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*Review and Evaluation
of the Great Lakes*

RAP

Remedial Action Plan

PROGRAM
1991



International Joint Commission
United States and Canada

Great Lakes Water Quality Board
Report to the International Joint Commission

*Review and Evaluation
of the Great Lakes*

RAP

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**PROGRAM
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International Joint Commission
United States and Canada

Cover Photo:
Area of Concern *Clinton River*,
(credit) Taro Yamasaki

Page 34 Photo:
Area of Concern *Rouge River*
where it enters the *Detroit River*

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INTRODUCTION

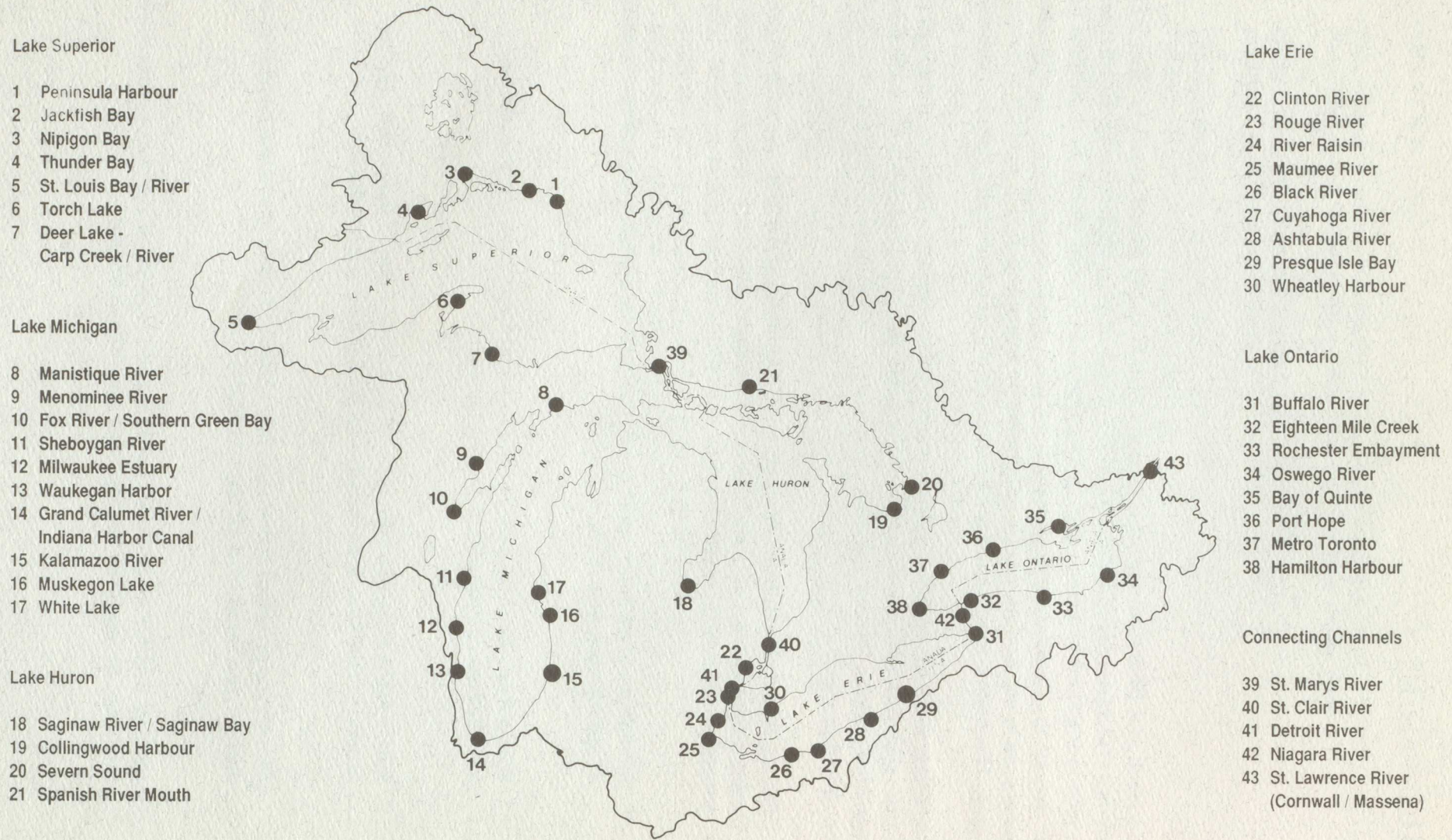
As a result of a 1985 recommendation of the Water Quality Board, the eight Great Lakes states and the Province of Ontario committed themselves to developing and implementing remedial action plans (RAPs) to restore impaired beneficial uses in each Area of Concern within their political boundaries (Figure 1). The intent of RAPs has not changed since 1985: RAPs are intended to identify when specific remedial actions are to be taken and who is responsible for implementation in an effort to restore impaired beneficial uses. The intent is to accelerate remediation. Priority is intentionally placed on remedial actions.

In addition, the RAP planning process is intended to facilitate remediation through increasing accountability, rather than to forestall it. Planning or public participation must not be used as excuses for delaying remedial actions. Where sufficient information exists on problems and remedial options, remediation should proceed.

In 1990, the International Joint Commission (IJC) identified RAPs as one of three priorities for the Water Quality Board during the 1990-1991 reporting cycle. The purpose of this report is to review and evaluate progress in the RAP program. Information will be structured following the IJC's five priority issues:

1. *Identify progress being made in addressing Areas of Concern and recommend, as appropriate, new Areas of Concern;*
2. *Where RAPs have yet to be developed for Areas of Concern, suggest how jurisdictions can expedite RAP development;*
3. *Where RAPs exist, describe specific, and in the Board's judgement, effective programs that have been initiated as part of RAP implementation;*
4. *Identify the principal barriers to, and review the types of specific benefits to be derived as a result of, RAP implementation; and*
5. *Indicate whether and how the Board's and Commission's processes for reviewing RAPs can be improved, and the time involved shortened.*

FIGURE 1. FORTY-THREE AREAS OF CONCERN IDENTIFIED IN THE GREAT LAKES BASIN



1. *Identify Progress Being Made in Addressing Areas of Concern and Recommend, as Appropriate, New Areas of Concern*

A. PHILOSOPHY OF TWO-TRACK PROCESS TO IMPLEMENT RAPs AND RESTORE USES

The Water Quality Board has recognized that implementing RAPs and restoring beneficial uses is a two-track process: 1) existing programs must be expedited and accelerated; and 2) the schedule of steps must be identified as must the sequencing to determine actions beyond existing programs that are needed to restore fully beneficial uses in Areas of Concern. Because this is a long-term, iterative process, it is essential that a schedule of key action steps or 'milestones' be identified to measure progress in RAPs. As well, the celebration of milestones then becomes an important aspect in sustaining momentum in RAPs over the long-term (see Section 3 for specific examples of progress).

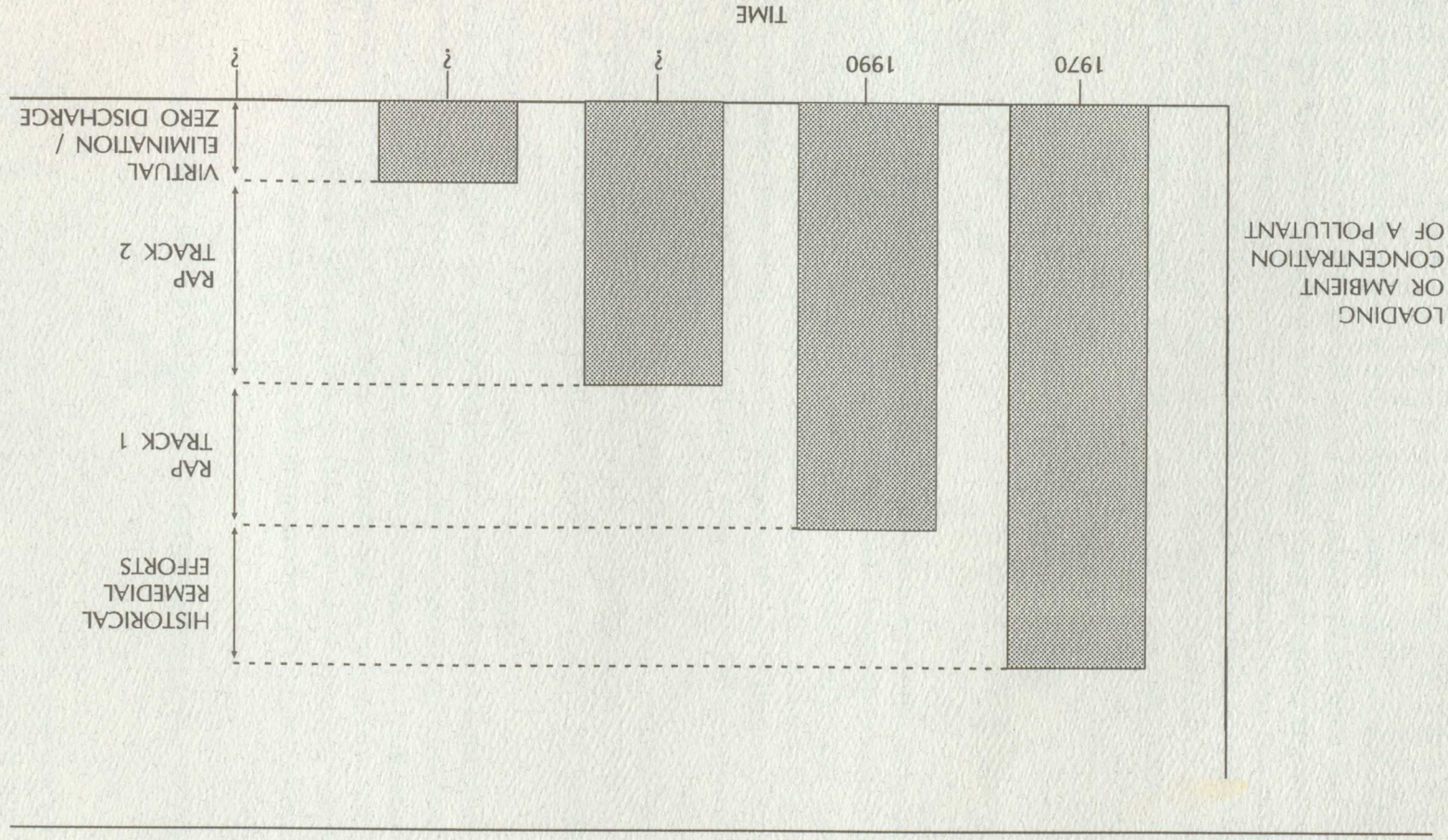
Figure 2 presents one example of the two-track process of RAPs and its relationship to the long-term goal of the virtual elimination of persistent toxic substances identified in the Great Lakes Water Quality Agreement. A hypothetical chronology for pollutant loadings/concentrations shows an incremental decrease over time. Between 1970 and 1990, considerable remedial efforts were undertaken which resulted in a decrease in pollutant loadings/concentrations as depicted in Figure 2. Implementation of track one of RAPs (i.e. expedite and accelerate existing programs) will lead to further quantifiable reductions in pollutant loadings/concentrations; however, implementation of track two of RAPs will probably be required to restore fully all impaired beneficial uses. Subsequently, additional efforts and time will probably be required to achieve the virtual elimination of persistent toxic substances. A similar illustration could be used to depict improvements in other issues such as eutrophication and habitat.

B. STEPS TOWARD ECOSYSTEM MANAGEMENT

The Great Lakes Water Quality Agreement states that RAPs shall embody a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses in Areas of Concern. The ecosystem approach attempts to account for the interrelationships among land, air, water and all living things, including humans. Historically, governments have implemented separate programs for regulation or management of point sources, nonpoint sources, fisheries, wildlife, dredging, land-use, and other issues with little attempt to account for the interrelationships between programs and components of the ecosystem. RAPs are attempting to take a multi-institutional, multiple-use, ecosystem approach to restoring beneficial uses.

RAP institutional structures are one primary way of accounting for interrelationships among ecosystem components. Currently, 33 of the 43 Areas of Concern have a stakeholder group, basin

FIGURE 2. A GRAPHIC DEPICTION OF THE TWO-TRACK PROCESS FOR RAPS AND ITS RELATIONSHIP TO VIRTUAL ELIMINATION OF PERSISTENT TOXIC SUBSTANCES



committee, citizen advisory committee or comparable group broadly representative of environmental, social and economic interests within an Area of Concern (Table 1). Such groups are working to promote institutional cooperation and implement the ecosystem approach at the local level. Where RAP institutional structures are lacking in Areas of Concern, this may reflect the fact that public participation and institutional cooperation are at different stages of their evolution.

In the process of trying to understand the causes of problems as complex as persistent toxic substances and to find solutions, every effort must be made to facilitate integration of all plans within a specific Area of Concern (RAPs, fishery management plans, habitat management plans, land use plans, economic development plans, and others), facilitate achieving complementary and reinforcing goals in different plans, and facilitate explicit recognition of the interrelationships among plans. RAPs should not duplicate other planning efforts, but must account for interrelationships and ensure integration. It is important to note that a RAP is not simply an additional plan, but a means of refocusing media-specific plans in a coordinated fashion. Good examples of this effort include:

- For the Fox River/Green Bay RAP, Wisconsin's effective institutional arrangements with strong commitments to cooperative, integrated resource management and ecosystem redevelopment;
- For the Hamilton Harbour RAP, Ontario's commitment to a stakeholder group, explicit adoption of the ecosystem approach and the goal of virtual elimination of persistent toxic substances as guiding principles, and commitment to manage the resource through balancing social, environmental and economic concerns in a sustainable way; and
- For the Rouge River RAP, Michigan's effective use of the Rouge River Basin Committee and Southeast Michigan Council of Governments to facilitate cooperation and account for interrelationships among the RAP, the fishery management plan, the recreational enhancement plan, dredging and harbor maintenance, and land use within the entire Rouge River watershed.

There is no single 'best' model for implementing the ecosystem approach or for RAP institutional structures. Every RAP is unique, and the makeup of RAP institutional structures reflects the diversity of people and interests in the Area of Concern. Some agency personnel are unaccustomed to dealing with the public and to having their recommendations subjected to direct scrutiny and discussion; for them the transition to fulfilling the Agreement's requirement for public participation and use of the ecosystem approach in RAPs has been a difficult one. In other groups, agency staff concede that while stakeholder involvement may slow some stages of planning, the need to explain planning rationale has made governments evaluate more thoroughly the decisions that they make. Having industries, municipalities, land-use planners, citizens, and others at the table when key decisions are made has been a major breakthrough for RAPs and provides a model for cooperation in environmental planning outside the Great Lakes basin. Local governments can do much to help or hinder the RAP process. Local actions are particularly valuable because municipalities have the implementation responsibilities for many actions identified in RAPs. Further, the implementation of local actions is a sign of acceptance of the goals and principles expressed in the RAP.

The evolution of RAPs toward integrated resource management and multi-institutional, multiple-use planning is very positive and consistent with the ecosystem approach called for in the Agreement. Although the Water Quality Board recognizes the uniqueness of each Area of Concern, it encourages a multi-institutional, multiple-use ecosystem approach be implemented or modified for other Areas of Concern.

TABLE 1. INSTITUTIONAL STRUCTURES ESTABLISHED TO ASSIST IN DEVELOPMENT OF REMEDIAL ACTION PLANS IN AREAS OF CONCERN IN THE GREAT LAKES BASIN

AREA OF CONCERN [date committee established]	ORGANIZATIONAL/ INSTITUTIONAL STRUCTURE(S)	REPRESENTATION
1. Peninsula Harbour [1989]	Public Advisory Committee (PAC)	Chamber of Commerce, Citizens-at-Large, Industry, Interest Group, Municipal Government, Recreation
2. Jackfish Bay [1989]	Public Advisory Committee (PAC)	Business/Industry, Citizens-at-Large, City Official, Interest Group, Recreation, Tourism, Union
3. Nipigon Bay [1989]	Public Advisory Committee (PAC)	Chamber of Commerce, Church, Citizens-at-Large, Industry, Interest Group, Municipal Government, Native Group
4. Thunder Bay [1989]	Public Advisory Committee (PAC)	Business/Industry, Citizen, City Official, Conservation Authority, Environmental Group, Interest Group, Municipal Government, Native Group, Power Generation, Tourism
5. St. Louis River [1989]	St. Louis River Citizens Advisory Committee (CAC)	Academia, Business/Industry, Citizens-at-Large, City/County Official, Environmental Groups, Native Group, Power Generation, Recreation, Regional Government, State/Federal Government
6. Torch Lake	Does not currently exist - two public meetings and a public comment period held. The desire/need for an institutional structure will be re-evaluated when the Stage 2 RAP is developed.	
7. Deer Lake - Carp Creek - Carp River	Does not currently exist - two public meetings and a public comment period held. The desire/need for an institutional structure will be re-evaluated when the Stage 2 RAP is developed.	
8. Manistique River	Does not currently exist - two public meetings and a public comment period held. The desire/need for an institutional structure will be re-evaluated when the Stage 2 RAP is developed.	
9. Menominee River [1988]	Menominee River RAP Citizens Advisory Committee (CAC)	Academia, Business/Industry, Chamber of Commerce, Citizens-at-Large, City Official, County Representative, Environmental Group, Federal Government, Fishing Club, Interest Group
10. Fox River/ Southern Green Bay [CAC est. 1986- disbanded 1988; IC-1988]	Citizens Advisory Committee (CAC) Implementation Committee (IC)	Academia, Business/Industry, Chamber of Commerce, Citizens-at-Large, City County Officials, Elected Officials, Interest Group, Native Group, Regional Agencies

11.	Sheboygan River [1984]	Sheboygan County Water Quality Task Force	Citizens-at-Large, Private Industry, Sportmen's Groups, State Government
12.	Milwaukee Harbor [CAC-1989 TAC-1989]	Milwaukee River RAP Citizens Advisory Committee (CAC)	Academia, Business/Industry, Chamber of Commerce, Citizens-at-Large, City/County Officials, Elected Officials, Interest Group, Native Group, Regional Agencies
13.	Waukegan Harbor [1990]	Waukegan Harbor Citizens Advisory Group	City Government, Industry, Environmental Groups, Health Department, Municipalities, Sport Fishery Groups, Business, Recreation, Universities
14.	Grand Calumet River/ Indiana Harbor Canal [1990]	Citizens Advisory for the Remediation of the Environment Committee	Academia, Business, Citizens Groups, Environmental Groups, Industry, Local Government
15.	Kalamazoo River [1987]	Kalamazoo River Basin Strategy Committee (disbanded in 1989). Future efforts will be coordinated with Superfund. The desire/need for an institutional structure will be evaluated.	Business, Charter Boat Owners, County Officials, Government, Industry, Property Owners, Teachers
16.	Muskegon Lake	Does not currently exist - two public meetings and a public comment period held. The desire/need for an institutional structure will be re-evaluated when the Stage 2 RAP is developed.	
17.	White Lake	Does not currently exist - two public meetings and a public comment period held. The desire/need for an institutional structure will be re-evaluated when the Stage 2 RAP is developed.	
18.	Saginaw River/ Saginaw Bay [1987]	Saginaw Basin Natural Resources Steering Committee	Academia, Agriculture, County Officials, Environmental Groups, Municipal Officials, Regional Planning Commission
19.	Collingwood Harbour [1988]	Collingwood Harbour RAP Public Advisory Committee (PAC)	Academia, Chamber of Commerce, Citizens-at-Large, Conservation Authority, Environmental Groups, Industry, Interest Groups, Power Generation, Recreation/Tourism, Sewage Treatment Plant
20.	Severn Sound [1989]	Severn Sound Remedial Action Plan Public Advisory Committee (PAC)	Citizens-at-Large, Interest Groups, Local Municipalities, Recreation
21.	Spanish River [1988]	Public Advisory Committee (PAC)	Academia, Citizens Groups, Environmental Groups, Health, Industry, Local Government, Native People, Recreation/Tourism

32.	Eighteen Mile Creek	RAP has not been initiated. RAP development will begin when Buffalo River and Niagara River RAPs are finished	
33.	Rochester Embayment [1989]	Water Quality Management Committee (WQMC)	Citizens, Economic Interests, Ex-officio Non-voting Members, Public Interests, Public Officials
34.	Oswego River [1987]	Oswego River Remedial Action Plan Citizens Committee (ORCC)	Business/Industry, Elected Officials, Environmental Groups, Governmental Agencies, University, Public Interest Groups
35.	Bay of Quinte [1988]	Public Advisory Committee (PAC)	Academic, Agriculture, Environmental, Human Health, Industry, Labour, Municipal, Naturalist/Nature, Tourism/Recreation
36.	Port Hope [informal local advisory - 1988; Public Advisory Comm. 1989]	Port Hope Harbour Remedial Action Plan Local Advisory Group	Concerned Citizens, Conservation Authority, Federal Siting Task Force, Harbour Commission, Industry, Local Government, Low-level Radioactive Waste Management Office, Yacht Club
37.	Metro Toronto [1989]	Public Advisory Committee (PAC)	PAC Sectors: Agriculture, Business/Industry, Community Groups/Individuals, Environment/Conservation, Labour, Metro Toronto & Region Conservation Authority, Recreation/Tourism, Toronto Harbour Commission. TAC: Federal/Provincial, Health & Planning, Public Works
38.	Hamilton Harbour [1986]	Hamilton Harbour Stakeholders	Academia, Boat Clubs, Business/Industry, Chamber of Commerce, City Officials, Citizens, Conservation Authority, Environmental Groups, Fed./Prov./Mun. Government, Interest Groups, Union
39.	St. Marys River [1988]	St. Marys River Binational Public Advisory Council (BPAC)	Academic, Citizens-at-Large, Environmental Groups, Fisheries, Industry, Labour, Municipal Representatives, Native People, Public Health, Recreation/Tourism, Small Business
40.	St. Clair River [1988]	St. Clair River Binational Public Advisory Council (BPAC)	Agriculture, Business/Industry, Citizens-at-Large, Commercial Fishery, Community Groups, Conservation & Environmental, Health, Labour, Municipal, Native People, Provincial/State Agencies, Tourism/Recreation
41.	Detroit River [1988]	Detroit River Binational Public Advisory Council (BPAC)	40 Members (20 U.S. & 20 Canadian): Academic, Citizens, Conservation/Environmental, Industry & Port Authority, Labour, Municipal, Nonpoint Sources, Recreation
42.	Niagara River (Can.) [1988]	Public Advisory Committee (PAC) for the Niagara River (Ontario) Remedial Action Plan	Academia, Agriculture, Citizens-at-Large, Commissions, Community Group, Conservation Authority, Environmental Groups, Health, Industry, Labour, Municipal Government, Power Generation, Tourism/Recreation
42.	Niagara River (U.S.) [1989]	Committee of Canadian and U.S. Citizens from Niagara River area	Academia, Economic Interests, Government Official, Labour, Private Citizen, Public Interests, Researcher
43.	St. Lawrence River (Can.) [1988]	Public Advisory Committee (PAC)	Academia, Agriculture, Boating/Cottagers, Downstream Interests, Environmental Groups, Fishing, General Public, Health, Industry, Labour, Municipalities, Native People
43.	St. Lawrence River (U.S.) [1988]	Massena RAP Citizen's Advisory Committee (CAC)	Academia/Education, Agency Representation, Agriculture, Appointed Official, Civic Groups, Environmental Groups, Economic/Business, Industry, Labour, Local Elected Officials, Native People, Sportsmen

C. WATER QUALITY BOARD TOOLS TO FACILITATE ITS WORK (AGREEMENT ON LISTING/DELISTING GUIDELINES)

In its 1987 report the Water Quality Board recommended that a common set of criteria be developed to determine when ecosystem conditions have been affected enough to warrant designation as an Area of Concern, and when ecosystem conditions have sufficiently improved to delist an Area of Concern. On the basis of scientific input from a 1988 International Association for Great Lakes Research Symposium, the Water Quality Board developed and reached agreement, in principle, on a set of listing/delisting criteria for Areas of Concern. The Water Quality Board and the IJC also recognized that these criteria could be improved and, upon adoption of the criteria, published them in IJC's newsletter, *Focus*, in 1989 to obtain widespread public and scientific comment. Approximately 50 responses were received.

The Water Quality Board requested that its Restoration Subcommittee recommend revisions to the listing/delisting criteria in light of all new literature and input received, and that it ensure that the recommended revisions were consistent with the Great Lakes Water Quality Agreement. **The revision is now completed and the IJC has approved these guidelines.** Every effort has been made to ensure that these guidelines are scientifically supportable, sensitive to public concerns and pragmatic. **Over 200 people contributed to the revision of these guidelines and the Water Quality Board views the agreement on these guidelines as a significant milestone in its work.**

The intent for these listing/delisting guidelines is that they serve as indicators of use impairment for Great Lakes Areas of Concern. They will be used to assist the International Joint Commission and its Boards in: 1) reviewing all stages of remedial action plans; and 2) making recommendations for new Areas of Concern. These guidelines are intended to establish a consistent "set of yardsticks" that can be uniformly applied throughout the Great Lakes basin. Further, these guidelines are intended to help ensure that the RAP program is properly focused and pragmatic so that it clearly identifies key actions needed to restore uses in order to derive maximum benefit from limited resources.

Annex 2 of the 1987 Protocol to the Great Lakes Water Quality Agreement defines Areas of Concern as geographic areas that fail to meet the general or specific objectives of the Agreement where such failure has caused or is likely to cause impairment of beneficial use or of the area's ability to support aquatic life. Impairment of beneficial use is defined as a change in the chemical, physical or biological integrity of the Great Lakes system sufficient to cause any of the 14 use impairments in Table 2 or other related uses covered by Article IV, such as the microbial objective for waters used for body-contact recreational activities.

The listing guidelines presented in Table 2 are intended to be used by the IJC and its Boards in making recommendations for new Areas of Concern. It must be recognized that remedial action plans are intended to address use impairments of local, geographical extent and cause, rather than lakewide or basinwide phenomena. An example of the application of these listing guidelines is that if an area within or directly affecting the waters of the Great Lakes, connecting channels or the international section of the St. Lawrence River has a health advisory on fish due to contamination from a local watershed, it could be recommended for identification as an Area of Concern. An exception to this procedure would occur when a health advisory on fish in a localized area is no different from the health advisory for the whole lake and this local area is not contributing to a whole lake problem. Under these circumstances the area would not be recommended for identification as an Area of Concern. Such whole lake problems will be addressed within lakewide management plans, as identified in Annex 2 of the Agreement.

When a geographic area is being considered for listing as an Area of Concern, the Parties and jurisdictions should reach agreement, in writing, on the definition of the problem (i.e. assessment of use impairments), based on the guidelines in Table 2. Supporting documentation will be included. The use impairments identified will be the issues addressed in a RAP. If additional impaired uses are discovered during the development of the RAP, the Parties and jurisdictions will revise, in writing, the definition of the problem, based on the impaired use guidelines in Table 2.

Once a new Area of Concern has been identified and listed, a RAP would be developed, following the guidelines in the 1987 Protocol to the Great Lakes Water Quality Agreement. As stated in the Agreement, RAPs shall embody a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses in Areas of Concern.

As part of the IJC's overall responsibility to review and comment on the adequacy of RAPs, it will be making recommendations to the Parties/jurisdictions regarding whether or not data and information presented in Stage 3 RAPs confirm restoration of impaired beneficial uses. A determination will be made following the process identified in Figure 3. Specifically, once the Party/Jurisdiction submits a Stage 3 RAP, the IJC will perform its independent review and determine whether or not:

- The delisting guidelines identified in Table 2 have been met for the use impairments identified in the Stage 1 RAP (implicit in problem definition is the use of all available state, provincial and federal standards, criteria and guidelines, and Great Lakes Water Quality Agreement objectives as indirect evidence of use impairment);
- The existing site-specific goals in the RAP, relative to the 14 use impairments, have been addressed;
- The level and extent of remediation is consistent with the corresponding lakewide management plan; and
- The results of implementation of the RAP represent an important step toward the virtual elimination of persistent toxic substances.

If the answer to each of the questions in Figure 3 is "yes", the IJC will recommend delisting the Area of Concern. Conversely, if an answer to any of the questions in Figure 3 is "no", the IJC would recommend revision of the RAP.

There is an obvious need to use "common sense" in the application of these listing/delisting guidelines. For example, the purpose of Stage 1 RAPs is to reach agreement on beneficial use impairments and their causes and sources. Once this task is accomplished, Stage 2 RAPs identify the remedial actions necessary to restore fully the impaired uses. However, it may not be possible to restore fully some uses because of natural factors (e.g. sedimentation) or social or economic factors (e.g. the necessity to dredge navigational channels may preclude fully restoring the benthic community). In these special cases, there may be very persuasive and practical reasons why the impaired uses cannot be fully restored; such reasons and rationales should be provided in a Stage 3 RAP. The intent here is to recognize explicitly that there may be some impaired uses that may not be fully restored for justifiable reasons, and that this situation should not prohibit the possible delisting of an Area of Concern following Party/jurisdiction submission and IJC review of a Stage 3 RAP. Similarly, a reasonable and pragmatic approach should be taken in recommending new Areas of Concern.

TABLE 2. GUIDELINES FOR RECOMMENDING THE LISTING AND DELISTING OF GREAT LAKES AREAS OF CONCERN

USE IMPAIRMENT	LISTING GUIDELINE	DELISTING GUIDELINE	RATIONALE
RESTRICTIONS ON FISH AND WILDLIFE CONSUMPTION	When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines, or public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must be due to contaminant input from the watershed.	When contaminant levels in fish and wildlife populations do not exceed current standards, objectives or guidelines, and no public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must be due to contaminant input from the watershed.	Accounts for jurisdictional and federal standards; emphasizes local watershed sources.
TAINTING OF FISH AND WILDLIFE FLAVOR	When ambient water quality standards, objectives, or guidelines for the anthropogenic substance(s) known to cause tainting are being exceeded or survey results have identified tainting of fish or wildlife flavor.	When survey results confirm no tainting of fish or wildlife flavor.	Sensitive to ambient water quality standards for tainting substances; emphasizes survey results.
DEGRADED FISH AND WILDLIFE POPULATIONS	When fish and wildlife management programs have identified degraded fish or wildlife populations due to a cause within the watershed. In addition, this use will be considered impaired when relevant, field-validated, fish or wildlife bioassays with appropriate quality assurance/quality controls confirm significant toxicity from water column or sediment contaminants.	When environmental conditions support healthy, self-sustaining communities of desired fish and wildlife at predetermined levels of abundance that would be expected from the amount and quality of suitable physical, chemical and biological habitat present. An effort must be made to ensure that fish and wildlife objectives for Areas of Concern are consistent with Great Lakes ecosystem objectives and Great Lakes Fishery Commission fish community goals. Further, in the absence of community structure data, this use will be considered restored when fish and wildlife bioassays confirm no significant toxicity from water column or sediment contaminants.	Emphasizes fish and wildlife management program goals; consistent with GLWQA and Great Lakes Fishery Commission goals; accounts for toxicity bioassays.
FISH TUMORS OR OTHER DEFORMITIES	When the incidence rates of fish tumors or other deformities exceed rates at unimpacted control sites or when survey data confirm the presence of neoplastic or preneoplastic liver tumors in bullheads or suckers.	When the incidence rates of fish tumors or other deformities do not exceed rates at unimpacted control sites and when survey data confirm the absence of neoplastic or preneoplastic liver tumors in bullheads or suckers.	Consistent with expert opinion on tumors; acknowledges background incidence rates.

BIRD OR ANIMAL DEFORMITIES OR REPRODUCTIVE PROBLEMS	When wildlife survey data confirm the presence of deformities (e.g. cross-bill syndrome) or other reproductive problems (e.g. egg-shell thinning) in sentinel wildlife species.	When the incidence rates of deformities (e.g. cross-bill syndrome) or reproductive problems (e.g. egg-shell thinning) in sentinel wildlife species do not exceed background levels in inland control populations.	Emphasizes confirmation through survey data; makes necessary control comparisons.
DEGRADATION OF BENTHOS	When the benthic macroinvertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when toxicity (as defined by relevant, field-validated bioassays with appropriate quality assurance/quality controls) of sediment-associated contaminants at a site is significantly higher than controls.	When the benthic macroinvertebrate community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics. Further, in the absence of community structure data, this use will be considered restored when toxicity of sediment-associated contaminants is not significantly higher than controls.	Accounts for community structure and composition; recognizes sediment toxicity; uses appropriate control sites.
RESTRICTIONS ON DREDGING ACTIVITIES	When contaminants in sediments exceed standards, criteria or guidelines such that there are restrictions on dredging or disposal activities.	When contaminants in sediments do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.	Accounts for jurisdictional and federal standards; emphasizes dredging and disposal activities.
EUTROPHICATION OR UNDESIRABLE ALGAE	When there are persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation, decreased water clarity, etc.) attributed to cultural eutrophication.	When there are no persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation, decreased water clarity, etc.) attributed to cultural eutrophication.	Consistent with Annex 3 of GLWQA; accounts for persistence of problems.
RESTRICTIONS ON DRINKING WATER CONSUMPTION OR TASTE AND ODOR PROBLEMS	When treated drinking water supplies are impacted to the extent that: 1) densities of disease-causing organisms or concentrations of hazardous or toxic chemicals or radioactive substances exceed human health standards, objectives or guidelines; 2) taste and odor problems are present; or 3) treatment needed to make raw water suitable for drinking is beyond the standard treatment used in comparable portions of the Great Lakes which are not degraded (i.e. settling, coagulation, disinfection).	For treated drinking water supplies: 1) when densities of disease-causing organisms or concentrations of hazardous or toxic chemicals or radioactive substances do not exceed human health objectives, standards or guidelines; 2) when taste and odor problems are absent; and 3) when treatment needed to make raw water suitable for drinking does not exceed the standard treatment used in comparable portions of the Great Lakes which are not degraded (i.e. settling, coagulation, disinfection).	Consistency with GLWQA; accounts for jurisdictional standards; practical; sensitive to increased cost as a measure of impairment.
BEACH CLOSINGS	When waters, which are commonly used for total-body contact or partial-body contact recreation, exceed standards, objectives or guidelines for such use.	When waters, which are commonly used for total-body contact or partial-body contact recreation, do not exceed standards, objectives or guidelines for such use.	Accounts for use of waters; sensitive to jurisdictional standards; addresses water contact recreation; consistent with GLWQA.

TABLE 2. GUIDELINES FOR RECOMMENDING THE LISTING AND DELISTING OF GREAT LAKES AREAS OF CONCERN (cont'd)

USE IMPAIRMENT	LISTING GUIDELINE	DELISTING GUIDELINE	RATIONALE
DEGRADATION OF AESTHETICS	When any substance in water produces a persistent objectionable deposit, unnatural color or turbidity, or unnatural odor (e.g. oil slick, surface scum).	When the waters are devoid of any substance which produces a persistent objectionable deposit, unnatural color or turbidity, or unnatural odor (e.g. oil slick, surface scum).	Emphasizes aesthetics in water; accounts for persistence.
ADDED COSTS TO AGRICULTURE OR INDUSTRY	When there are additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to, livestock watering, irrigation and crop-spraying) or industrial purposes (i.e. intended for commercial or industrial applications and noncontact food processing).	When there are no additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to, livestock watering, irrigation and crop-spraying) and industrial purposes (i.e. intended for commercial or industrial applications and noncontact food processing).	Sensitive to increased cost and a measure of impairment.
DEGRADATION OF PHYTOPLANKTON AND ZOOPLANKTON POPULATIONS	When phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when relevant, field-validated, phytoplankton or zooplankton bioassays (e.g. <i>Ceriodaphnia</i> ; algal fractionation bioassays) with appropriate quality assurance/quality controls confirm toxicity in ambient waters.	When phytoplankton and zooplankton community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics. Further, in the absence of community structure data, this use will be considered restored when phytoplankton and zooplankton bioassays confirm no significant toxicity in ambient waters.	Accounts for community structure and composition; recognizes water column toxicity; uses appropriate control sites.
LOSS OF FISH AND WILDLIFE HABITAT	When fish and wildlife management goals have not been met as a result of loss of fish and wildlife habitat due to a perturbation in the physical, chemical or biological integrity of the Boundary Waters, including wetlands.	When the amount and quality of physical, chemical, and biological habitat required to meet fish and wildlife management goals has been achieved and protected.	Emphasizes fish and wildlife management program goals; emphasizes water component of Boundary Waters.

Again, the intent of these listing/delisting guidelines for Great Lakes Areas of Concern is to assist the IJC and its Boards in fulfilling their responsibilities relative to Areas of Concern/RAPs, called for in the Great Lakes Water Quality Agreement. It is recognized that there will undoubtedly be a need to revise these guidelines in the future, based on the development of new indicators and standards, and new protocols for application of these guidelines.

D. OPPORTUNITIES FOR INNOVATION IN RAPs

New techniques, instrumentation and technology are needed to cope with many problems in Areas of Concern, for example can technology be developed to treat or permanently bind in situ organic contaminants in sediment? Is high-temperature incineration the best solution for PCB-contaminated sediments? Investment of resources by the Parties and industry in research and development to discover this new science will assist not only in the recovery of Areas of Concern, but also in the development of marketable and exportable technology for use elsewhere.

In some Areas of Concern, the greatest potential benefits will come from nonpoint source controls and combined sewer overflow controls. In others, greatest progress is likely to come as a result of industrial process change, industrial pretreatment of wastes, or remediation of contaminated sediments. In addition, the prohibition of or reduction in the manufacture and use of some toxic and hazardous substances will contribute to the goal of virtual elimination.

Tom Sawyer used good business skills and advertising to convince his friends not only to whitewash his aunt's fence, but also to pay for the privilege. Similar opportunities may abound for the implementation of environmental cleanup through RAPs. Partners selecting potential solutions to replace lost uses need to advertise the attractions of innovation and entrepreneurship. Recovery, reuse and recycling should be encouraged whenever possible, for example where metal-contaminated sediment is one cause for the deterioration of the local aquatic system, clean sediments can be reused to replace lost habitat, or sold to offset the costs of remedial actions. Similarly, where organic solvents and reagents are lost in wastewater, plants such as Dow Chemical in Sarnia have introduced wastewater recovery and realized a net saving of \$20,000 per year.

A number of approaches can be taken to deal with dredged spoils. Uncontaminated material taken from reservoirs might be mixed with clean fill and sold as topsoil. Clean material from river dredging could be used to build roads (this technique has already been successfully applied in Duluth, Minnesota, with dredged material from the St. Louis River Area of Concern being used as a base for road construction) or to provide fish and wildlife habitat. Some specific examples of the application of new or alternative technologies to remediation include the U.S. Bureau of Mines study of copper tailings in the Torch Lake Area of Concern for possible reclamation. Another example is Stelco Steel in the Hamilton Harbour Area of Concern, which is going to complete a recycle system in its primary areas of iron and steel making and partial recycling, in addition to other improvements, at its finishing mills. Substantial reductions in discharge levels of zinc, phenol, cyanide and ammonia have been achieved. In Waukegan Harbor, sediments which are heavily contaminated with PCBs will be thermally extracted (to at least 97%) onsite and incinerated at >2000°F at an offsite facility. Recently, the Toronto Harbour Commission has made plans to recycle contaminated soils from coal storage facilities and oil refinery operations along the

waterfront. The proposed \$320 million project is expected to reclaim a 490-hectare site for use of a more commercially-viable self-sufficient nature. The spirit of innovation and entrepreneurship must be encouraged wherever possible through RAPs. This approach also applies to institutional cooperation and funding initiatives. In the Saginaw River/Bay Area of Concern, a non-profit organization (i.e. Saginaw Bay Alliance) was established as a result of the RAP process to address natural resource issues and facilitate public education and participation. In the Buffalo River Area of Concern, a non-profit organization (i.e. Friends of the Buffalo River) was established to lobby for remediation.

E. NEW AREAS OF CONCERN

Following IJC's recommendation, the United States federal government designated Presque Isle Bay (Erie, Pennsylvania) as an Area of Concern. The Commonwealth of Pennsylvania is currently collecting data to evaluate comprehensively all 14 use impairments and determine their causes. No other Areas of Concern have been identified, although there are a number of geographical areas (e.g. Trail Creek, Indiana; Black River, New York; St. Joseph River, Michigan) which are receiving special monitoring through the Great Lakes surveillance program and the jurisdictions.

2. *Where RAPs Have Yet to be Developed for Areas of Concern, Suggest How Jurisdictions Can Expedite RAP Development*

A. COMPREHENSIVE PROBLEM DEFINITION

The intent in the Great Lakes Water Quality Agreement of requiring RAPs to be submitted in three stages (i.e. 1: problem definition; 2: selection of remedial actions; and 3: confirmation of use restoration) is to ensure that there is broad-based agreement on strategic aspects of RAPs at key points in the planning process. **Experience has taught that broad-based agreement among stakeholders on a comprehensive problem definition is essential for the success of a RAP.**

A Stage 1 RAP should define and describe environmental problems in Areas of Concern in terms of their seriousness and their extent. The Agreement outlines 14 beneficial use impairments to guide the Parties and jurisdictions in defining problems. In addition, Stage 1 RAPs are expected to identify the causes of the impairments and to pinpoint the sources of contaminants that may be causing the impairments. Such an understanding is necessary to guide the setting of appropriate priorities for remedial actions and to identify solutions that hold the best chance for success. Since remediation is costly, it is important that the right decisions be made at the stage of problem definition.

Figure 4 presents a summary of use impairments identified by the jurisdictions and Parties in the 43 Areas of Concern. In addition, it identifies which RAPs have been reviewed by the IJC and whether, according to the IJC review, the problem definition and description of causes are complete. It is important to note that of the first 19 RAPs reviewed by the IJC, a comprehensive problem definition and description of causes are complete in only six. In most cases where agreement on a comprehensive problem definition was lacking, it was attributable to incomplete data or an absence of data on use impairments. In others, data were minimal or lacking on quantification of the causes and sources of toxic substances problems. Such additional data and information on problem definition can be included in Stage 2 RAP submissions. Where RAPs have yet to be completed, every effort should be made to:

1. Comprehensively identify problems, in terms of the 14 use impairments identified in Annex 2 of the Agreement;
2. Ensure adequate funding to fill data and information gaps to complete Stage 1 RAPs; and
3. Utilize RAP institutional structures, such as stakeholder groups, basin committees and public advisory committees, to reach broad-based agreement among the jurisdictions, Parties, affected organizations and agencies, the public, and others on problems and causes in Areas of Concern.

FIGURE 4.

SUMMARY OF USE IMPAIRMENTS IDENTIFIED BY THE JURISDICTIONS IN AREAS OF CONCERN AND WHETHER OR NOT PROBLEM DEFINITION AND DESCRIPTION OF CAUSES IS COMPLETE

Area of Concern	Restrictions on fish and wildlife consumption	Tainting of fish and wildlife flavor	Degradation of fish and wildlife populations	Fish tumors or other deformities	Bird or animal deformities or reproduction problems	Degradation of benthos	Restrictions on dredging activities	Eutrophication or undesirable algae	Restriction on drinking water consumption, or taste and odor problems	Beach Closings	Degradation of aesthetics	Added costs to agriculture or industry	Degradation of phytoplankton and zooplankton populations	Loss of fish and wildlife habitat	RAP reviewed by IJC	Based on IJC Review, problem definition and description of causes is complete
Penninsula Harbour	●		●			●	●							●	N	
Jackfish Bay	●		●			●	●		●		●			●	N	
Nipigon Bay	●	●	●			●	●	●	●		●			●	N	
Thunder Bay	●		●			●	●			●	●			●	N	
St. Louis Bay / River	●		L	○	○	●	●	L		L	●	L	○	●	N	
Torch Lake	●			●		●									Y	N
Deer Lake-Carp Creek / River	●				●										Y	N
Manistique River	●					●	●								Y	N
Menominee River	●		●			●	●			●				●	●	Y
Fox River / Green Bay	●	○	●	●		●	●	●		●	●		●	●	Y	Y
Sheboygan River	●		●		L	●	●	●				●	○	●	Y	Y
Milwaukee Harbor	●		●	●		●	●	●		●	●		●	●	N	
Waukegan Harbor	●					●	●								N	
Grand Calumet River	●	●	●	●	L	●	●	●	●	●	●	●	●	●	N	
Indiana Harbor Canal															N	
Kalamazoo River	●														N	
Muskegon Lake	●														Y	N
White Lake	●														Y	N
Saginaw River/ Bay	●				●	●	●	●	●				●		Y	N
Collingwood Harbour	●		L		L	●	●	●		●	●		L	●	Y	N
Severn Sound	●		●			●	●	●			●		●	●	Y	Y
Spanish River	●		●			●	●					●		●	N	
Clinton River			●			●	●								Y	N
Rouge River	●		●	●		●	●	●			●				Y	N
River Raisin	●					●	●	●							Y	N
Maumee River	●		●	●		●	●	●	●	●			L	●	N	
Black River	●		●	●	○	●	●	●		●	●		L	●	N	
Cuyahoga River	L		●	●	○	●	●	●		●	●		●	●	N	
Ashtabula River	●		●	●	○	●	●						L	●	N	
Presque Isle Bay										●					N	
Wheatley Harbour				●		●	●	●		●				●	N	
Buffalo River	●	L	L	●	L	●	●	L		●	●		○	●	Y	N
Eighteen Mile Creek															N	
Rochester Embayment	●		●	L	○	L	L	L	L	L	●		L	●	N	
Oswego River	●	○	●	L	L	●	●	●		○			L	●	Y	N
Bay of Quinte	●		●		●	●	●	●	●	●	●		●	●	Y	
Port Hope						●	●								Y	Y
Metro Toronto	●		●		L	●	●	●		●	●		●	●	Y	N
Hamilton Harbour	●		●	●	●	●	●	●		●	●		L	●	Y	Y
St. Mary's River	●		●	●		●	●	●		●	●		○	●	N	
St. Clair River	●		●	●	●	●	●	●	●	●	●	●	●	●	N	
Detroit River	●		●	●		●	●	●	●	●	●		●	●	N	
Niagara River*	●		●	●		●	●	●					●	●	N	
St. Lawrence River* (Cornwall/Massena)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	N	
St. Lawrence River (Cornwall / Massena)	●		L	L	L	L							○	●	N	

Symbols Used:

Blank	- Data confirm no use impairment	●	- Beneficial use impaired
○	- No data available	○	- Under assessment
*	- Use impairments identified by Ontario	L	- Likely impaired
		Y	- Yes
		N	- No

B. GIVING RAPs THE FORCE OF LAW

The RAP workshop held at the 1989 Biennial Meeting of the IJC recommended that top management of the Parties and jurisdictions consider incorporating RAPs into law, either by developing new statutes or incorporating of RAPs/Areas of Concern into existing statutes. It was recommended that the statutes include the direction, authority and funding to both develop and implement the RAPs. While there are many things that can be done to integrate RAPs into federal-state-provincial priorities, there is a distinct difference between integrating in that manner and giving RAPs the force of law for development and implementation.

In the United States, the Great Lakes Critical Programs Act of 1990 has given the force of law to develop RAPs in each Area of Concern. A time schedule and process has been established by this federal law. Whether adequate resources will be available to the Parties and the jurisdictions to fulfill the requirements of the law remains to be seen.

Giving RAPs the force of law in terms of implementation, however, cannot be done with a single statute. The RAPs are, in fact, plans. They deal with point and nonpoint sources and with prevention and cleanup. In most cases, specific cleanup activities can be undertaken with existing laws once the appropriate cleanup methodology and resources are identified. To the extent that new laws are required specifically for cleanup in any jurisdiction, they should be pursued. Full implementation of preventive measures may require new laws, new rules, new permits, new water quality standards or other regulations, which will need to be promulgated following the administrative procedures within each jurisdiction.

Although a simple law making RAPs enforceable will not work, the following is a list of examples of what is being done or could be done:

- The Great Lakes Critical Programs Act of 1990 mandates, among other things, the development of a RAP for each U.S. Area of Concern and submittal to IJC by January 1, 1992; it further mandates that all U.S. RAPs will be included within each state's Water Quality Management Plan by January 1, 1993;
- Michigan Environmental Response Act, P.A. 307 of 1990, as amended, calls for the identification of all sites of environmental contamination, which currently includes 8 of Michigan's 14 Areas of Concern. The rules promulgated under this statute require that remedial action plans, which consider alternatives, address the 14 use impairments in the Agreement;
- Possibly identifying U.S. Areas of Concern as "areas of nonattainment" under Section 304(L) of the U.S. Clean Water Act, could make the parts of RAPs dealing with sources of pollutants for which water quality standards are not met, the legally-enforceable control strategy required by U.S. law;
- The Water Resources Development Act of 1990 authorizes the U.S. Army Corps of Engineers to provide technical, planning, and engineering assistance to states and local governments to develop and implement RAPs for U.S. Areas of Concern; and
- Giving Canadian RAPs official status under Ontario's Planning Act, the statute by which Ontario approves municipal plans. Recognizing RAPs as a legitimate component of an official municipal plan gives the RAP process status under the Planning Act and reinforces the concept that municipalities have RAP implementation responsibilities.

C. SUSTAINING RAP INSTITUTIONAL STRUCTURES AND PUBLIC PARTICIPATION

Since the conception of RAPs, emphasis has been placed on the importance of public participation. First, local citizens have a vital interest in Areas of Concern; they drink the water, eat the fish or simply walk along their shores. Citizens are vitally important to the restoration process. Second, with the best-intentioned agency in the world, the political imperative to spend money on remediation can be heard only if it comes from the public; public support for the RAP process is essential in securing funding from politicians. Third, the public is in a unique position to maintain the process and ensure that local needs and priorities are met. If management of the environment is left to the 'experts' and the politicians, the public becomes disenfranchised. It has been demonstrated many times that members of the public can contribute a great deal to the preparation of a RAP.

The public's influence on RAP development is well illustrated in the case of the St. Clair River Binational Public Advisory Committee (BPAC). Representatives of environmental and labour groups on the BPAC walked out in September 1990, charging the governments with repeated failure to make serious progress on the St. Clair River RAP. The problems which they identified included: high turnover of RAP coordinators, lack of timely development of RAP chapters and lack of upper-level, governmental, management support. In response, the Ontario Ministry of the Environment hired a new technical writer to assist in RAP preparation. By February 1991, the RAP team had distributed all draft chapters of the Stage 1 RAP to the BPAC for its review. To avoid such situations in the future, governments must devote adequate resources to ensure timely development of RAPs, demonstrate top-level political support, and ensure sharing the decision-making process with RAP institutional structures (rather than limiting them to a review role).

D. FOSTERING COMMUNICATION AMONG RAP GROUPS

Binational, national and jurisdictional communication among RAP groups has the potential to provide solidarity of purpose, and could do much to save RAP teams from "reinventing the wheel." Much of the work on a RAP involves interpretation of data and negotiation and debate on appropriate conclusions and remedial actions. If teams are informed about the processes going on in other Areas of Concern, they might be able to proceed more rapidly with RAP preparation and implementation.

Previous IJC RAP forums and workshops have been invaluable in fostering communication and helping RAP groups and citizens to learn from each other's experiences. The IJC is in a unique position to foster communication among RAP groups and help with information and technology transfer. Therefore, the IJC must continue to review and evaluate RAP progress by sponsoring regular RAP workshops and forums. This role will become more important in the development of Stage 2 RAPs. Communication among RAP institutional structures and citizens has also been fostered through province-wide and state-wide RAP conferences and public advisory councils and RAP workshops.

E. EFFECTIVE USE OF VOLUNTEERS

All of the citizens, including industrial, municipal and business representatives, participate in the RAP process as volunteers. Where citizen volunteers have been given the opportunity for meaningful involvement in the RAP process, they have made significant contributions. The value of this involvement cannot be overestimated. It is important to acknowledge the valuable role of citizens, ensure their valuable and effective use and recognize their unique contributions. This acknowledgement is particularly important because of the limited resources within governments.

3. *Where RAPs Exist, Describe Specific, and in the Board's Judgment, Effective Programs that have been Initiated as Part of RAP Implementation*

A. RAPs ACCELERATING EXISTING PROGRAMS

As noted in Section 1, the Water Quality Board views the implementation of RAPs and the restoration of impaired beneficial uses as a two-track process: 1) expedite and accelerate existing programs and 2) identify the schedule of steps and sequencing to determine actions beyond existing programs to fully restore impaired beneficial uses. Primary emphasis is placed on the implementation of remedial actions. However, it is recognized that planning and implementation are pursued simultaneously in the open and iterative RAP process.

Therefore, most of the remedial actions taken to date have been implemented through existing programs. Table 3 (p.27) presents selected examples of remedial actions in each of the 43 Areas of Concern. The impetus for some of these remedial actions came as a result of the RAP process; the impetus for others from existing programs. In general, however, the Water Quality Board concludes that RAPs have pushed existing remedial programs further and faster than could otherwise have been expected. RAPs are serving as a catalyst for the implementation of existing programs. This action is precisely what the Water Quality Board views as track one in RAPs (Figure 2).

It is particularly worth noting the range of remedial actions being taken in Areas of Concern and the amount of resources being spent (Table 3). In total, several billion dollars have been spent since 1988 on the selected remedial actions presented in Table 3. Further, these remedial actions address a broad range of water pollution issues, including proactive control of contaminants at point sources, nonpoint source control measures, remediation of hazardous waste sites and contaminated sediments, combined sewer overflow control measures and habitat rehabilitation.

The Water Quality Board considers that the remedial actions presented in Table 3, although not comprehensive, demonstrate substantial acceleration of existing remedial programs and substantial progress. Furthermore, the fact that many RAP teams are now at the stage where additional remedial options are being evaluated and selected is another major indicator of progress. Progress in remediation is not consistent among Areas of Concern because RAPs are at different stages of development and implementation. Continued, long-term support will be required for RAPs in order to implement fully track one of RAPs and achieve the goals of track two (Figure 2). It must be remembered that it took decades to manifest the degree and extent of toxic substances contamination in Areas of Concern and rehabilitation will not occur in a few short years. Long-term, continuous support will be required. Specific ways for the governments to sustain the RAP process include:

- Continuing support for public participation;
- Achieving continuity through the stakeholder groups, basin committees, public advisory committees, and citizen committees established in Areas of Concern;
- Building a record of success; and
- Celebrating milestones (e.g. program milestones, target loading milestones, ecosystem health milestones).

One effective way of celebrating milestones is to publish annual or biennial RAP progress reports or to host public "State-of-the-RAP" events to manifest successes and assign priorities to remaining challenges.

B. COALITION-BUILDING AND PARTNERSHIPS

The Water Quality Board considers that the RAP institutional structures established in 33 of the 43 Areas of Concern (i.e. stakeholder groups, basin committees, public advisory committees, and others) are important not only in implementing the ecosystem approach at the grassroots level, but in building coalitions and partnerships for rehabilitation of local geographic areas which are degraded. Such coalition-building and partnerships should be encouraged in all Areas of Concern in order to appropriately assign priorities to remedial actions within a broader societal agenda and to help achieve greater accountability within regulatory and resource management programs.

C. ANNUAL CLEANUP DAYS

The success of annual cleanup days held in a number of Areas of Concern is particularly worth noting. For example, the annual Rouge River Rescue in Southeastern Michigan attracts several thousand people to clear log-jams and remove debris. This provides not only a first-hand, personal experience of the pollution of the Rouge River, but an opportunity for a personal contribution to the rehabilitation of their resource. In Green Bay, Wisconsin, cleanup days are scheduled in conjunction with regular contests for school children. This action has the added benefit of integrating the RAP into school curricula. In the Buffalo River Area of Concern in New York, annual cleanup days have not only attracted more people to the river, but have led to community proposals to obtain greater public access to the river. Therefore, annual cleanup days have proven very effective in elevating the profile of RAPs and gaining broad-based community support.

D. EDUCATION PROJECTS

To a large degree the RAP institutional structures and public outreach activities, such as newsletters, foster education for adults. However, equally important is education of school-age children. The Saginaw School District implemented a highly successful Saginaw River Journal Project in 1989-1990. The project was supported jointly by the school district, General Motors Corp. and the University of Michigan to help increase student awareness of water quality issues in the Saginaw River System. In the Rouge River Basin in Southeastern Michigan, a Rouge River Interactive Water Quality Project has involved 52 high school science classes in monitoring water quality. High school classes share data by computer and every year a Water Quality Congress is organized to help interpret data and learn from each other's experiences.

TABLE 3. SELECTED EXAMPLES OF REMEDIAL ACTIONS TAKEN IN GREAT LAKES AREAS OF CONCERN

1.	Peninsula Harbour	<ul style="list-style-type: none"> Public access to the waterfront has been improved by the construction of a temporary launch ramp on James River-Marathon Ltd. property.
2.	Jackfish Bay	<ul style="list-style-type: none"> In 1989, Kimberly-Clark Canada Ltd. constructed secondary treatment effluent lagoons at a cost of \$30 million.
3.	Nipigon Bay	<ul style="list-style-type: none"> \$930,000 was allocated for Nipigon Bay from the Great Lakes Clean-Up Fund to initiate a 6-staged, 4-year project, beginning in 1990 to rehabilitate the walleye population by augmenting the remnant fish stock, reopening migratory routes and restoring degraded habitats. Various agencies will contribute an additional \$1,862,000 toward the 4-year project.
4.	Thunder Bay	<ul style="list-style-type: none"> Canadian Pacific Forest Products (CPFP) is constructing a Thermal Mechanical Pulp treatment facility to be operational by 1991, at a cost of \$300-million. The new process will replace chemicals with heat and grindstones to produce cleaner pulp and cut production in the sulphite mill. CPFP is constructing a \$35 million activated sludge type process for its secondary treatment facility. A 6-staged, 4-year habitat rehabilitation project will begin in 1990. Contributions from the Great Lakes Cleanup Fund and various agencies totalled \$2,305,000 and \$3,006,000, respectively. The project is anticipated to create/restore degraded and lost nearshore aquatic habitat in four tributaries, rehabilitate the littoral zone, stabilize wetlands, restore riverine diversity and increase abundance of fish and wildlife populations in the Thunder Bay Area of Concern. Since 1988, new sludge management practices at Northern Wood Preservers will reduce suspended solids and related toxins by treating sludge with chlorophenol. In 1988, Reichhold Chemicals provided secondary treatment on site, prior to discharge into the municipal sewer system.
5.	St. Louis Bay/River	<ul style="list-style-type: none"> Due to soil, surface water and groundwater contamination at Arrowhead Refinery, a Superfund site, a French drain and pumping system will be installed to remove PAHs, PCBs, heavy metals and other organic compounds from groundwater, which will be sent to Western Lake Superior Sanitary District for treatment. Other actions include on-site incineration of contaminated sludges and soils, and provision of city water for residents. The 3-part project has an approximate cost of \$40-\$60 million. The Superfund site, U.S. Steel Duluth Works Site, began a cleanup plan in 1988 which involved the demolition of buildings, removal of barrels and dismantling of tanks and pipelines that were cleaned and recycled. Additional proposed actions include construction of a slurry wall to prevent coal tar from seeping into the St. Louis River and dredging of coal tar seeps. Approximate cost of cleanup is \$8 million. In 1990, 40 barrels containing coal tar were removed from an area adjacent to the Duluth Air Force Base, a Superfund site. This hazardous waste is being stored and awaiting transport for incineration at an approved site. A plan is anticipated in spring 1991.
6.	Torch Lake	<ul style="list-style-type: none"> In 1988, Torch Lake was ranked on the National Priorities List of Superfund and received funding for a remedial investigation and feasibility study of contaminated sediments and tailings. Barrels and debris have been removed from the shoreline and municipal sludge is being used to stabilize various tailing deposits, encourage revegetation and prevent erosion.

7. Deer Lake - Carp Creek/River
- In 1985, a new \$8-million Ishpeming Regional Wastewater Treatment Plant came online with secondary treatment and phosphorus removal to replace three inadequate primary wastewater treatment plants.
 - From fall 1985 to spring 1987, Deer Lake was drawn down to eradicate fish and reduce human and wildlife exposure to mercury.
 - In 1987, Deer Lake impoundment was gradually refilled; in 1987 and 1988, approximately 2 million walleye fry and 50,000 yellow perch were stocked in the lake.
-
8. Manistique River
- \$6000 was allocated in July 1990 under Public Act 328 to develop a work plan to evaluate the extent of sediment contamination and effects on aquatic life.
 - Manistique Papers, Inc. received a new NPDES permit containing limits on Zn, Cu and Ag.
-
9. Menominee River
- The Menominee Paper Company implemented activated sludge secondary treatment at its facility in August 1989.
 - Maintenance dredging in the shipping channel of the river has been approved by MDNR and the U.S. EPA, and is being scheduled by the U.S. Army Corps of Engineers in 1991.
 - A cleanup program will remove paint sludge from two areas in the bay and collect stray nodules along the shoreline south of the Flander Industries, Inc. plant site in spring 1991.
 - A consent order was signed by the City of Menominee and U.S. EPA in August 1989, resulting in a submission of a plan for the elimination of CSOs in the Menominee wastewater collection system and to require compliance with established effluent limits.
-
10. Fox River/Green Bay
- The Green Bay Metropolitan Sewage District voluntarily reduced phosphorus and ammonia discharges from 0.8 mg/L to 0.5 mg/L. This represents a 4% reduction in the total phosphorus load from the Fox River to the lower bay. The facility received the "Clean Bay Backer" award in March 1990.
 - Three nonpoint source watershed projects have been initiated between 1988 and 1990, covering approximately 790 km². The goal is to significantly reduce loadings of suspended solids and phosphorus to the Fox River and Green Bay.
 - Approximately \$100,000 was allocated in 1990 for development of riverfront walkways, walleye spawning habitat, shoreline fishing access and boat launching facilities.
 - A \$250,000 grant from Wisconsin DNR allowed the City of DePere to construct wet detention ponds designed to retain and treat urban stormwater runoff in East River watershed.
-
11. Sheboygan River
- From December 1989 to June 1990, 2,300 m³ of PCB-contaminated sediment has been removed from the river under the Superfund program at a cost of over \$2 million.
-
12. Milwaukee Harbor
- As part of a Milwaukee Metropolitan Sewerage District Abatement Program, an estimated \$2.2 billion project is underway to upgrade and rehabilitate the sewage treatment plant and construct a deep tunnel system for CSOs.
 - The legislature has selected 5 Priority Watersheds affecting the Area of Concern to be designated as on-going clean-up sites. These are the East-West, South and North Branch of the Milwaukee River; Menominee River; Cedar Creek and a sixth watershed, designated in 1990, Kinnickinnic River.

13. Waukegan Harbor
- As a result of a 1988 Consent Decree, Outboard Marine Corporation has provided \$20 million for remediation of PCB-contaminated sediments. PCBs from sediment 'hot spots' will be thermally extracted and high-temperature incinerated. Sediments with lower PCB contamination will be placed in containment cells.
 - The Yeoman Creek Landfill, a Superfund site, was closed and fenced-off from the public due to leaching of contaminants into Yeoman Creek. In 1990, the adjacent Edwards Field ball park was also closed and negotiations are on-going with potentially responsible parties to conduct a Remedial Investigation/Feasibility Study.
 - Thirty 55-gallon drums were found to be deteriorating at the Waukegan Paint facility and are being stored on-site to prevent soil contamination, awaiting removal to an off-site treatment facility.
-
14. Grand Calumet River/
Indiana Harbor Canal
- USX Corporation has agreed to pay \$34.1 million to help clean up the river; \$26.6 million will be used to stop discharges, \$5 million to help clean up sediments and \$2.5 million for studies.
 - Cleanup efforts at the Amoco Oil Co. in Whiting will include a 16.8 million gallon pool of leaked oil beneath the company's and nearby residential property. In 1991, Amoco pledged \$15 million for overall cleanup.
-
15. Kalamazoo River
- Three potentially responsible parties for PCB contamination have been identified by the State to date and enforcement actions are proceeding.
 - Approximately \$5 million of remedial action funds have been secured under State Act 307 to implement interim actions at three drawn down impoundments of Plainwell, Otsego and Trowbridge.
-
16. Muskegon Lake
-
17. White Lake
- Purgewells installed and maintained to prevent contaminated groundwater from entering the lake.
 - In 1990, a system of cluster wells was installed to monitor static water levels and to assure that a descending water gradient was being maintained by the system. The goal is to fully intercept contaminated groundwater before it enters White Lake.
-
18. Saginaw River/Bay
- The City of Saginaw's new discharge permit, issued in October 1989, mandates a construction schedule for 6 retention basins at a cost of \$81 million; two are to be completed by 1992.
 - Over \$3.2 million of federal money (U.S. DA and EPA) has been appropriated to address various nonpoint source issues in the Saginaw Basin.
 - Michigan DNR has purchased \$7 million worth of land along Saginaw Bay during the past three years to preserve important habitat and to provide recreational opportunities.
 - Michigan DNR is stocking Hexagenia eggs in selected areas of the Bay to re-establish this historically abundant invertebrate.
-
19. Collingwood Harbour
- The municipal Sewage Treatment Plant (STP) in Collingwood lowered the phosphorus content in its effluent to meet provincial objectives in 1986 and, during 1988-1989 reduced the phosphorus content to half of that objective.
-
20. Severn Sound
- The Great Lakes Clean-up Fund contributed \$25,000 in 1990 to the Ontario MOE inspection/correction program for primary sewage systems. It will continue to partially fund the program for the next four years.
 - In 1990, Severn Sound Remedial Action Plan Team assisted North Simcoe Soil and Crop Improvement Association in operating a no-till drill for soil conservation measures. Future demonstration is anticipated in 1991.

21. Spanish River
- E.B. Eddy introduced process changes, substituting chlorine for chlorine dioxide in softwood and hardwood bleaching in 1988 and 1990, respectively, to reduce dioxin and dibenzofuran production.
 - In 1989, all waste streams from E.B. Eddy, which previously received only primary treatment, were directed to a secondary treatment lagoon.
 - Small Craft Harbour Canada, in conjunction with the Village of Spanish, funded a dredging operation in the harbour channel in 1990 at an approximate cost of \$300,000 to expand its marina facilities. The dredged material exceeded contaminant guidelines for metals and was deposited in an upland disposal facility.
-
22. Clinton River
- In 1989, a Consent Judgement was signed with Liquid Disposal Inc. for a \$22 million clean-up of Michigan's highest ranked Superfund site. Over 500 industries have agreed to share costs for excavation, solidification and permanent storage behind slurry wells.
 - Armada and Mount Clemens Wastewater Treatment Plants were recently upgraded at a cost of \$4.2 and \$12.7 million, respectively, to reduce the amount of discharge of both conventional and toxic pollutants.
 - Dredging of sediment deposits across the mouth of the natural river channel was completed in December 1990.
-
23. Rouge River
- Since 1988, local, state and federal governments have reached agreement and funded over \$500 million in sewer improvements to address combined sewer overflows (CSOs).
 - As a result of a NPDES permit violation, Rouge Steel Co. and USX were required to dredge 30,600 m³ of zinc-contaminated sediment, at a cost of \$1 million and to place it in a confined disposal facility.
 - In 1988, the City of Southfield created a sequence of deep pools and shallow riffles by constructing six triangular wing dams to improve fish habitat (cost was \$8,000 and resulted in Southfield winning a 1988 Clean Water Award).
 - \$111,000 was awarded to the Soil Conservation Service to implement Best Management Practices in a tri-county area that includes the lower branch of the Rouge River.
-
24. River Raisin
- Consolidated Packaging South Plant completed the removal of 300 barrels and transformers containing PCBs.
 - Port of Monroe Landfill - Phase 1 of remedial investigation on east side of landfill complete; west side investigation scheduled for completion in spring 1991.
 - Ford Motor Co. is developing hazardous waste site cleanup plans.
-
25. Maumee River
- The City of Toledo will complete a 9-phase CSO abatement program in 1996. Currently underway are Phases 1 and 2, at a cost of \$12.5 million.
 - Cleanup at several RCRA facilities has been completed in 1990. These are Allied Automative, Toledo Stamping, Owens-Illinois (Hilfinger), Philips Petroleum and Webstrand.
 - The U.S. Congress has authorized 50% funding for a \$13.2 million project to dredge the lower Ottawa River for PCBs and PAHs-contaminated sediment from Suder Ave. to Lost Peninsula.
 - A Swan Creek litter cleanup is conducted annually by volunteers to improve aesthetics.
-

26. Black River
- In 1990, following a Consent Decree, USX/Kobe Steel was required to dredge approximately 35,200 m³ of PAH-contaminated sediment from the river at the cost of \$1.5 million to USX. The dredged material will be placed in a containment cell on company property.
 - As a result of a legal action by U.S. EPA, the City of Elyria upgraded its municipal wastewater treatment plant at a cost of \$33,401,600 to bring it into compliance with its NPDES permit.
 - In 1988, a new municipal wastewater treatment plant was built in Lorain, at a cost of \$27,935,000 to relieve the overload on the existing plant and provide improved sewer service to the west side of Lorain.
-
27. Cuyahoga River
- A new biological wastewater pretreatment system was implemented in 1990 at LTV Steel as a result of negotiations between Ohio EPA and LTV Steel to reduce loadings of ammonia, phenols and cyanide. The cost was \$20 million.
 - The City of Cuyahoga Falls lined a 235-ft. section of sewers with a plastic sleeve, and a manhole shaft was constructed to facilitate cleaning of a partial blockage and cracked sewer. These actions will eliminate dry-weather leakage of bacteria-contaminated water in the Cuyahoga Falls Gorge area, at a cost of \$20,000 and \$70,000, respectively. The impetus for this action came from RAP participants.
 - In 1990, the City of Akron stabilized riverbanks near the "Old City Landfill" in order to control debris and litter entering the Area of Concern, at a cost of \$196,000.
-
28. Ashtabula River
- In 1990, the State of Ohio received \$7 million in state funding for the removal and disposal of contaminated Ashtabula River sediments. Ohio is seeking federal matching for this expenditure.
 - Occidental Chemical Corporation completed construction of drains and slurry walls in 1990, at a cost of \$3.5 million, to allow removal of organic chemicals prior to discharge. There are now no detectable organics in the treated discharge. Occidental was also required to contribute \$7,500 to the Ashtabula RAP process.
-
29. Presque Isle Bay
- The City of Erie, Pennsylvania recently signed a Consent Decree with the Pennsylvania Department of Environmental Resources to address the sewer and CSO problems in the area. A \$1 million contract was signed by the City in February 1991 to investigate and remediate the problems associated with the Mill Creek Tube (i.e. to locate all sources of input into the Tube and direct it to the wastewater treatment plant).
-
30. Wheatley Harbour
- Since 1988, all industries with process water, except Omstead Foods, discharge into the communal activated sludge sewage treatment plant for Wheatley-Rommney Township, constructed at a cost of over \$4 million (residential areas on the east side of the harbour are also connected to the system). This action has eliminated point source discharges from these industries.
 - Omstead Foods upgraded its wastewater treatment plant in 1989 to include improved sludge treatment and a change of piping. This improved their ability to maintain high temperatures in winter within the aeration section, allowing for better removal of biological contaminants.
 - Students Cleaning Our Urban Rivers cleaned Muddy Creek wetlands and Wheatley Harbour in 1988.
-
31. Buffalo River
- The U.S. Congress has allocated \$600,000 to the U.S. EPA/GLNPO for dredging and disposal of contaminated sediments from the lower Buffalo River.
 - New York State has acquired land in the Area of Concern to construct a recreational access facility, and a 7.6 m setback requirement has been issued by the City of Buffalo for the lower Buffalo River shoreline.
 - Remedial measures that were completed at two inactive waste sites include excavation of contaminated soils and installation of groundwater and leachate collection systems.
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32. Eighteen Mile Creek • The recent upgrade of the sewage treatment facility in the City of Lockport has allowed implementation of a local composting project due to more complete drying and handling of solids at the plant. Total cost of upgrading could reach \$500,000.
- Upgrades to the General Motors, Harrison Radiator Division treatment facility will be necessary to complete the implementation of a stormwater segregation and treatment system that directs potentially-contaminated surface runoff from the facility back to on-site treatment works.
-

33. Rochester Embayment • A city-wide CSO collection and treatment system has been developed at a cost of \$475 million.
- Stormwater runoff has been reduced and 'treated', using wetlands to catch, filter and detain flows. Nutrient and sediment inputs to Irondequoit Bay have been reduced at a cost of \$150,000.
 - Kodak is implementing a \$250 million reconstruction of their chemical bulk storage containment system at their facility in Rochester. These plans exceed state and federal regulations in terms of backup systems, and should better protect surface and groundwater from risk of spills.
-

34. Oswego Harbor • Fulton Sewage Treatment Plant has been extensively upgraded resulting in significant reductions in phosphorus discharges into the Oswego River.
- The Ley Creek stormwater control system, which serves a large portion of Syracuse, has been improved to eliminate dryweather overflows and to significantly reduce wet weather overflows into the Oswego River drainage basin.
 - Enforcement actions have been taken against Anheuser-Busch and Nestlé's to reduce their discharge of conventional pollutants.
 - Syracuse Metropolitan Treatment Plant has reduced phosphorus loadings into Onondaga Lake through (pilot scale) nutrient removal techniques. The action was undertaken against the City for exceeding discharge limits.
-

35. Bay of Quinte • In 1988, Domtar Wood Preserving Plant in Trenton completed a wastewater treatment system program and upgraded from straw filters to activated carbon filters, at a cost of approximately \$700,000.
- In June 1990, 185 buried drums containing trichlorethylene were removed by the Ontario government from an illegal waste disposal site in Ameliasburgh Township. The owner of the site, president of Blackbird Holdings Inc., was successfully prosecuted under the Ontario Environmental Protection Act and the Water Resources Act for the offence, and was sentenced to a prison term of six months; the company was fined \$90,000. As of June 23, 1990, clean-up has cost Ontario Ministry of the Environment \$250,000. They will probably seek reimbursement from the company.
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36. Port Hope • A siting process has been initiated to locate a contaminant facility to store radionuclide-contaminated sediment from the Port Hope Harbour. Three of the five stages of the siting process are completed.
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37. Metro Toronto • In 1989 Metro Toronto and the province allocated \$71 million for upgrading wastewater treatment plants and infrastructure improvements.
- Phase 1 of the Eastern Shore Beaches Retention Tank Clean-up was completed in July 1990, at a cost of \$4.4 million.
 - \$1.7 million is to be spent in 1990 in Metro Toronto and Peel Region on a Household Hazardous Waste Collection program.
-

38. Hamilton Harbour
- Construction of three retention basins to control CSOs from 1988 to 1991.
 - A three-stage dredging project was initiated in 1988 to contain an estimated 353,000 m³ of contaminated sediment in Windermere Basin.
 - Stelco has gone to complete a recycle system in its primary areas of iron and steel making and has introduced partial recycling at its finishing mills; Dofasco has upgraded its acid generation plant, implemented recycling of blast furnace cleaning water and introduced stream distillation stripping in coke ovens.
-
39. St. Marys River
- Construction of a wastewater filtration plant was completed in March 1990 by Algoma Steel. Preliminary monitoring indicates a significant reduction in suspended solids. In addition, Algoma Steel constructed a new biological oxidation treatment unit, which became operational in fall 1990. Both projects have a combined cost of \$33.9 million.
 - Combined sewer overflow control program is required by the NPDES permit for the City of Sault Ste. Marie, MI.
 - Interim remedial actions, including dike construction and sprinkler installation, have been completed at the Cannelton Tannery Waste Site in Sault Ste. Marie, MI under Superfund.
-
40. St. Clair River
- Dow Chemical Canada Inc. announced in 1989 to spend \$10 million on plant process changes and environmental improvements at the Sarnia Division. The Sarnia Division has planned 25 projects in environmental protection and improvement; \$1.6 million of this sum will be used to reduce benzene evaporation by replacing two existing storage tanks with a tank which can tolerate pressure and capture benzene vapours, using pressure-swing absorption technology.
 - Shell spent \$37.5 million on sewer upgrades.
 - Polysar has allocated \$20 million for sewer separation and spill containment.
 - Esso Petroleum and Suncor have also invested in upgrading wastewater treatment.
 - NPDES permits for Marine City, Marysville, St. Clair and Port Huron, MI require implementation of interim CSO control programs, and development of final programs.
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41. Detroit River
- NPDES permit for City of Detroit requires development and implementation of a CSO control program.
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42. Niagara River (NY)
- 5,740 m³ of contaminated soils will be excavated from the Love Canal 93rd Street School Site, at an estimated cost of \$4 million in 1990-1991. Following the excavation process, the soils will be permanently immobilized through on-site solidification/stabilization.
 - Construction of leachate storage and handling facilities at the Hyde Park Landfill was completed in 1989. The leachate is treated by a combination of biological and carbon filtration.
 - Approximately 3,800 m³ of dioxin-contaminated waste (contained in drums) and 19,100 m³ of dioxin-contaminated sediment from Black and Bergholtz Creeks have been excavated and stored at Occidental's Buffalo Avenue Plant. Occidental is setting up a high-temperature (>2,200°F) incinerator for these wastes, and ash will be stored on-site.
 - At the Occidental-Durez hazardous waste site an interceptor drain was installed, and storm-sewer cleaning was introduced to remove contaminated sediment.
 - A groundwater pumping and treatment system was initiated at the Dupont hazardous waste site.

Niagara River (ONT) • Fort Erie Sewage Treatment System consists of two water pollution control plants, the Anger Avenue Plant and the Crystal Beach Plant. The Anger Avenue Plant increased its capacity by 58 million litres/day in 1990 and was upgraded from primary to secondary treatment, at a cost of \$13.7 million. Construction of a new water pollution control plant adjacent to the existing Crystal Beach Plant commenced in September 1990, at an estimated cost of \$13.3 million.

43 St. Lawrence (NY) • A Record of Decision taken under Superfund requires General Motors Central Foundry in Massena, New York to remediate PCB-contaminated sediments and soils at an estimated total cost of \$78 million. In addition, the capping and temporary closure at the GM industrial landfill cost an estimated \$2 million.

- Of four outfalls at Reynolds Metal Corporation, installation of a carbon treatment system in one has reduced PCB levels from approximately 10 mg/L to nondetectable levels. Another outfall has been eliminated, and discharge from a third is now being collected and treated. Contaminated soil and sediment below two outfalls have been removed, at a total cost of over \$2.25 million.
- New York State Department of Environmental Conservation enforcement actions have required flow reductions and end-of-pipe treatment at two of ALCOA's five outfalls. PCB-contaminated sediment and soil have been removed from a ditch below a third outfall, and from a small marsh nearby. To date, over \$7 million has been spent on remedial actions at ALCOA.

St. Lawrence (ONT) • The 1988 expansion and upgrading of the Cornwall Sewage Treatment Plant and sewer system has reduced the number of CSO discharges and overflow points, at a cost of \$7 million.

- Courtaulds Films voluntarily shut down in 1989, an action which should significantly reduce total pollutant loadings in the area.



4. *Identify the Principal Barriers to, and Review the Types of Specific Benefits to be Derived as a Result of, RAP Implementation*

A. BARRIERS

In this section, the principal barriers to RAP implementation are, in general, identified as: inadequate problem definition, insufficient accountability, resource and technology limitations, and insufficient enforcement. One substantial barrier is lack of a clear statement on problems and causes as evidenced in 13 of the first 19 RAPs reviewed by the IJC (Table 4). A Stage 1 RAP should contain a point-by-point evaluation of the status of the 14 use impairments and should quantify, to the maximum extent possible, the causes and sources of environmental problems. Every effort should be made to put in writing a clear and precise problem statement, consistent with the Great Lakes Water Quality Agreement. Further, there should be sufficient data and information to proceed with development of a Stage 2 RAP.

Why are so many RAPs falling short of the Stage 1 criteria? A basic reason is that RAPs require a new way of thinking, focusing not on pollution per se, but first defining ecosystem problems and their causes - including biological effects of toxic substances. Each RAP is unique; while some problems, such as fish consumption advisories, are ubiquitous (in all but four of the Areas of Concern), other problems are a function of local conditions, such as geography, geology and land and water use. To some extent the data gaps may be due to limited resources to fund environmental surveys or research, but the absence of data obviously cannot conclusively demonstrate that an impairment does not exist. A second reason is that the 1987 amendments to the Agreement provided greater clarity and precision in defining problems by focusing on the 14 specific use impairments (Table 2). For the first time, specific uses were identified for which all Areas of Concern should be evaluated. Nine of the first 19 RAPs (Table 4) were completed by the jurisdictions prior to the 1987 amendments. Several RAPs did a good job of addressing conventional pollutants and problems with sewage systems, but fell short in dealing with persistent toxic substances (e.g. Metro Toronto and Rouge River). However, the two-track philosophy outlined earlier in Section 1 is designed to allow the flexibility to proceed on remedial actions that are well understood and clearly needed, while investigations simultaneously proceed on issues that are less well understood. Stage 1 and Stage 2 are sequential for any use impairment, but all of Stage 1 need not be complete before any Stage 2 work is carried out. Planning should not slow down clearly-needed remediation.

A crucial test of the RAP process is the clarity and specificity of Stage 2 RAPs. It is critically important in Stage 2 RAPs that the schedule of steps and sequencing of remedial actions be laid out in a manner that demonstrates progress and the passage of milestones. Stage 2 RAPs must identify the organizations, agencies or individuals responsible for implementation of remedial actions. In addition, Stage 2 RAPs should present work plans and resource commitments in sufficient detail to be able to ensure accountability. This requirement, in itself, presents a problem for many agencies that must budget in a hand-to-mouth fashion as they are dependent on variable annual budget allocations from the jurisdictions. RAPs are a good example of a program that requires a sustained budget; their lifespan extends over decades, rather than months or years. It is likely that not all remedial actions will be assured or budgeted when the Stage 2 RAP is written. The essential point is that the necessary actions be clearly identified,

together with who is responsible for the actions.

In general, the allocation of funding for environmental issues appears to be rather volatile, particularly in an environment of international conflict, industrial layoffs and budget deficits on both sides of the border. Both money and qualified personnel for work on the Great Lakes are limited.

Three specific examples where resources and/or technology are limiting are presented below.

- Agricultural Nonpoint Source Pollution Controls - Although technical solutions are available, persistent economic, social, institutional and legal problems often represent impediments to rapid and consistent implementation. Continued implementation of nonpoint source pollution controls will require long-term support for education, technical assistance and financial assistance.
- Combined Sewer Overflow Controls - Current controls measures fall into three categories: controlling pollutants at source, optimizing existing collection and treatment systems, and retention of wet-weather flows for later treatment. Costs can run into billions of dollars. Key considerations include flexibility, timing and securing long-term creative financing.
- Remediation of Contaminated Sediments - Both technology and resources are severely limiting. The federal governments must seek sufficient, long-term resource commitments and evaluate new/alternative technologies in pilot-scale tests and demonstration projects. One example is the Canadian Great Lakes University Research Fund which was established in 1990 to sponsor research on potential technical solutions for remediation of contaminated sediments. Furthermore, the lack of sediment criteria for establishing cleanup levels for contaminated sediment will be problematic. Sediment criteria should be scientifically defensible, consistent with other relevant programs such as Superfund, pragmatic, politically-accepted and uniformly applicable.

One way of overcoming resource limitations is to give priority to using the U.S. Clean Water Act funds for implementation of remedial actions in Areas of Concern, as the Canadian Great Lakes Cleanup Fund has done. In addition, other mechanisms, such as the U.S. Superfund program, Michigan's Act 307/328 program, or enforcement actions must be pursued. It is suggested that governments explore means of financing 'up-front' costs, such as engineering and feasibility studies, required to establish firm costs for remedial actions proposed in the Stage 2 RAPs. The current practice of including such studies as part of Stage 2 has resulted in poor estimates of the true costs required to implement remedial actions.

Consistent with Track 1 of RAPs in Figure 2, it is recommended that existing laws and statutes be promptly enforced so that those polluters responsible for creating the problems will finance the cleanup and remediation through fines, penalties and Consent Agreements. Where responsibility is known, emphasis should be placed on the concept of "polluter pays." Specific examples can be found in Table 3. Another important concept is the ecosystem approach to financing. A good example of this concept is the settlement reached for the highest-ranked Superfund site in Michigan (i.e. Liquid Disposal, Inc.). In this settlement, over 500 industries which used the facility in the 1960s and 1970s agreed to share equitably the costs of excavation of contaminated soils, solidification, containment of solidified waste and treatment of contaminated groundwater (\$23 million), based on the amount of hazardous waste each industry disposed of at Liquid Disposal, Inc. New and creative financing techniques are very much needed and must be encouraged.

With respect to Track 2 of RAPs, it is important that barriers to the selection of additional programs needed to fully restore uses be clearly stated in the RAP. This includes the action steps needed to clarify the gaps left by existing programs and exactly what new programs are needed. Open-ended statements that further study is needed, are not adequate. Track 2 requires clear statements of what remains unresolved and the sequence of action steps needed to answer unknowns and specify remedial actions.

TABLE 4. THE INTERNATIONAL JOINT COMMISSION REVIEW COMMENTS ON THE ADEQUACY OF RAPS

AREA OF CONCERN (Jurisdiction)	IJC REVIEW COMMENTS
Torch Lake (Michigan)	Environmental problems adequately described, but cause of tumors in fish not determined. Studies outlined in RAP must be completed to satisfy requirements of Stage 1 in RAP process, as well as a more precise definition of RAP goals. U.S. EPA has initiated a remedial investigation and feasibility study under Superfund.
Deer Lake/ Carp Creek/River (Michigan)	Mercury contamination of fish and resulting reproductive problems of bald eagles are well defined; information on other use impairments, socio-economic factors and institutional frameworks is needed, as is expansion of public involvement in plan. Point sources were addressed, but nonpoint sources were not. Michigan has taken action to drain the lake and contaminated fish have been killed; mercury discharge by the mining company has ceased. The IJC has concluded that uses are still impaired (a fish consumption advisory, due to mercury in fish at the mouth of the Carp River, remains in place).
Manistique River (Michigan)	Cause-and-effect relationships are clear; the IJC is encouraged by state's efforts to identify sources of contamination and use impairments, but plans are needed to remediate contaminated soils and sediment.
Fox River - Southern Green Bay (Wisconsin)	The RAP combined significant public involvement and an ecosystem approach. Stage 1 requirements were met. Some Stage 2 requirements met. Detail on major industrial point source problems and level of remedial action should be included in future stages; specific agency responsibilities should also be listed for each identified remedial action.
Muskegon Lake (Michigan)	The RAP lacks quantitative goals and adequate assessment of contaminated sediments and sources of PCB and mercury contamination. Greater identification of these areas is needed, as well as information on other use impairments, socio-economic factors and institutional frameworks, and expansion of public involvement in development of plan.
White Lake (Michigan)	RAP provides historical record of causes and effects of remediation. The plan does not include information on other use impairments, socio-economic factors and institutional frameworks, and expansion of public involvement is needed; development of timetables and agency responsibilities were not identified. Contaminated groundwater from Occidental Chemical Company occasionally continues to enter White Lake. A Consent Judgement calls for completely halting contaminated groundwater intrusion.

AREA OF CONCERN
(Jurisdiction)

IJC REVIEW COMMENTS

River Raisin
(Michigan)

Area's problems identified, but additional information on the sources and extent of contamination, more precise definition of impaired uses and outlines of remedial actions are needed.

Rouge River
(Michigan)

The level of community involvement and public support is exemplary. Stage 1 and 2 requirements were met for CSOs, separate sanitary sewers and bacterial problems, but not with respect to toxic substances. The cause of toxic contamination and additional remedial measures to address this pollution are needed.

Clinton River
(Michigan)

Stage 1 requirements not met. Impaired uses and their causes are not defined, and comprehensive source loading data for toxic substances is lacking. Information on remedial measures, socio-economic factors and institutional frameworks, and expansion of public involvement is needed. Work plans and resource commitments are also needed.

Saginaw Bay/River
(Michigan)

The RAP does not adequately identify and describe all impairments to beneficial uses, their causes and implications, particularly to human and ecosystem health. Information on remedial measures, socio-economic factors and institutional frameworks is needed. Public involvement efforts are commended and encouraged to continue.

Collingwood Harbour
(Ontario)

Addresses serious pollution problems in harbour, but additional analysis of causes of use impairments and impacts of nonpoint sources of pollution are needed. Information on remedial measures, socio-economic factors and institutional frameworks is needed. Data from 1989 surveys should provide information sufficient to fulfill Stage 1 requirements.

Sheboygan River
(Wisconsin)

Stage 1 requirements have been met for all but two of the use impairments. The RAP has not adequately described deformities and reproduction problems in birds and other animals or degradation of phytoplankton and zooplankton populations. Excellent interagency coordination and fostering of public participation.

Hamilton Harbour
minor

Stage 1 requirements met. Use impairments have been comprehensively identified and the causes of each have been well described, with only deficiencies in source loading data. Additional information on implications of land use practices would be helpful. Hamilton Harbour Stakeholders' Group provides a model for public participation in Areas of Concern.

AREA OF CONCERN
(Jurisdiction)

IJC REVIEW COMMENTS

Buffalo River
(New York)

The RAP **does not** meet Stage 1 requirements because of incomplete problem definition. Five use impairments are adequately addressed, and for these Stage 2 activities can proceed. The Buffalo River Citizens Committee and the NYSDEC have worked productively together, and should complete the problem definition once necessary data have been collected.

Port Hope
(Ontario)

Stage 1 requirements have been met. The harbour is polluted with radionuclides and heavy metals which have caused two use impairments: degradation of benthos and restrictions on dredging. Public involvement has been valuable and should be sustained throughout subsequent stages of RAP development and implementation.

Severn Sound
(Ontario)

Stage 1 requirements have been met. Problem definition is good, and causes and sources have been generally addressed. Information is sufficient to proceed with Stage 2 RAP development, although more detailed information should be provided on the causes of several use impairments in the Stage 2 submission.

Metro Toronto
(Ontario)

This RAP **does not** meet Stage 1 requirements because it does not adequately describe the sources and causes of ecosystem impairment due to persistent toxic substances. The primary focus is on conventional pollutants. Use impairments have been generally described, but more quantitative information on causes and sources of these problems is required.

Oswego River/
Harbor
(New York)

This RAP **does not** meet Stage 1 requirements because problem definition is incomplete for four use impairments, and because causes and sources of use impairments are not adequately addressed, partly due to limited data. The RAP is well organized and dealt with some of the contaminants from sources upstream. For these, Stage 2 activities should proceed. The RAP assesses possible inputs to Lake Ontario and relates them to a Lakewide Management Plan.

Menominee River
(Wisconsin)

Stage 1 requirements have been met. Use impairments are comprehensively identified and the causes of each well described. Effective industrial and business involvement, successful interjurisdictional cooperation, and strong community leadership through the citizens' advisory committee.

B. BENEFITS OF RAPs

The benefits of RAP implementation are obvious. Prime among them is the restoration of beneficial uses. Although some consider the term "beneficial uses" to be anthropocentric, the list of the 14 use impairments that is assessed incorporates several measures of the health of the Great Lakes biota. The socioeconomic benefits of remediation will clearly include enhanced valuation of the resource - it will be more attractive for recreation and sport/commercial fishing, and the value of waterfront properties will increase. For example, in Green Bay, waterfront properties have generally increased in value since RAP implementation began. This phenomenon is, of course, a two-edged sword: the likely tendency will be for increased shoreline development, which tends to encourage draining, water level controls, and increased pressure on the surviving spatial and living resources. There is, therefore, an obvious need for continued planning, even as beneficial uses are restored, for long-term protection of Areas of Concern.

From the point of view of stakeholders involved in a local RAP, there are obvious benefits in terms of enhanced 'self-image' for the community. The Buffalo River was described in harsh terms as "an open sewer" by some commentators in the RAP, yet the energy that has gone into improving the riverbanks, that were once little more than a local embarrassment, demonstrates that such perceptions can be turned around. A RAP can provide a tremendous rallying point for public participation in local planning, and can be a catalyst for integrated planning among agencies that previously operated in isolation. If RAPs successfully promote integrated resource management, they will have achieved a great deal.

RAPs, with their local focus, are enhancing the public's environmental awareness. Indeed, they epitomize the "think globally, act locally" philosophy. Environmental awareness is no longer a peripheral activity; it is mainstream, and becoming an integral component of civic pride and concern over human welfare. Environmental information is being incorporated in grade school and high school science curricula, and science fairs include a growing proportion of ecological projects on the Great Lakes. Further, an added benefit is a greater sense of partnership as a result of the RAP institutional structures (Table 1).

A report to the Canada-Ontario Agreement Board of Review outlines some of the significant benefits of RAPs from the Canadian perspective. One that will have a significant impact on public appreciation of progress in remediation is the addition of about five million swimming occasions per year in Ontario, in addition to a general improvement in swimming conditions. The increase in fishing activity was estimated at a value of over \$30 million per year, with an additional 166,000 angler days per year, as well as economic benefits from an enhanced sport fishery. The total economic value of these fishing experiences would be about \$16 million per year. However, by far the greatest economic benefit was associated with the improved environment for Ontario residents, which the consultants termed "non use". This term refers to the general improvement of aesthetics, the maintenance and enhancement of a self-sustaining fishery from which the products are edible, and the knowledge that the waters of the Great Lakes would be safe for swimming. Such amenities are generally evaluated in terms of their value as bequests to future generations; they are currently estimated at \$220 million. This amount brings the total annual benefit estimate to about \$266 million in 1989 dollars.

The value of volunteers cannot be overestimated. Experience has shown that substantial numbers of stakeholders in RAPs are willing to devote significant amounts of time to the remediation of the areas in which they live. However, every effort must be made to ensure that an individual's time spent on RAPs is useful and productive, and that recognition is given for such contributions. Finally, the role of these volunteer publics in providing leverage for funding for remedial actions has tremendous potential.

5. *Indicate Whether and How the Board's and Commission's Processes for Reviewing RAPs Can Be Improved, and the Time Involved Shortened*

A. EXPERIENCE OF THE WATER QUALITY BOARD

The Restoration Subcommittee of the Water Quality Board has been charged with the task of coordinating the review of RAPs on behalf of the Board. One member of the Restoration Subcommittee assumed the responsibility of acting as RAP Review Coordinator, and, with the assistance of IJC staff and selected experts from the Water Quality Board, Science Advisory Board and Great Lakes Fishery Commission, performed the independent review of the adequacy of a RAP. All independent reviews were considered in preparing a consolidated review on behalf of the Water Quality Board. The first seven RAPs were received by the IJC prior to the existence of the 1987 Protocol to the Great Lakes Water Quality Agreement and reviewed as complete RAPs, following the guidelines from the Water Quality Board. All subsequent RAPs have been reviewed for consistency with Stage 1 requirements (i.e. problem definition and description of causes and sources) identified in the 1987 Protocol to the Agreement. The RAP reviews have evolved to a stable structure, that has been in place for the 13 most recent RAPs. A systematic treatment of the Commission's questions and scrutiny of all 14 use impairments has generally allowed the IJC to maintain consistency throughout these reviews. The Water Quality Board is pleased with the thoroughness and quality of the reviews, although occasional inconsistencies have arisen. The revised listing/delisting guidelines for Great Lakes Areas of Concern should help ensure more consistency in the review of RAPs.

The time taken for the IJC review of RAPs is a source of delay and frustration for RAP teams and the public. Although independent technical reviews are generally collated within three months of the IJC's receipt of a RAP, a survey of time intervals for the consolidated reviews of the Water Quality Board and the IJC indicates that, for some RAPs, the overall process has taken over two years (Table 5). If the RAP reviews are to effectively impact the RAP planning and implementation process, they must be completed in a more timely fashion.

In general, however, the Water Quality Board is pleased with the recent improvements in reviewing RAPs. Review of the most recent RAPs has been completed in approximately 10 months. On the basis of the cumulative experience of over three years of reviewing RAPs within the Restoration Subcommittee, there is also greater consistency among RAP reviews. In addition, with the adoption of the listing/delisting guidelines for Great Lakes Areas of Concern, the Water Quality Board feels confident that technical peer reviews of RAPs can be delivered in a more timely fashion.

TABLE 5. TIME INTERVALS FOR WATER QUALITY BOARD AND IJC REVIEW OF RAPS

	Date RAP Received by IJC for Review	Date WQB Transmitted its Review to IJC	Time Interval for WQB Review (months)	Date of IJC Letter to Parties	Time Interval for Commission Review (months)	Total Time Interval (months)
Torch Lake	October 1987	November 1988	13	March 1989	4	17
Deer Lake/Carp River and Creek	October 1987	July 1989	21	December 1989	5	26
Manistique River	October 1987	November 1988	13	April 1989	5	18
Fox River/Lower Green Bay	October 1987	November 1988	13	March 1989	4	17
Muskegon Lake	October 1987	July 1989	21	December 1989	5	26
White Lake	October 1987	July 1989	21	December 1989	5	26
River Raisin	October 1987	November 1988	13	April 1989	5	18
Rouge River	October 1988	July 1989	9	December 1989	5	14
Clinton River	November 1988	September 1989	10	February 1990	5	15
Saginaw River/Bay	October 1988	September 1989	11	March 1990	6	17
Collingwood Harbour	May 1989	April 1990	11	June 1990	2	13
Severn Sound	June 1989	September 1990	15	June 1991	9	24
Sheboygan River	October 1989	April 1990	6	June 1990	2	8
Hamilton Harbour	October 1989	April 1990	6	June 1990	2	8
Buffalo River	November 1989	July 1990	8	September 1990	2	10
Port Hope	January 1990	September 1990	8	February 1991	5	13
Toronto Harbour	February 1990	September 1990	7	February 1991	5	12
Oswego River/Harbor	April 1990	March 1991	11	June 1991	3	14
Menominee River	November 1990	April 1991	5	June 1991	2	7
Bay of Quinte	November 1990					

B. TIMELY SUBMISSION OF RAPs, AND FIRM SCHEDULES AND COMMITMENTS

The Water Quality Board has attempted to track the expected dates of RAP transmittal to the IJC to ensure that necessary staff can be allocated to the task of facilitating the RAP review process. Although the IJC has received 20 RAPs for review as of 1991, most jurisdictions have shown considerable slippage in their schedule of RAP delivery. Sometimes these delays have been due to the fact that public participation commonly slows down a planning process. In other cases, there has been disruptive turnover in RAP coordinators. Other delays have been caused by the need to reach agreement where a RAP affects two jurisdictions, by lengthy internal review, by submission of supplemental information and by mechanical problems connected with the printing and publication of the document. These delays fall outside the control of the IJC.

The Restoration Subcommittee has expressed considerable frustration with the slippage and delays in submission of RAPs to the IJC for review, a condition which has made it very difficult to schedule reviews and manage the review process. Timely development and submission of RAPs by the jurisdictions and Parties is as important as timely reviews of RAPs by the IJC. Public confidence and trust are at stake in both instances.

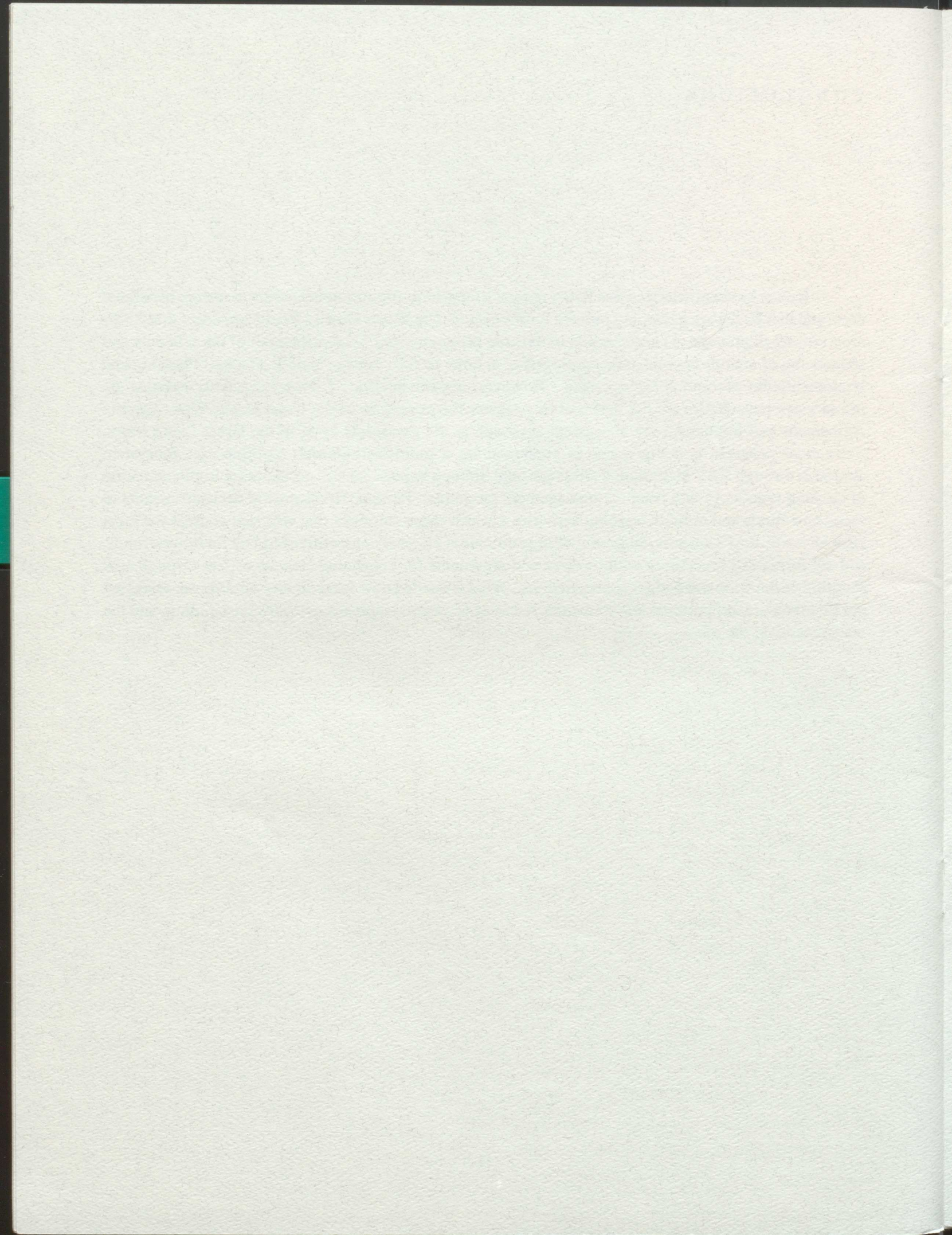
C. IJC LETTERS TO PARTIES

Some IJC letters to the Parties have been difficult to decipher; the 'bottom line' is often buried in complimentary and obscuring language. The time taken to draft and send IJC letters to the Parties has often been extensive. The IJC letters should clearly state whether or not Stage 1, 2 or 3 requirements are met, clearly identify where the RAP is deficient, and clearly identify the priority initiatives which need to be undertaken to fulfill the requirements of the Great Lakes Water Quality Agreement. It should also be recognized that Stage 1 RAPs are snapshots in time and in most cases additional data and information will be collected to complete the problem definition and description of causes as part of a dynamic planning process.

In summary, there is no doubt that the RAP review process can be improved and the review time shortened. The IJC has recognized this situation and is initiating changes to streamline the process and make it more effective.

CONCLUSIONS

It must be acknowledged that RAPs require a long-term commitment in order to restore beneficial uses, and that RAPs are a learning process for everyone. The Water Quality Board considers that RAPs are a two-track process: 1) acceleration of existing programs; and 2) identification of the schedule and sequencing of actions beyond existing programs in order to fully restore beneficial uses. Planning and implementation proceed simultaneously. However, implementation of remedial actions remains the primary priority. RAPs are the best tool to integrate the principles of the Great Lakes Water Quality Agreement and implement the ecosystem approach at the grassroots level in the Great Lakes basin. Substantial progress is being made in implementing a multi-institutional, multiple-use, ecosystem approach through RAP institutional structures and through expediting and accelerating implementation of existing regulatory and resource management programs. Further, RAPs enable decision-makers to focus new funds and redirect ongoing activities towards those solutions that will best address the most critical needs. RAPs are providing compelling rationale at a time of competitive bidding for limited funds, and are furnishing legislators with motives and arguments for enhancing cleanup efforts through new statutory authorities and budget appropriations. What is needed now is continuity of purpose, sustained public involvement, political will to restore Areas of Concern, emphasis on coalition-building, and the resources to do the job.



RECOMMENDATIONS

The Water Quality Board presents the following recommendations concerning RAPs:

- The Water Quality Board recommends that the Parties and jurisdictions ensure that RAPs are appropriately integrated and assigned priorities within a broader societal agenda in Areas of Concern. For example, this action can be accomplished by ensuring that all plans within Areas of Concern (e.g. RAPs, fishery management plans, habitat management plans, land use plans, economic development plans) have complementary and reinforcing goals; that there is explicit recognition of the interrelationships between plans and that members of RAP institutional structures (e.g. stakeholder groups, basin committees, citizen committees) actively participate in the RAP decision-making process rather than just provide input to it. Further, other planning initiatives, such as economic development, must not be allowed to forestall or hinder remediation, which is the primary purpose of RAPs.
- The Water Quality Board recommends that the Parties and jurisdictions ensure that priority is given to sustaining the RAP process because of the long-term commitment necessary to restore beneficial uses. For example, this action can be accomplished by continuing support for public participation, achieving continuity through long-term support of RAP institutional structures, building a record of success and identifying and celebrating milestones (e.g. program milestones, target loading milestones, ecosystem health milestones).
- The Water Quality Board recommends that the Parties and jurisdictions adhere more closely to their RAP development and submission schedules, and that the IJC consider a six-month target for completion of its review of a RAP in order to affect, in a timely fashion, the planning and implementation processes. Further, the IJC letters on RAPs to the Parties should clearly state whether or not Stage 1, 2 or 3 requirements are met, clearly identify where the RAP is deficient and clearly identify the priority initiatives which need to be undertaken to fulfill the requirements of the Great Lakes Water Quality Agreement.