructure maintenance to decrease infiltration.

Agricultural Runoff
1. Programs to evaluate effectiveness of BMPs.
2. Promotion and education of BMPs.
3. Water quality “trading” as a tool.
4. Stewardship ethic–attitude change.
5. Voluntary efforts fist, regulations second.
6. Passive infrastructure controls.
7. Cooperative partnerships for funding (Chesapeake Bay model).
8. Proper pesticide application rates.
9. GMOs–acceptance of.
10. Alternatives to pesticides.
11. Incentive grants, subsidies, cost-sharing.
12. Clean Sweeps for pesticides.

13. Comprehensive nutrient management plans
14. Knowledge of breakdown products.

Industrial Sources/Regulations
1. Coordinated monitoring program.
2. TMDL for mercury
3. Watershed management plans with the ability to correct voluntarily before enforcement.
4. Understand multi-media discharge/exposure.
5. Quantification of loads and sources.
6. Adequate enforcement (staff and training of staff and citizens).
7. Technology transfer to smaller industries/businesses.
8. System to share monitoring data.
9. Focus and prioritize in light of work already done (i.e., non-traditional sources).
10. Pollution prevention.
11. Education
12. Innovative approaches through local initiatives
13. Re-use and recycle byproducts.

Sediments
1. Understand causes of fish advisories.
2. Sharing sampling plans and data.
3. Funding for remediation.
4. Better knowledge of sediment dynamics.
5. Sediment educational campaign.
6. Better understanding of bio-accumulative effects.
7. Mapping of sample results to identify "hotspots."
8. Characterize the hotspots and agree on remedial plans.
9. Increase understanding and sensitivity to religious/cultural beliefs of Native American populations.
10. Source reduction.
11. Sediment disposal.
12. Short and long-term implications of cleanups.
13. Remove upstream sources (including land).

ACTIONS

Urban Runoff
1. Promote pollution prevention, source reduction, outreach/education, decreased impervious surfaces.
2. Watershed management and planning.
3. Issue storm water permits–get all municipalities to apply for voluntary permits on a subwatershed basis.
4. MDEQ general permit, Phase II rules.
5. Basin planning–target "subwatersheds."
6. Recognize "binational" goals and objectives.
7. Improve communication–binationally, tribal/First Nation, etc.
8. Technology transfer from Rouge NWWDP–mainly for illicit connections.

CSOs/Municipal Sources
1. Promote pollution prevention, source reduction, outreach/education
2. Find funding for sewer separation, implementation of BMPs, and other activities.
3. Consider return to "grant" program.
4. Cost share among four governments.
5. Pollution control plans/evaluate alternatives.
6. Tech transfer from the Rouge Program.
7. Adequate enforcement programs to maintain compliance.
8. Implications of CSOs in industrial pretreatment programs.
9. Relating outcomes to other programs–multi-media/cross-cutting initiatives.

Agricultural Runoff
1. Funding for research on the effectiveness and implementation of BMPs.
2. Promote economic incentives to farmers–cost/benefit studies.
3. More incentives to promote stewardship (e.g., donation of easements, etc.).
4. Promote use of Michigan's Agricultural Pollution Prevention Program (through MDA and others).
5. Incentives from MDNR on natural resource side.

Industrial Sources/Regulations

1. Promote pollution prevention, source reduction, outreach/education.
2. Four agency monitoring program needs to be done–use UGLGS study data.
3. Agree on common water quality standards for the U.S. and Canada.
4. GIS Atlas to present all data in one place (sediments, water quality, land use, etc.).
5. Watershed planning
6. Clearinghouse for sharing data–accessible to governments, citizens, etc.
7. Increase in enforcement/compliance oversight (enforcement staff for inspections and training for local law enforcement.
8. Standardized audit to measure success–"environmental report card."
9. Continuous prioritization and reprioritization.

Sediments

1. Improved enforcement of Soil Erosion Act.
2. Increased funding for local staff.
3. Clearinghouse to share data.
4. GIS Atlas for data.
5. Comprehensive study of sediments of the entire system–Lake Huron to Lake Erie.
6. Other governments should include First Nations in policy setting that effects them (jurisdictional issues).
7. Prioritize areas where sediments are mobile.

Session Four: Physical Conditions and Processes

ISSUES

1. Inform the public of results of the conference, including technical information. Include community-specific information in utility bills.
2. Mechanism to assist coordination of planning and rezoning.
3. Better bathymetric grids for Lake St. Clair. Closer grid.
4. Current models, flow models.
5. Bathymetric data for the whole system, specifically for the St. Clair River and Detroit River.
6. Leaching of *E. coli* from beach study.
7. Lack of wind and wave data for modeling.
8. Farm, sewer, storm outflows in Canada.
9. What kind of bacteria is present, DNA fingerprinting.
10. Educate the public on the best management practices for homeowners on storm water, watershed wide.
11. Increased dredging due to low water levels and associated problems.
12. Impacts of lower water levels on circulation and plants.
13. List of physical conditions affecting the lake.
14. More rapid field-test for bacteria.
15. Outreach and cooperative efforts in education between groups.
16. Identify main sources of *E. coli*, agencies should work together.
17. Identify hard and soft changes to the watershed.
18. Educate the public on watershed impacts.
19. Balancing issues; what is good about the lake.
20. Clearinghouse of research groups for information.
21. Develop a substance to calibrate models for flow.
22. Real-time wind/wave instrumentation.
23. Get communities to look beyond borders and work together.
24. Coordinated effort.
25. Coordination between environmentalists and preservationists; lack of ecosystem balance.
26. Increased control of erosion.
27. Model toxic deposition in sediments, specifically in the delta.
28. Fragmented actions degrade the whole; inform the public on impacts
29. Mechanism to elevate Lake St. Clair as an environmental concern.

ACTIONS

Modeling and Real-Time Data

1. Conduct bathymetric survey/lakebed survey
   USACE, USGS, USEPA, NOAA, CHS, MDEQ–one year.
2. Monitoring buoys to monitor windspeed and direction, water temperature, wave height, current, etc.
3. Circulation surveys

4. Relate information to the public

Toxic Substances

1. Beach testing
   Health departments
2. Develop rapid testing methods

Education

1. Lake St. Clair website
   Macomb County, MSU Sea Grant, other agencies, GLIN
2. TV/radio environmental news
   WWJ
3. K-12 education “kits”
   Macomb County Water Quality Board
4. Speaker pool
   Great Lakes Commission

Appendix C

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Lake St. Clair: Its Current State and Future Prospects

Nov. 30 - Dec. 1, 1999
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Appendix D

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Lake St. Clair: Its Current State and Future Prospects

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Appendix E

U.S. and Canadian Positions Relating to the Designation of Lake St. Clair as an Area of Concern Under the Great Lakes Water Quality Agreement

U.S. and Canadian Positions Relating to the Designation of Lake St. Clair as an Area of Concern Under the Great Lakes Water Quality Agreement

Background

In 1987, the governments of the United States and Canada signed a protocol to the Great Lakes Water Quality Agreement under which they agreed to cooperate with state and provincial governments in designating Areas of Concern in the Great Lakes Basin. Areas of Concern (AOCs) are locations where one or more of 14 identified beneficial uses are impaired due to historic or current pollution. Forty-three AOCs were subsequently designated by the U.S. and Canadian governments, including the St. Clair River and the Detroit River. The U.S. and Canadian governments are preparing and implementing Remedial Action Plans for each designated AOC in cooperation with state and provincial governments and in consultation with the public and other entities.

Recommendation of the International Joint Commission

As part of its role in overseeing implementation of the Great Lakes Water Quality Agreement, the International Joint Commission (IJC) reviews progress in addressing AOCs and recommends additional AOCs for designation by the parties to the Agreement. In its *Ninth Biennial Report on Great Lakes Water Quality* (1998, available at www.ijc.org/comm/9br/9main.html), the IJC recommended that the U.S. and Canadian federal governments:

> ...review the current environmental status and programs in place to address environmental issues in the Lake St. Clair....area, and report this information to the Commission, so that the Commission may direct the Great Lakes Water Quality Board to advise on [the] possible designation as [an] Area of Concern under the Agreement.

U.S. and Canadian Response

In its formal response to the IJC's biennial report (available at www.cciw.ca/green-lane/doc/ninth-ijc-response/intro.html), the Canadian federal government made the following statement regarding the potential designation of Lake St. Clair as an AOC:

> Canada does not believe that the designation of Lake St. Clair as an AOC is warranted at this time. Canada has reviewed the report and recommendations made by the Macomb County Blue Ribbon Commission on Lake St. Clair and is currently reviewing its own environmental data and programs. Following this review, further specific actions that may be warranted to address the environmental issues in Lake St. Clair will be identified. Based on a preliminary assessment most of the issues appear to be local in nature and can best be addressed by local jurisdictions. Mechanisms and agencies are in place to deal with these issues.

The U.S. federal government's response to the IJC report (available at www.epa.gov/glnpo/glwqa/ijc9th/index.html) included the following statement:

> The states of Michigan and Indiana have undertaken thorough reviews of the environmental status and programs in place in both Lake St. Clair and the St. Joseph River areas. Based on their findings, the U.S. does not believe that either of these areas need to be nominated for AOC status. This information will be made available to the Water Quality Board for their information and review.

Appendix F

Four Agency Agreement to Include Lake St. Clair within the Existing Framework of Roles and Responsibilities for the Implementation of the Detroit River, St. Clair River and St. Marys River Shared Remedial Action Plans

Four Agency Agreement to Include Lake St. Clair within the Existing Framework of Roles and Responsibilities for the Implementation of the Detroit River, St. Clair River and St. Marys River Shared Remedial Action Plans

1–WHEREAS, Lake St. Clair is a binational body of water that lies between two binational Areas of Concern, the St. Clair River and Detroit River, that are both included in the Four Agency Letter of Commitment;

2–AND WHEREAS; many of the environmental issues and concerns regarding Lake St. Clair are the same or similar in nature to those regarding these two binational Areas of Concern,

3–AND WHEREAS; the impacts and activities that influence environmental conditions of Lake St. Clair are the same or similar in nature to those affecting these two binational Areas of Concern,

4–AND WHEREAS; the ecosystem and watersheds of Lake St. Clair and these two binational Areas of Concern are interrelated;

5–AND WHEREAS; the St. Clair River and the Clinton River, two major tributaries of Lake St. Clair, as well as the Detroit River, which is the outflow from Lake St. Clair, have been designated as Areas of Concern;

6–AND WHEREAS; the Four Agencies recognize limited resources among the agencies and recognize the efficiency of utilizing an existing framework over creation of a new management structure;

THEREFORE the Four Agencies, in keeping with the intent and policies of the Four Agency Letter of Commitment, agree to an undertaking with respect to Lake St. Clair, for the purposes of improving coordination and communication.

AND THEREFORE, the Four Agencies intent to address the environmental issues regarding Lake St. Clair in context of the St. Clair River/Detroit River Corridor, rather than three discreet water bodies, when appropriate.

Environment Canada

U.S. Environmental Protection Agency

Ontario Ministry of the Environment

Michigan Department of Environmental Quality

March 17, 2000