Clean Waters, Clear Choices

Recommendations for Action

Metro Toronto & Region
Remedial Action Plan

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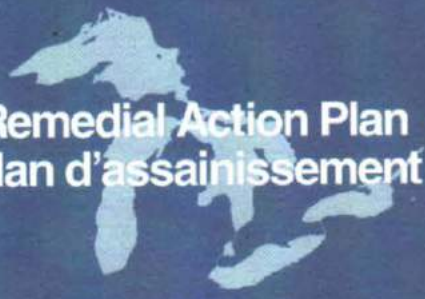

Remedial Action Plan
Plan d'assainissement

Canada Ontario

PIBS 3033E
ISBN 0-7778-2805-7
Printed on recycled paper

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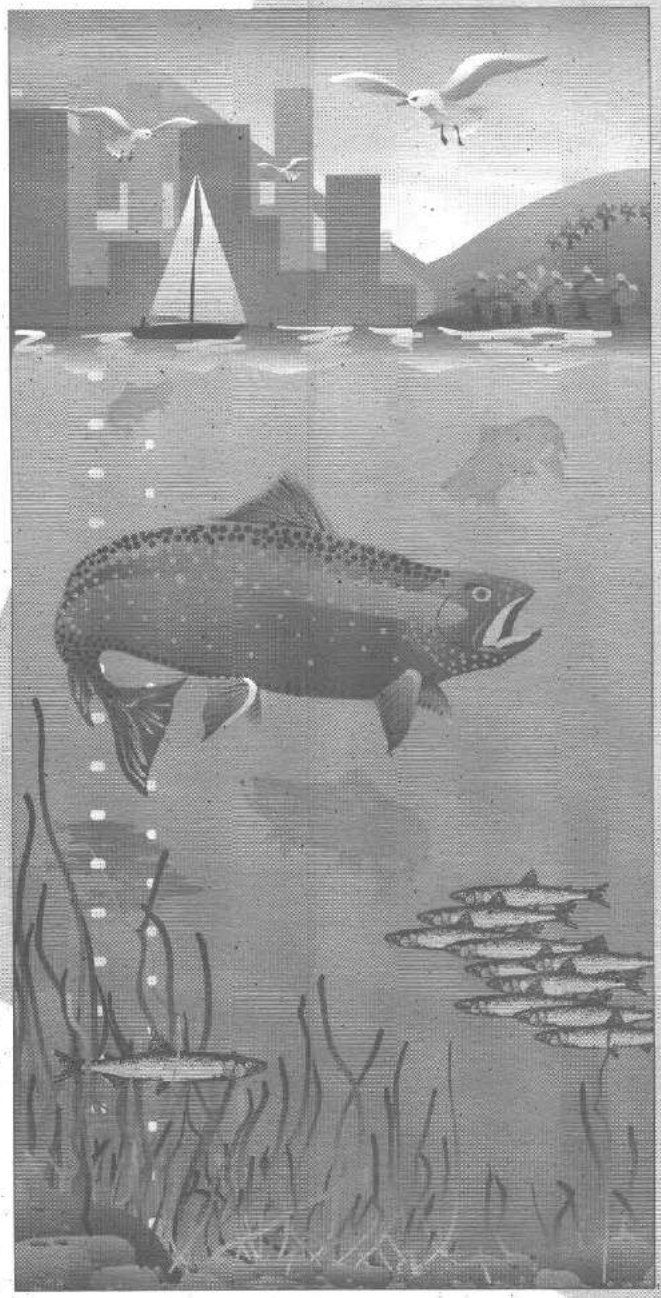


INTRODUCTION

The RAP process

This report presents an action plan to restore the polluted waterways and waterfront in the Metro Toronto area, from Etobicoke Creek in the west to the Rouge River in the east (Figure 1). Similar "Remedial Action Plans" (RAPs) are underway in forty-two other "Areas of Concern" around the Great Lakes (Figure 2), in accordance with the Canada-US Great Lakes Water Quality Agreement and under the watchful eye of the International Joint Commission (IJC), an agency charged with promoting the protection of the boundary waters between the two countries. Seventeen of the "Areas of Concern" are in Canada, Metro Toronto and Region among them. Although each area has a unique combination of problems, sources and solutions, they are all moving towards the virtual elimination of persistent toxic chemicals.

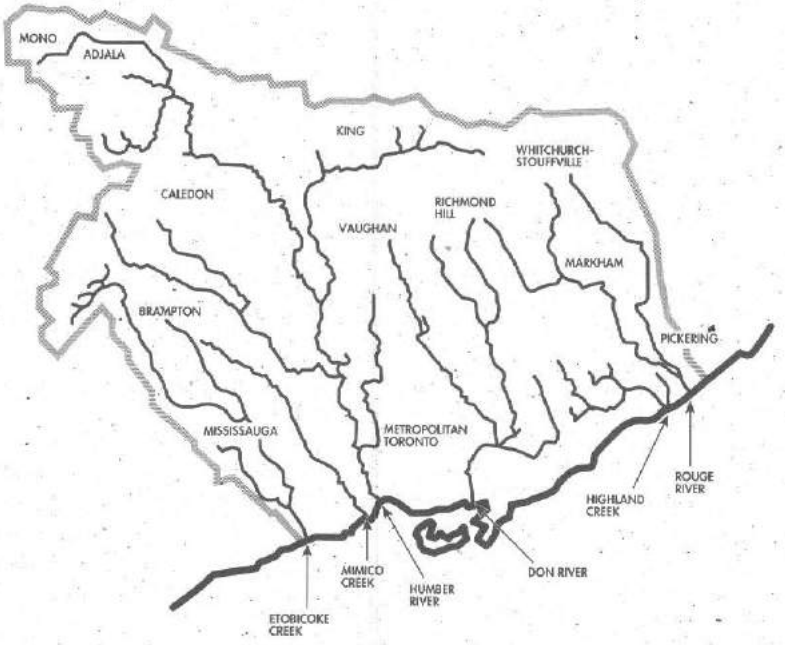


FIGURE 1: METRO TORONTO AND REGION RAP AREA: ORIGINALLY DESIGNATED AS THE WATERFRONT, THE AREA HAS EXPANDED TO INCLUDE THE WATERSHEDS FROM ETOBICOKE CREEK TO THE ROUGE RIVER TO BETTER REFLECT POLLUTION SOURCES.

A COMPLEX ECOSYSTEM WITH COMPLEX PROBLEMS

The degradation of the aquatic ecosystem in the Metro area has occurred gradually, over more than 200 years of intensive human settlement. Physical alteration of the system, through shoreline and stream channel alteration, land clearance and drainage and other activities has made many areas unsuitable for fish and wildlife habitat. Chemical and bacterial inputs from sewage and urban and rural runoff continue to enter waterways, posing risks to human health and the viability of food chains. Some of these sources may not be readily apparent

The RAP process

LAKE SUPERIOR
1. Peninsula Harbour
2. Jackfish Bay
3. Nipigon Bay
4. Thunder Bay
5. St. Louis River
6. Torch Lake
7. Deer Lake

LAKE MICHIGAN
8. Manistique River
9. Menominee River
10. Fox River/Green Bay
11. Sheboygan Harbor
12. Milwaukee Harbor
13. Waukegan Harbor
14. Grand Calumet River
15. Kalamazoo River
16. Muskegon Lake
17. White Lake

LAKE HURON
18. Saginaw River
19. Collingwood Harbour
20. Severn Sound
21. Spanish River

LAKE ERIE
22. Clinton River
23. Rouge River
24. River Raisin
25. Maumee River
26. Black River
27. Cuyahoga River
28. Ashtabula River
29. Erie Harbor
30. Wheatley Harbour
31. Buffalo River

LAKE ONTARIO
32. Eighteen Mile Creek
33. Rochester Embayment
34. Oswego River
35. Bay of Quinte
36. Port Hope
37. Metro Toronto and Region
38. Hamilton Harbour

CONNECTING CHANNELS
39. St. Marys River
40. St. Clair River
41. Detroit River
42. Niagara River
43. St. Lawrence River

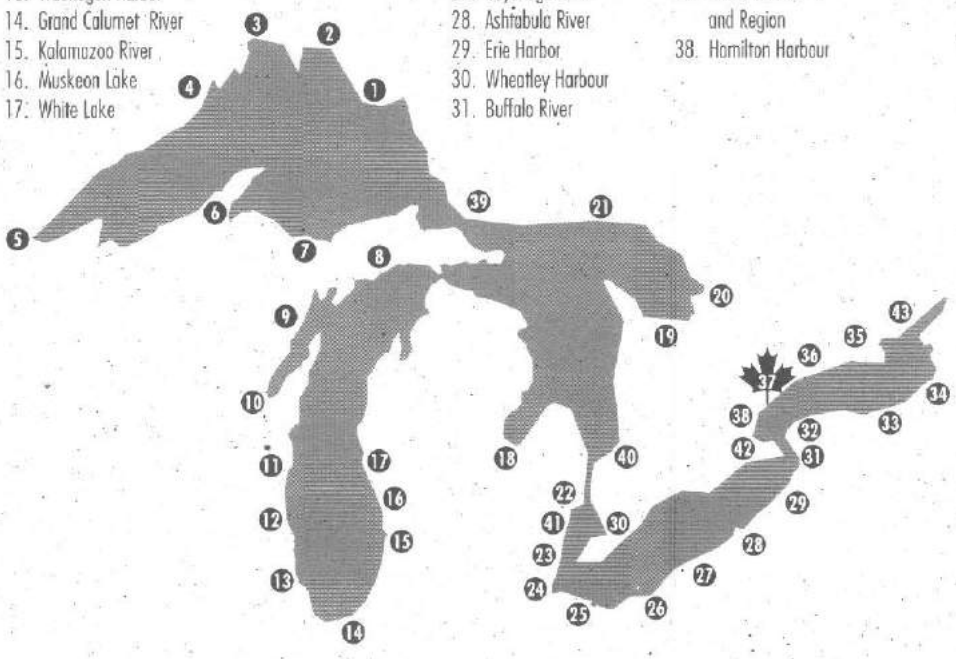


FIGURE 2: METRO TORONTO AND REGION IS ONE OF THE 43 "AREAS OF CONCERN" AROUND THE GREAT LAKES.

to the casual onlooker. Stormwater runoff, for example, is a significant source of pollution associated with human activities and animal faeces. The presence of trace contaminants in sewage treatment plant discharges can often be traced to industries using municipal sewer systems. Biological components of the ecosystem show many impacts of deterioration. There are now fewer native fish, bird, mammal and plant species than there were before European settlement and the balance of the system is thus more precarious and prone to disruption.

MANY BENEFICIAL USES ARE NOW RESTRICTED

As a result of these influences, many water uses are now restricted. Bathing beaches are often closed because of high bacterial levels in storm sewer discharges and combined sewer overflows. All levels of the food chain show the influence of the polluting activities of humans, but the most dramatic of those effects may be in contaminated fish tissues and poor reproductive success in fish-eating birds. Recreational uses are affected because of unsightly accumulations of nuisance weeds, murky waters and accumulations of debris.

HOPE FOR THE FUTURE: CONSENSUS-BASED CLEAN-UP ACTIONS

But grim though this picture seems, there is hope for the future. Under the Remedial Action Plan program, the Canada-U.S. Great Lakes Water Quality Agreement requires that both countries clean up local water quality in each of the "Areas of Concern." The RAP process is carried out in three stages.

Stage 1 of a RAP contains the definition of the water pollution problems in an area, and the probable sources of those problems. The Metro Toronto Stage 1 document, entitled ***Environmental Conditions***

and Problem Definition, was released in September 1988. It describes the water pollution problems and identifies their causes.

Stage 2 of a RAP — the stage described in this document — ***Clean Waters, Clear Choices*** sets goals, identifies specific remedial actions, responsible agencies, costs and timetables, and establishes monitoring programs to track progress.

Stage 3 is the implementation stage, one that lasts until the problems have been solved and the system restored to health.

Remedial Action Plans are intended to be community-based. Although led by Environment Canada and the Ontario Ministry of Environment and Energy, the Metro Toronto and Region RAP reflects the work of many individuals inside and outside government. Figure 3 shows the committee structure and make-up of the Metro Toronto and Region RAP. A RAP Team, made up of representatives of the two lead agencies, local and area municipalities and other agencies provides overall leadership for the process. Technical advice is supplied by Technical and Scientific Advisory Committees drawn mainly from government departments. A Public Advisory Committee, made up of representatives from many sectors provides ongoing input as the plan proceeds. The Public Advisory Committee is also represented on the other committees and provides an important conduit of information on public concerns to member groups. Appendix A provides a listing of the participants on each of these teams.

The RAP Goals for Ecosystem Restoration

The Public Advisory Committee has set a number of specific goals (Box 1) for the Metro Toronto RAP. These goals provide a general guideline to assess progress and set direction for the future and were discussed in an earlier RAP report: ***Strategies for Restoring Our Waters***. Some of these goals described how the ecosystem should

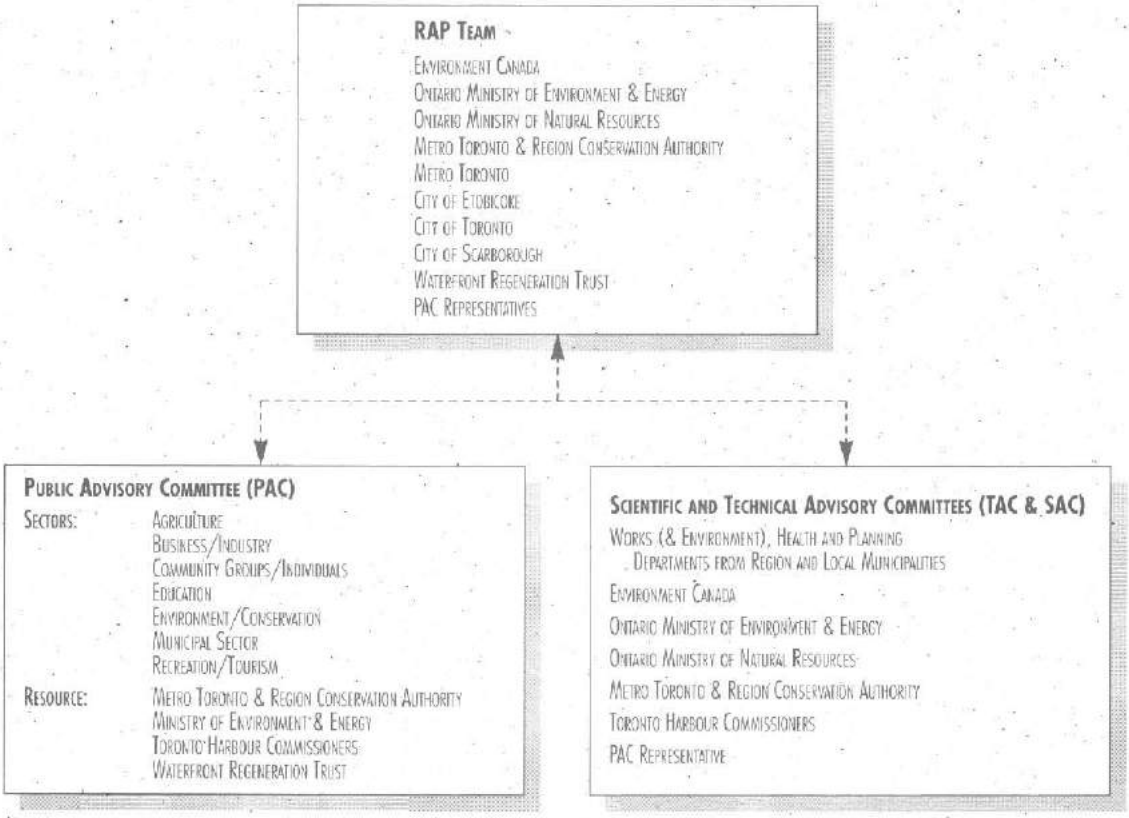


FIGURE 3: METRO TORONTO AND REGION RAP COMMITTEE STRUCTURE: THE RAP PLAN REFLECTS THE WORK OF MANY INDIVIDUALS BOTH INSIDE AND OUTSIDE GOVERNMENT.

be managed (using an ecosystem approach) and others goals describe a future vision for the RAP waters "fishable, swimmable, drinkable". These latter goals have been used to set specific targets or "delisting criteria" (see Table 1 on pg. 8). If these targets are met then the aquatic ecosystem can be considered to be restored.

The Ecosystem Approach and RAP Principles

The Great Lakes Water Quality Agreement, a joint commitment between Canada and the United States for management of their shared waters, has as its purpose "...to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem." Although not everyone agrees on a definition of the "ecosystem approach" to environmental management, it is generally agreed that such an approach does not focus only on people, but does not exclude people either. An ecosystem approach (Figure 4) is integrated and holistic. It considers connections between different portions of the ecosystem. Our water pollution problems cannot be solved without considering impacts on air, land, humans and other living things. Instead of short term crisis response, a true ecosystem approach includes strategic planning for long-term solutions, integrating environmental, economic and social concerns.

To assist in the decision making process the Metro Toronto RAP has identified a number of guiding principles (Box 2) that are consistent with a true ecosystem approach to

Box 1: The RAP Goals

1. Ecosystem Health: Metro Toronto's waterfront and watersheds should be a diverse, healthy, integrated ecosystem. They should be managed using an ecosystem approach in order to restore beneficial uses of our aquatic resources. An ecosystem approach is a comprehensive and systematic consideration of the interacting components of air, land, water and living organisms, including humans.
2. Fishable, Swimmable, Drinkable: Metro Toronto and Region's watersheds and nearshore zone should provide citizens with fishable, swimmable, drinkable and aesthetically pleasing water and aquatic habitats.
   a. Any fish species indigenous to the Metro Toronto waterfront and its watersheds should be able to return to the region, to live and naturally reproduce here.
   b. Opportunities to sustain and create fish and wildlife habitat throughout the Metro Toronto and Region watersheds should be pursued in parallel with water quality initiatives.
   c. Within the waterfront, watershed and headwaters, protection of the remaining wetlands should be a primary concern. A priority for any development or remedial measure should be, where possible, to avoid effects on existing wetlands, and where possible to provide increases in wetland habitat.
   d. People should be able to consume fish from the Metro Toronto waterfront and its watersheds without any restrictions resulting from contaminants of human origin.
   e. People should be able to swim and engage in water sports in Lake Ontario and Metro Toronto and Region's watersheds without risk of disease or illness.
   f. Levels of potentially toxic chemicals in Metro Toronto and Region's drinking water should not exceed acceptable standards as determined by the best scientific methodology available and when no health standards have been established, should not be detectable by the best scientific methodology available.
   g. The aesthetic quality of the waterfront, river valleys, ravines, wetlands and water bodies in the watersheds should be of sufficient quality to enhance passive and active recreational uses for all people.
   h. Opportunities should be provided for residents and visitors to study or observe a functioning, healthy ecosystem.
   i. People should be able to swim and engage in water sports in Lake Ontario and Metro Toronto and Region's watersheds without encountering dangerous or hazardous materials.
3. Discharges to Waterbodies: Discharges to Metro Toronto's waterfront and watersheds should not contain harmful micro-organisms or hazardous chemicals at levels which impair beneficial uses, inhibit biota or produce other adverse impacts on the ecosystem. There should be zero discharge of persistent toxic chemicals.
   a. The quality of stormwater discharged to receiving waters should be of sufficient quality so that it does not impair beneficial uses, inhibit indigenous biota or produce other adverse impacts on the ecosystem.

Box 1: The RAP Goals (continued)

b. The discharge of combined sewage to receiving waters should be virtually eliminated and any remaining discharge should be of sufficient quality so that it does not impair beneficial uses, inhibit indigenous biota or produce other adverse impacts on the ecosystem.

c. The quality of effluent discharged to receiving waters from sewage treatment plants should be of sufficient quality so that it does not impair beneficial uses, inhibit indigenous biota or produce other adverse impacts on the ecosystem.

4. Costs of Clean-up; Cost-Effectiveness: The costs associated with environmental controls and rehabilitation should be the responsibility of those who are the source of pollution. It is explicitly recognized in the Metro Toronto and Region RAP area that much of the pollution is caused by individuals and the public, including industry and agriculture.

   a. Cost effectiveness analysis should be used in RAP development and implementation to prioritize resources for water quality improvement.

5. Public Access: The public should have sufficient access to Metro Toronto's waterfront and valley systems in order to make them a focus of public involvement, recreation, enjoyment and cultural activities.

6. Sediments: The volume of in-place and transported sediments being deposited in Metro Toronto and Region's watersheds should be stabilized at near natural levels by controlling their release at the point of origin. These sediments should be free of persistent contaminants, and contain safe levels of non-persistent contaminants.

7. Lakefilling: Lakefilling should not be permitted unless it can be demonstrated not to impair beneficial uses of aquatic ecosystems. All possible means of improving the environment as a result of each project should be explored as part of the planning process in any development.

8. Atmospheric Deposition: The atmospheric deposition of potentially hazardous substances resulting from human activities in Metro Toronto and Region should have no adverse impacts on the ecosystem.

9. Coordination with Other Programs: Opportunities should be created and resources identified for the Metro Toronto and Region RAP, in the spirit of cooperation, to have input to plans in other areas, such as the Niagara River or the setting of lake water levels, which have significant impact on Metro Toronto and Region's water quality.

10. Navigation and Recreation: Navigational and recreational uses in the Metro Toronto waterfront should be maintained. An ongoing dredging option should be available so long as it is carried out in an environmentally acceptable manner.

11. Public Awareness and Consultation: Public awareness activities and consultation should continue throughout the RAP implementation phase.

12. Monitoring and Review: There should be a mechanism for regular review of the goals and the implementation of the remedial action plan.

environmental management. They reaffirm the RAP's commitment to source control and stress the importance of involving all stakeholders in clean-up. Finally, they emphasize the need for immediate action and they provide a basis against which to judge the worthiness and urgency of possible remedial measures for the RAP area.

Stage 2: Clean Waters, Clear Choices

This report targets eight major areas where action is needed. In some of them, such as repairs and improvements to the sewer systems, the local and regional municipalities will have the primary role. In others, such as communication programs and legal reforms, leadership by higher levels of government will ensure consistency among stakeholder groups and geographical areas. Individuals and community groups provide essential contributions throughout the plan, through direct action and as links between government agencies and the citizens they serve. Partnerships among the many players will be supported and enhanced through ongoing collaborative arrangements.

Consensus among a variety of viewpoints is vital and is reflected in the decisions presented in this report. The report reflects the work of many people, representing many agencies and activities, in developing a set of mutually acceptable water use goals and solutions. The plan includes details on how much each action will cost, how long it will take, and how far it will go in meeting specific objectives.

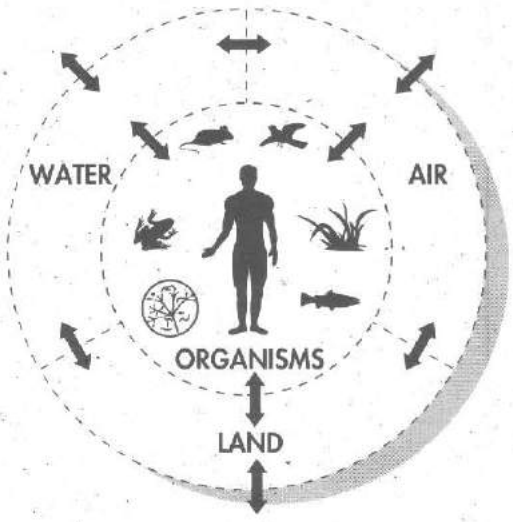


FIGURE 4: THE ECOSYSTEM APPROACH: EVERYTHING IS CONNECTED TO EVERYTHING ELSE!

BOX 2: METRO TORONTO AND REGION RAP PRINCIPLES

1. Water is a basic necessity of life and should be conserved. Its quality should be protected and restored.
2. The waterfront and watersheds must be planned and managed using an ecosystem approach. Ecosystem means using a comprehensive and systematic consideration of interacting components of air, land, water and living organisms, including humans.
3. The RAP goals form the basis for RAP action.
4. Environmental decision-making and the selection of remedial options should be coordinated by, and involve the participation of, all stakeholders. Stakeholders include all perspectives, for example: all levels of government, the private sector, non-governmental organizations, conservation groups and agencies, community groups and individuals.
5. We are all polluters and must be part of the solution.
6. Public awareness and education, including access to information, are important to the success of all stages of the RAP.
7. Both voluntary action and legislation should be considered as a means of implementing remedial actions.
8. Source control shall be an objective of the RAP and take priority over end-of-pipe solutions.
9. Neither dilution nor dispersion should be considered satisfactory substitutes to reducing pollution.
10. There should be zero discharge of persistent toxic chemicals.
11. The RAP should encourage and review research that supports RAP principles, but research must not be allowed to be an excuse for inaction.
12. Implementation consistent with RAP goals and principles should proceed along with development of the RAP.
13. In addition to remediation, the RAP must include and encourage preservation, conservation, rehabilitation and prevention.
14. The RAP goals and applicable remedial actions should be integrated into land use planning and construction approvals.
15. A RAP implementation action should be led and coordinated by the appropriate and clearly defined and mandated party.
16. An integrated and coordinated program of environmental monitoring and reporting of progress is essential in developing, implementing, evaluating and revising the RAP.

Although the plan's recommendations are generally directed at regional actions, they provide a framework for developing more specific local initiatives. All participants are agreed that actions should be first and foremost preventive, secondly protective, and finally, and only where necessary, reactive.

An important element of the RAP program is regular review and revision of the plan, deletion of actions that are no longer appropriate, and addition of new, more effective actions. The RAP will need to evolve over time to meet new challenges and priorities and to take advantage of new technologies and information.

The plan provides a critical step towards restoring our degraded water systems. It's not the final answer — we don't even know all the questions yet! — but it is a detailed, specific, and most of all achievable plan that, fully implemented, will result in significant water use improvements. As we learn more about the workings of the Metro Toronto and Region ecosystem, we can and will refine this plan with the help of our partners in government, industry and the private sector.

The challenge of restoring our water resources is a difficult one, and one that can only be undertaken through partnerships and ongoing commitment. It will take many years and millions of dollars to complete the more than fifty actions that comprise the plan. With your support, we can meet that challenge and fulfil our shared vision for a healthy, balanced ecosystem.

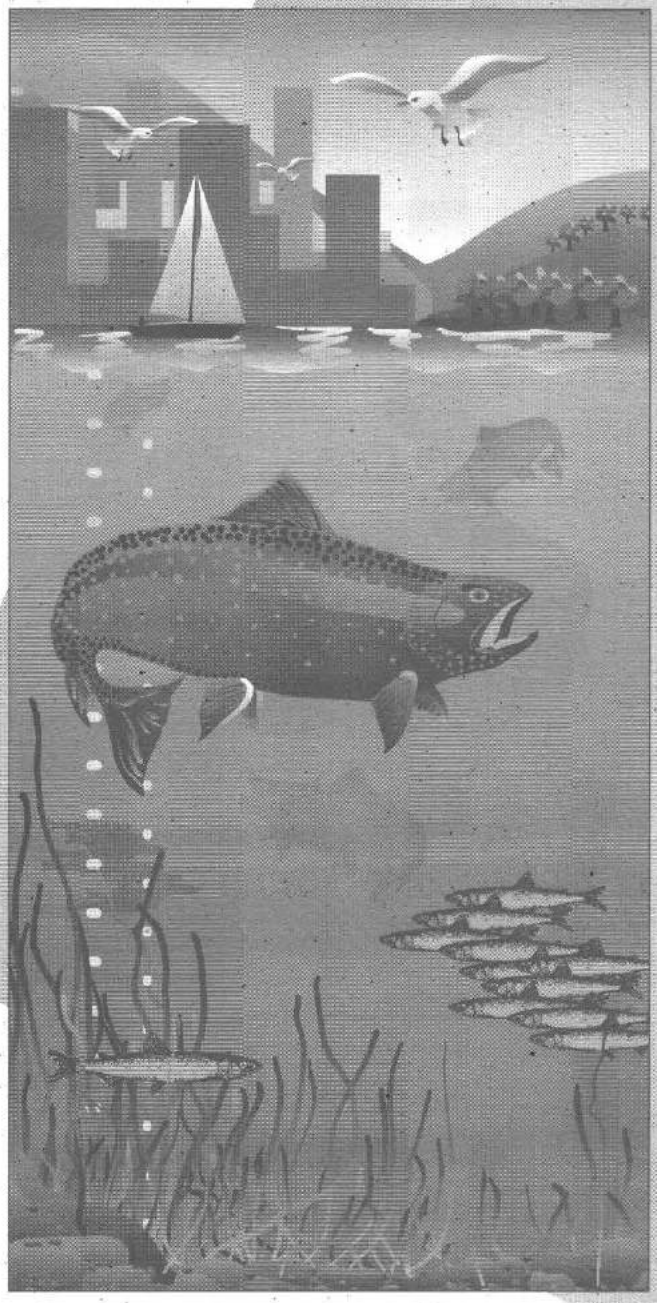
TABLE 1: RESTORATION TARGETS (DELISTING CRITERIA)

GOAL	SPECIFIC TARGETS
1. *Ecosystem Health:* An all-encompassing goal reflecting other goals and objectives.	• Discharges of persistent toxic substances are virtually eliminated. Discharges of toxic substances in toxic amounts are eliminated. • The numbers of fish displaying diseases, tumours, ulcers or deformities associated with the presence of toxics are reduced or maintained at levels considered background for the community. • The incidence rates of deformities and reproductive problem in "sentinel" wildlife species are the same as, or less than, background levels in populations in uncontaminated systems. • Tests on phytoplankton and zooplankton confirm that ambient waters do not cause death or long-term health or reproductive effects.
2a. *A Self Sustaining Fishery:* This goal requires action on both water quality and habitat. Habitat objectives are specified under goals 2b and 2c.	• Water quality is as good or better than Provincial Water Quality Objectives 95% of the time. • Tests on fish confirm that ambient waters and sediments do no not cause death or long-term health or reproductive effects. *Waterfront* • Biomass of resident, fish-eating fish species increased to levels above 20% of total resident biomass; biomass of specialist fishes increased to at least 40% of total biomass. • Formerly abundant fish populations are rehabilitated where locally depressed or extinct.

GOAL	SPECIFIC TARGETS
	• Proportion of native species is increased towards 100% of total fish community. *Watersheds* • Specific targets contained in watershed plans should be used. Where no plans exist they should be developed.
2b. Rehabilitation of Fish and Wildlife Habitat	*Waterfront* • Open coast habitat is rehabilitated suitable for spawning populations of salmonoid fish such as trout. • Sheltered bays are rehabilitated to encourage re-establishment of aquatic plants suitable for northern pike, smallmouth bass and largemouth bass spawning, nursery and feeding habitat. • Diverse aquatic plant communities are re-established in river mouths and estuaries suitable for largemouth bass and northern pike production; rubble/rock slopes are established in fast-flowing river areas favourable for smallmouth bass production. *Watersheds* • Biotic corridor linkages are protected, enhanced, or rehabilitated across the waterfront and throughout the stream and valley system.
2c. *Protection and Rehabilitation of Wetlands*	*Waterfront* • Remaining and created wetlands are protected. A significant amount (eg. a preliminary target of 75 hectares) of wetland areas should be restored to the waterfront and protected. *Watersheds* • Specific targets contained in watershed plans should be used. Where no plans exist they should be developed.
2d. *No Restrictions on Fish Consumption*	• There are no restrictions on fish consumption that are attributable to local sources.
2e. *Swimmable Beaches*	• Lake water at bathing beaches contains less than 100 *Escherischia coli* organisms per 100ml of water over 95% of the swimming season.
2f. *Drinkable Water*	• Water quality at drinking water intakes is of sufficient quality that it requires only standard settling, coagulation and disinfection treatment before being distributed to consumers.
2g. *Pleasing Aesthetic Quality*	• Waters are free of any substance that produces a persistent objectional deposit, unnatural colour or turbidity, or unnatural odour (for instance, oil slick or surface scum).

GOAL	SPECIFIC TARGETS
2h. *Ecosystem Observation*	• All municipal planning documents contain a statement to the effect that residents and visitors should be provided with opportunities to study or observe a functioning, healthy ecosystems.
2i. *No Aquatic Hazards*	• Waters are free of any substance that produces a persistent objectional deposit, unnatural colour or turbidity, or unnatural odour (for instance, oil slick or surface scum).
3a. *Control of Stormwater Quality and Quantity*	• The quality of storm run-off is protected and enhanced. • The natural hydrologic cycle is protected and re-established to the maximum extent possible. • In cold water fisheries areas, sufficient stormwater controls are established to control run-off from rainfall events of at least 25mm daily precipitation; buffer zones of 30m or more separate developed lands from receiving streams and lakes; temperature impacts should be mitigated. • In warm water fisheries area, sufficient stormwater controls are established to control run-off from rainfall events of at least 25mm daily precipitation; buffer zones of 15m or more separate developed lands from receiving streams and lakes. • Other than in four extreme discharge occurrences (heavy rainfall events) each year, stormwater discharges to receiving waters meet guideline of 100 *Escherischia coli* organisms per 100ml of water, and is devoid of debris, oil, scum and substances that produce objectionable odour, colour, deposits and excessive turbidity. • All subcatchments with more than 20% industrial/commercial/institutional land use have spill control techniques in place.
3b. *Virtual Elimination of Combined Sewer Overflows*	• 90% of the wet weather flow in the combined sewer system is controlled. • The controlled volume of combined sewage receives treatment at least equivalent to primary treatment plus disinfection (that is, treatment equivalent to 50% Biochemical Oxygen Demand removal and 70% total suspended solids removal).
3c. *Control Quality of Sanitary Discharges*	• Sanitary sewage receives secondary treatment with phosphorus removal and disinfection and produces non-toxic and non-mutagenic effluent with the following characteristics: Biochemical Oxygen Demand: 25 mg/l, Total Suspended Solids: 25 mg/l, Total Phosphorus: 0.5 mg/l • Per capita water consumption is reduced by 15-25% by 2011.
5. *Public Access to the Waterfront and Valley Systems*	• All municipal planning documents contain a statement to the effect that members of the public should have sufficient access to Metro area waterfront and valleys systems in order to make them a focus of public involvement, recreation, enjoyment and cultural activities.

GOAL	SPECIFIC TARGETS
6. *Clean Sediment*	• Suspended transported and in-place sediments contain levels of contaminants at or below the Provincial Sediment Quality Guidelines.
7. *Lakefilling Only Where Beneficial Uses will not be Impaired*	• Materials used in lakefilling meet the Fill Quality Guidelines for Lakefilling in Ontario. • Lakefilling produces no net loss of aquatic habitat • Lakefill structures do not have adverse effects on water circulation.
10. *Dredging Only Where Beneficial Uses will not be Impaired*	• Dredged sediments meet Provincial Sediment Quality Guidelines.



THE ACTION PLAN

What needs to be done

There are a great many possible actions for remediating the Metro RAP area. This section represents an overview of a consensus among the RAP participants as to the most desirable and cost-effective solutions. Chapter 3 "Recommendations" provides a listing of each individual action which is recommended.

There are three major pathways that contaminants follow in polluting our aquatic resources: stormwater runoff; combined sewage; and sanitary sewage. Polluted stormwater runoff can enter our waters either directly over land or through the stormwater sewer system. Combined sewer systems, built in older sections of the cities, tend to overflow sewage during wet weather. Sanitary sewers lead to sewage treatment plants which are designed to treat human wastes, but not chemicals. While other avenues (eg. direct air fallout to water and lakewide sources) exist, stormwater and combined and sanitary sewage dominate our local scene.

In examining the size of the loads of contaminants it is quite evident that for a majority of contaminants, stormwater runoff is the primary route. While the other two pathways are significant, they have already received considerable attention. The following discussion on recommendations is presented in a manner representing the relative order of importance of stormwater, combined sewer overflows and sewage treatment plant discharges in order to most effectively achieve ecosystem restoration. While this order of priority can help in allocating resources, implementation of the whole plan is required to achieve all of the RAP goals for protection and restoration of the aquatic ecosystem.

The guiding principles of the RAP provide a basis on which to set priorities for action. The principle that source control should take precendence over end-of-pipe control is particularly important. From that principle follows a hierarchy of environmental management actions (see Box 3) which have been used to choose the best solutions within each of these three major areas of action.

Following the discussion of these three main areas are recommendations dealing with fish and wildlife habitat. As water quality continues to improve it is essential that habitats continue to be protected and restored.

The final four areas deal with public awareness and education; laws and policies; planning; and research and monitoring. These areas are essential to the overall success of the plan and are complementary to the first four areas of action.

Box 3: A Hierarchy of Actions

1. The best solution is **source control** or prevention. An example of a preventative measure would be changing industrial processes to reduce the amount of toxic material used or produced. Source control means that fewer pollutants are poured down the drain or on driveways and lawns by residents, businesses and industries.
2. Following prevention, the next best action is the proper **management** of operations, materials and facilities. Sometimes know as "best management practices," examples of this approach include regular cleaning and maintenance of storm sewers and safe handling of hazardous materials to avoid spills.
3. Finally, **end-of-pipe** solutions or treatment of wastes should be undertaken. An example of this type of solution would be improvements to sewage treatment plants for enhanced pollution removal. The RAP guiding principles expressly forbid the use of dilution or dispersion to treat wastes. The RAP also uses an ecosystem approach which means that when dealing with water pollution, consideration must also be given to effects on land, air and living things, including humans.

Stormwater

Rain and snow are important mechanisms for the cycling of water in the ecosystem. Water leaves the earth's surface through evaporation and related processes, and is returned to the earth through condensation and precipitation (Figure 5). Stormwater is an important link in the return of rainwater to the ecosystem and a mechanism by which pollutants are transported within the ecosystem. While the total amount of water within the ecosystem may not change over time, land use may affect the amount of water that is present in each part of the system (see Figure 6) and the quality of that water.

In a natural forest environment much of the rain water filters into the ground, replenishing the groundwater and providing a source of cool spring water for streams. In the urban environment, however, much of the land surface is paved and impermeable and less water filters into the ground. Water falling on streets and parking lots is warmed as it drains into collection systems, carrying with it pollutants such as pesticides and fertilizers, bacteria from animal droppings, and trace metals and grit from car exhausts. In urban areas large volumes of stormwater runoff can lead to flooding and erosion and deliver a large amount of pollution to the water in a relatively short time. Also, because there is little groundwater to replenish stream flow in urban areas, urban streams tend to contain very little water during dry spells. This can cause problems for fish and wildlife using the stream.

In a rural setting, stormwater picks up pesticides, fertilizers, topsoil and animal manures from agricultural fields, manure storage areas and open land. This stormwater runoff may be diverted by structures such as tile drains and open ditches or may flow uncontrolled over the land surface, ultimately entering ponds and streams, or seeping down into groundwater. High volumes of stormwater runoff erode soils which

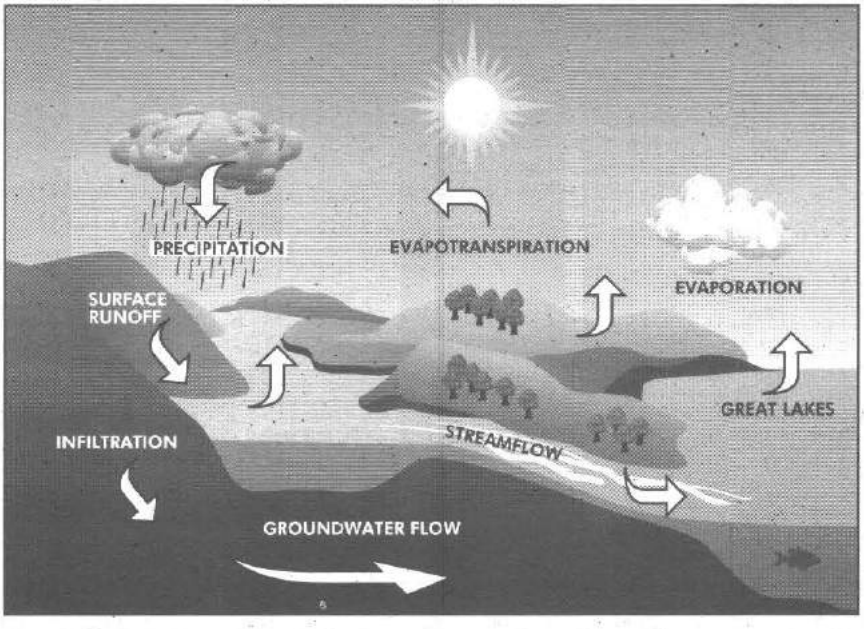


FIGURE 5: THE WATER CYCLE: WATER LEAVES THE EARTH'S SURFACE THROUGH EVAPORATION AND RELATED PROCESSES AND RETURNS THROUGH CONDENSATION AND PRECIPITATION

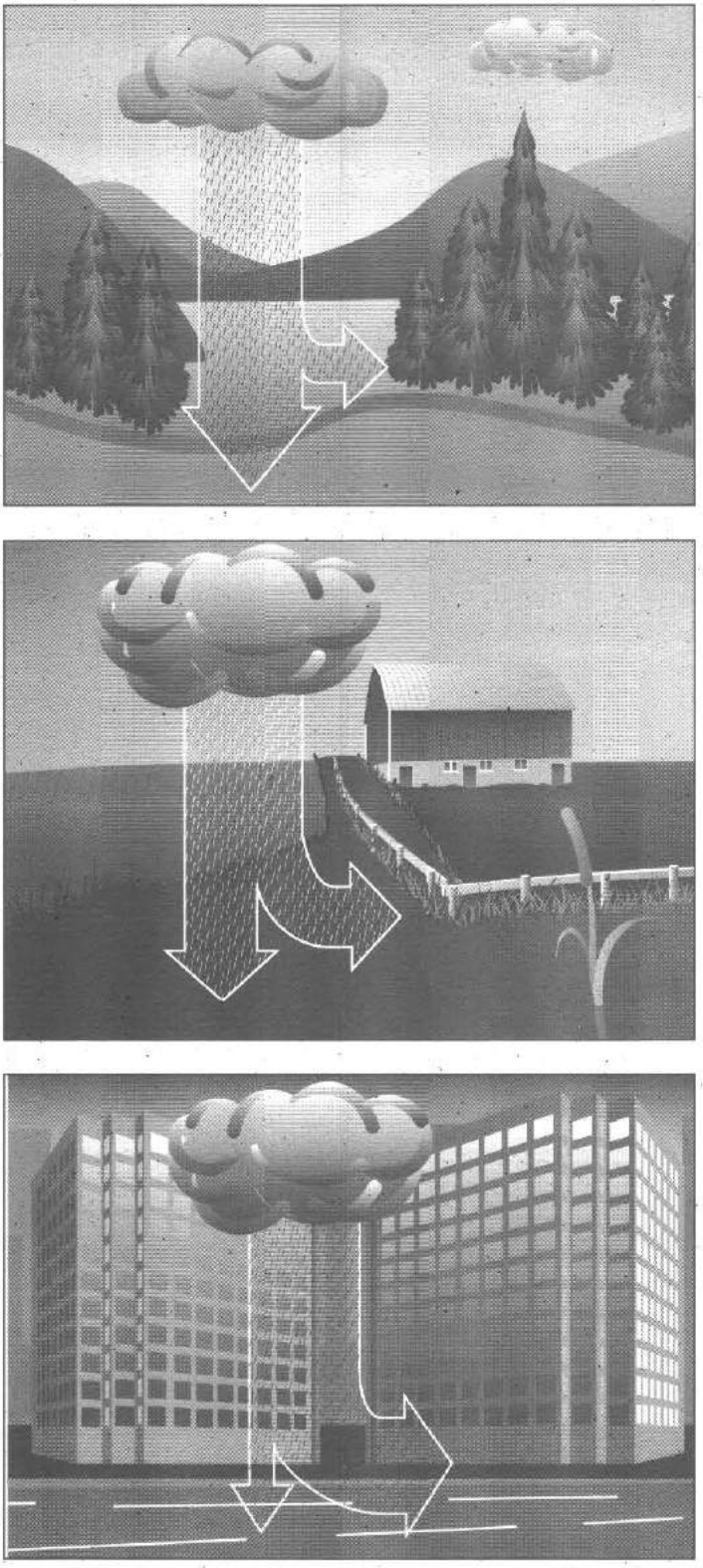


FIGURE 6: INCREASED URBANIZATION MEANS MORE STORMWATER RUNOFF AND LESS INFILTRATION

can clog waterways. In rural streams, high water levels during rainstorms and low flows during dry spells, while less pronounced than in urban areas, can still cause problems for aquatic life.

Poor stormwater quality is usually the result of pollutant contributions from many different sources, often in different parts of the watershed. Among the most important of these sources are:

- accumulated dirt and grit on streets, roofs and parking lots,
- excrement left by domestic and wild animals, including birds,
- spillage in industrial and commercial storage, loading and shipping areas,
- erosion from construction sites,
- illegal cross-connections between sanitary and storm sewers,
- dumping or spillage of "household toxics," including waste motor oils, paints, solvents and other chemicals into storm sewers,
- pesticides and fertilizers from urban and rural land surfaces,
- animal manures from agricultural activities, and
- malfunctioning septic systems.

Problems with both the quantity and quality of stormwater runoff are major issues in the RAP area. In developed areas remediation of stormwater needs to be given a high priority if we are to restore the health of our aquatic ecosystem. In developing areas, stormwater management needs to be given proper consideration in order to avoid the problems present in urban areas.

What needs to be done

Actions relating to stormwater management therefore have three objectives:

- to protect and enhance the ***quality*** of stormwater runoff,
- to limit the ***quantity*** of stormwater runoff, and
- to protect and (where necessary) re-establish the natural cycling of water.

To meet the goal of improving stormwater quality and reducing the quantity of runoff, we must take a variety of actions. The most important of these are:

- to ensure that every industry, commercial establishment and institution is using the best possible stormwater management practices (see Box 4),
- to improve the ability of municipalities to respond to and legislate against pollutant spills,
- to work with the development industry to improve methods of erosion control at construction sites,
- to trace and disconnect illegal cross-connections to the storm sewer system,
- to work with the agricultural community to develop farm management plans and associated financial assistance programs,
- to improve the operation of municipal storm sewer systems, particularly the frequency and efficiency of cleaning programs and the development of better stormwater treatment technologies, and
- to require comprehensive land use planning (including the preparation of sub-watershed plans) in developing and developed areas, consistent with current standards and community expectations.

Reduction in the quantity of stormwater runoff and the restoration of the natural cycling of water can also be achieved through increased infiltration of stormwater. This can be an added benefit of discouraging pavement, increasing greenspace and planting trees. Wetlands and stormwater ponds can be used along with other innovative techniques for improving infiltration (see Box 5). Other actions discussed in later sections of the chapter will also contribute toward achieving stormwater related goals.

The majority of the specific actions for addressing stormwater concerns (described in Chapter 3) can be undertaken in less than five years and should be given a high priority. Some long-term initiatives such as disconnecting cross-connections between sanitary and storm sewers will take ten to twenty years to complete.

Box 4: Stormwater Best Management Practices (BMPs)

Many factors contribute to the in-flow of pollutants to storm sewer systems. Poor materials-handling practices can result in spillage in storage and loading areas. Truck washing can transfer road dirts and associated pollutants from the truck surface into the sewers. Storage of chemicals in inappropriate containers, or mixing of different chemicals in the same container, can cause equipment failure and leakage.

Pollutant leakage from these sources are unpredictable and often occur without the knowledge of employees. They can therefore be very difficult to trace. An important key to reducing this kind of pollution is the development of pollution prevention strategies or Best Management Practices (BMP) Plans in collaboration with the facility.

Best Management Practices Plans are written on a site-by-site basis, usually by, or with, the potential polluter. Essential components of the Plan include:

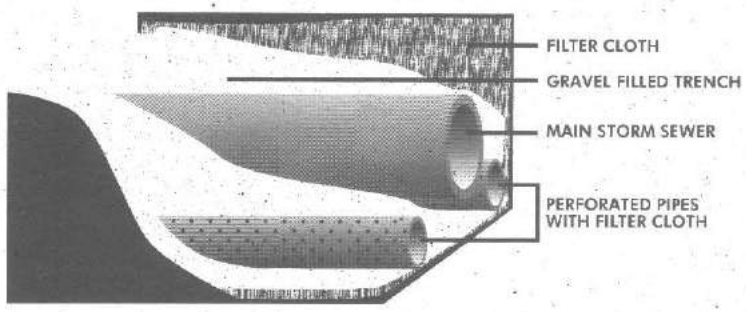
- establishment of a BMP Committee, who will develop the BMP Plan in much the same way that a fire prevention or safety committee develops fire prevention or safety practices,
- identification of toxic and hazardous materials, potential spill sources, and the potential risks of discharges of pollutants from each area,
- appropriate incident reporting procedures, BMP inspections and record-keeping, and
- establishment of BMP training programs for plant personnel, particularly with respect to "good housekeeping" practices and the handling and storage of toxic materials.

Best Management Practices Plans are now required by many jurisdictions around the world. They work well, are easily understood by staff, and are low in cost. Metro Toronto is working to develop BMP Plans for all major industrial, commercial, and institutional facilities. These should be in place in less than five years — with significant improvement in the stormwater quality from those sites.

Box 5: An Innovative Stormwater Management Solution

The City of Etobicoke is demonstrating a unique stormwater management system in an existing developed residential area. The site required reconstruction of its roadway and storm sewer system. However, instead of just reinstalling a conventional sewer pipe, the City installed a system containing two additional perforated pipes (see diagram below). Because of the design of the system, the perforated pipes capture all stormwater flows from about 90% of storm events. (Excess flows are carried by a conventional storm sewer pipe.) The holes in the perforated pipes allow water to seep into a gravel filled trench and then into the sandy soil which surrounds the system.

This increased infiltration restores groundwater flows and creates a more natural cycling of water. More traditional methods of stormwater control by stormwater management ponds were estimated to cost $1.4 million versus the $520,000 for the new storm sewer system.



Combined Sewer Systems

More than a hundred and fifty years ago, cholera epidemics in the growing city of Toronto drew attention to the need for careful sanitation and removal of wastes. The first Toronto "drains" were laid in the 1830s to carry human wastes down to the lake, where they could be diluted and washed away. And indeed, for many years the evolving patchwork of drains served the population well with little impact on the quality of nearshore waters.

As the city grew, additional ditches and drains were added — and connected to the existing drainage system — to carry rainwater and melting snow away from busy streets along with human wastes. Thus was born Toronto's original combined sewer system: "combined" because the storm drains and the sanitary drains were a common system (see Figure 7) which discharged directly to the rivers or lake. Overflow points were added along to system to protect it from damage from excessive flows.

In 1911, a new sewage disposal plant was opened near Ashbridge's Bay, and from that time sewage was diverted to it via a new trunk sewer. New storm drains were constructed as a separate sewer system draining directly to a local watercourse although in some areas combined sewers continued to be built up until the 1960s. These combined sewers still create a problem in older parts of Metro when they overflow, releasing a mix of storm and sanitary sewage to waterways and the waterfront. The problem has been compounded as the amount of area that is impermeable to rainwater (eg. roofs and road surfaces) increases. Combined sewage flows were manageable fifty or seventy-five years ago but now, with increased development and more stormwater runoff, combined sewer overflows and by-passes of secondary treatment have increased.

CSOs have serious consequences for water quality. The diverted flows are a significant source of pollutants. In the modern watershed they combine not only storm runoff, with its associated street dirts and pollutants, and sanitary sewage, with its bacterial contamination, but also wastes from industries using these sewers as well.

Less serious, but more immediate for residents, has been the problem of flooding streets and sewage back-up into basements, with associated structural and health impacts.

Over the years, considerable public funds have been expended on the task of digging up streets and "separating" combined sewers. Separation involves the building of an additional storm sewer to carry road drainage, thereby relieving pressure on the combined sewer system. Much of this work was prompted by the need to handle

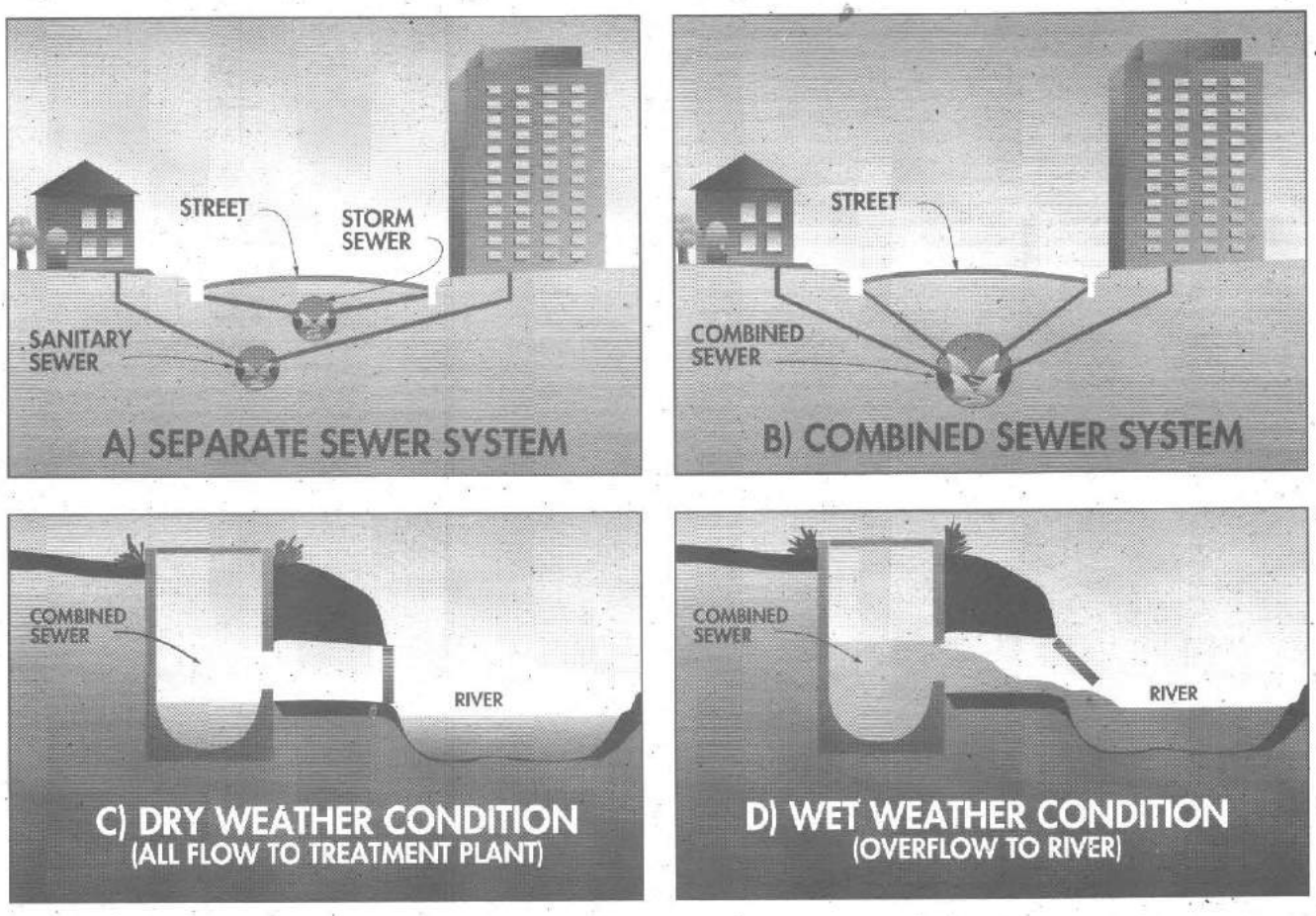


FIGURE 7: SEPARATE (A) VERSUS COMBINED (B) SEWER SYSTEM: COMBINED SEWER SYSTEMS CARRY BOTH SANITARY AND STORMWATER RUNOFF. OVERFLOWS OF UNTREATED SEWAGE ("COMBINED SEWER OVERFLOWS") CAN OCCUR IN WET WEATHER (C AND D).

increased quantities of storm and sanitary sewage — in many cases reflected in frequent basement flooding or street flooding — from a rapidly growing population.

The RAP area is not alone in its problems with combined sewer systems. Most older cities have evolved as the Metropolitan Toronto area has, and most are now dealing with the same problems. Cities such as Milwaukee have developed innovative — but expensive — measures suited to their own systems and landscapes.

Typically, control strategies for combined sewer overflows attempt to reduce the volume of the discharge (for example by limiting the amount of rainwater that can enter the system), or the frequency of the discharge, or both. The City of Toronto alone has 25 combined sewer overflow outlets discharging directly to Lake Ontario, and a further 22 on the Don River; other local municipalities have their own outlets. These overflows have been identified as major sources of bacterial contamination at Toronto bathing beaches, and have serious local impacts on the aquatic plants and animals near their outfalls.

Three types of actions may be appropriate for the control of combined sewer overflows in Toronto:

- **separation** of the combined sewer system
- **inlet control** or the restriction of the amount of water entering combined sewers, or
- **storage and treatment** of combined sewer flows.

These options are discussed in more detail in the following paragraphs.

Box 6: Virtual Elimination of Combined Sewer Overflows (CSOs)

The patchwork nature of sewer systems, their varying sizes and ages, and the overlying mosaic of land uses makes development of CSO control plans a complicated business. In areas prone to basement flooding, inlet controls (including roof leader disconnection) may be the answer. In areas where space is not at a premium, it may be possible to build storage tanks or satellite treatment systems. The solution to CSO problems may be different in different areas.

In the sewershed draining to the Humber Sewage Treatment Plant, there are five combined sewer overflows, all on Black Creek. These overflows are a potential source of bacterial and chemical contaminants to the Humber River and Humber Bay. One solution to the problem is the construction of detention tanks to store combined sewage during rain storms. This stored combined sewage would then be sent to the sewage treatment plant when flow rates return to normal levels.

For the Main Sewage Treatment Plant sewershed, the situation is much more complex. This sewershed contains dozens of combined sewer overflow locations, which discharge to the Don River, Massey Creek and the central waterfront. Solving the problem of CSO flows will be difficult and expensive. Much higher costs, and more difficult implementation, would be needed to control the central waterfront CSOs, many of which date from the earliest days of the sewer system.

Control of CSOs in both sewersheds may also require expansion in the capacity of the Main and Humber sewage treatment plants and expansion of trunk sewer systems serving those plants. The high costs involved, and the time necessary to complete sewer modifications, suggest that CSO control in both areas is likely to be a long term prospect extending over ten to twenty years at least.

Combined Sewer Separation

East York and the cities of Toronto, Scarborough and York (working with Metro Toronto) have all had active sewer separation programs in place, most for at least twenty-five years. The City of Toronto alone spent $237 million between 1966 and 1992 to provide road storm sewers in an area over 8000 hectares in size. Accelerated programs for sewer separation were in place in York, East York and Scarborough during the 1980's, while the City of Toronto has essentially completed its program for road stormwater drainage.

Although costly and disruptive, (because they involves street excavation and resurfacing) these actions have significantly reduced basement flooding in older areas of the city and have in some cases reduced the frequency and volume of combined sewer overflows. However, separation also increases the amount of stormwater runoff — in many cases almost as polluted as combined sewage — flowing through the storm sewer system and into our rivers and lake. There is a need to pair sewer separation with actions to control the quality and quantity of stormwater runoff.

Even with the building of separate road drainage, stormwater from roofleaders (downspouts) and foundation drains still enters the combined sewer system. The City of Toronto has taken the approach of requiring new and renovated buildings to install separate drainage systems, while leaving existing combined drains intact.

Municipal spending on combined sewer separation has declined somewhat in recent years, with a corresponding increase in expenditures on alternative methods such as inlet controls and storage tanks. Continued sewer separation should be pursued when road or sewer repairs are being carried out in an area.

Inlet Control

Another option to reduce combined sewer overflows is to restrict the amount of stormwater that flows into the system. Many municipalities have investigated the use of inlet controls to restrict the stormwater draining into combined sewers. Catchbasins, which collect stormwater under street gratings, can be sealed altogether, or can have flow restrictors installed to limit flows. At least $5 million was spent on inlet control projects under the Waterfront Water Quality Improvement Program (a funding program discontinued in 1992). Much of the work was directed at areas which were experiencing basement flooding problems.

A relatively low-cost method of reducing flows to the combined (and storm) sewers is the disconnection of roof leaders which are connected directly to sewers. Stormwater runoff can be allowed to flow onto lawns, or into special "soak away pits" or collected in rain barrels. Although downspout disconnection is not suitable for areas with poor

soil permeability or small lot size, a voluntary program in Toronto has demonstrated some success. Downspout disconnection can be particulary effective where a majority of property owners agree to participate. It reduces combined sewer overflows and encourages the use of stormwater as a resource. A major factor influencing the acceptability of roof leader disconnection seems to be a property owner's previous experience: those who have had no problem with sewage back-up see no need for change, while those who have experienced the problem readily agree to disconnection!

Still, even with road drainage separation and downspout disconnection, stormwater flows will enter the sewers from foundation drains. Foundation drains are considerably more expensive to disconnect, although development or redevelopment provides an opportunity to remove these flows from the combined sewer system.

Storage and Treatment of CSO

Another option to control combined sewer overflows is to build storage tanks at the overflow point. In this way excess flows can be stored temporarily for diversion to the sewage treatment plant after the storm has passed.

Storage and later treatment provides a means to treat a larger volume of flow by distributing the flow more equally over a given time period. This way there is less impact on pipes and treatment plants with limited capacity. The difficulty in some cases is that older sewage treatment plants are often operating close to their design capacity — the volume of flows they were designed to treat. Where they can accept a little more, there is often pressure on them to use that excess capacity to serve new housing or industrial developments rather than the retained flows from combined sewers. As a result, the Municipality of Metropolitan Toronto has been reluctant to agree to the building of storage facilities until studies of their potential impacts, on treatment plant capacity and treatment effectiveness, are complete. Nevertheless, Metro Toronto has allocated funds for additional storage facilities in its five-year capital works plan, anticipating the need for some CSO containment.

Storage proposals have been made to accommodate CSO flows on Black Creek, prompting concern by Metro that there may be insufficient capacity in the trunk sewer system — built in times of smaller populations and lower flows — and the Humber Sewage Treatment Plant to allow this. One solution is to construct new, larger trunk sewers in key areas, so that the sewer system itself is larger and better able to store excess flows.

Where it is not feasible to send the detained flow to the sewage treatment plant due to limited capacity, an option exists to provide treatment of the combined sewage at the point of discharge. These so-called "satellite" treatment systems can provide treatment equivalent to primary treatment at a sewage treatment plant and, since they only operate during high flow conditions, may provide a more cost-effective solution. Metro Toronto is proposing to test such a system at the North Toronto Sewage Treatment Plant site, where a combined sewer overflow point exists.

Sanitary Sewers and the Sewage Treatment Plants

Within the RAP area, the majority of the population lives within Metro Toronto, which has the responsibility of providing treatment for sanitary wastewater. Metro operates four sewage treat plants (See Table 2).

North of Metro, the majority of the urban areas drain to the York-Durham sewer system which delivers sanitary wastes to the Duffin Creek Sewage Treatment Plant. Even though this plant discharges outside the RAP area, the recommendations dealing with source control of sanitary drainage still apply and are essential to the achievement of the RAP goals. Similarly, the need for source control action applies to rural areas which generally rely on individual septic systems.

The previous section described the special problems we face in dealing with older, combined sewer systems in Metro. But problems also exist in newer, separate sanitary systems. In general, these relate to inappropriate use of sewers for waste disposal and linkages to a system whose roots lie in the early nineteenth century. Some key areas for improvement are described in the following paragraphs.

TABLE 2: RAP AREA SEWAGE TREATMENT PLANTS

PLANT	AREA SERVED	POPULATION SERVED	CAPACITY 1000M³/D	CAPACITY MIGD	AVERAGE DRY WEATHER FLOW 1000M³/D	AVERAGE DRY WEATHER FLOW MIGD
Main	North York, Toronto, East York, Scarborough	1,200,000	818	180	795	175
Humber	North York, York, Etobicoke, Toronto	660,000	473	104	354	78
Highland Creek	Scarborough	290,000	219	48	182	40
North Toronto	North York, Toronto, East York	55,000	34	7.5	34	7.5

Legend: 1000M³/D = thousands of cubic metres per day MIGD = million imperial gallons per day

Industrial Use of Sewers

Metro's ability to serve its industrial populations with adequate water supply and waste treatment was fundamental to its economic growth. In the modern city, we are now paying the price for a century or more of industrial use of sewers. Not a single Metro industry discharges its wastes, treated or otherwise, directly to the lake or rivers. Instead, every industry, from the smallest dry cleaner or metal plater to the largest manufacturer, sends its wastewaters through the sanitary system to the sewage treatment plants. Most of these industries now rely heavily on these municipal services — for which they pay — and many believe they have no alternative disposal option for their wastewaters.

The problem is that sewage treatment plants are designed to treat human sewage, not industrial chemicals. The sedimentation tanks, activated sludge processes, and nutrient removal schemes developed in the early years of this century are simply not effective in removing pesticides or heavy metals. Many of these trace contaminants are "hydrophobic" and tend to attach themselves to small sediment particles rather than remain in solution. By operating sedimentation processes effectively, we can remove large portions of the particulate matter in sewage, with its attached pollutants, but then must deal with the heavily contaminated sludges that accumulate in treatment.

The solution is clearly to reduce or eliminate the amount of industrial chemicals (and, as we will see, household toxics) that enter the sewer system. This is a complex business, because few municipalities have complete information on which industries are using their sewers, and what raw materials, products and waste materials are involved.

Improvements at the Sewage Treatment Plants

The RAP area's sewage treatment systems need more than controls on industrial dischargers to operate safely and well. As mentioned in the discussion on combined sewers above, the Humber and Main sewage treatment plants may need to be expanded to deal with increasing residential and industrial development, and to handle flows diverted from combined sewer overflows. Specific improvements can be made to reduce odours, improve sludge pumping and de-watering, and generally increase plant efficiency. New methods can be installed, and existing treatment processes can be improved to reduce the levels of

Box 7: Controlling Industrial, Institutional and Commercial Sewer Use

Municipalities have an important tool to use in controlling the use of sewer systems by industries, institutions and businesses: sewer use by-laws. These by-laws dictate the quality and quantity of wastewater that an industry can discharge into the sanitary (or storm) sewer system, protecting sewer lines, treatment processes and the environment. These by-laws can include programs for industrial inspection and sampling, spills control and related measures.

Ontario has a model sewer use by-law, developed in 1988, and many municipalities including Metropolitan Toronto have voluntarily adopted it in full or in part. This model by-law, which replaces a 1975 version, places new or more stringent limits on a range of heavy metals, pesticides, herbicides and designated hazardous wastes. It prohibits the use of dilution to achieve limits and disallows any discharge of specified explosive, corrosive and flammable materials. Spills reporting requirements are clearly specified, as are guidelines for the development of best management practices for contaminated runoff.

Ontario's model sewer use by-law is currently the most comprehensive in Canada, but can be extended further. Under proposed MISA (Municipal-Industrial Strategy for Abatement) legislation, Ontario will impose uniform, legally-binding standards for sewer use on over 20 industrial sectors. These standards will apply to all municipalities, but the requirements for one type of industry may differ from those for another.

In Metropolitan Toronto sewer systems have evolved over 150 years, and implementation of the by-law can be difficult. For example, a trunk sewer may be owned by Metropolitan Toronto, but the contaminants flowing through that sewer may have been contributed by dischargers in several local municipalities. In recent years, the regional government has assumed responsibility for control of industrial, institutional and commercial users of the sanitary system and storm sewers.

pollutants in the effluent, and thus the impact on receiving waters, or to reduce levels of chlorine and ammonia, both of which are toxic to aquatic life. Where industrial use of sewers is high, the contaminant "soup" may be such that it poses health risks to plant workers or neighbourhood residents. While the ultimate solution is to eliminate the sources of these materials, interim measures taken in the plant can help improve safety and working conditions, reduce odours, and protect workers and residents from adverse effects. In older plants, there may be a need to strengthen or replace aging structures and equipment to meet present day demands.

In developing plans to upgrade or expand sewage treatment plants it is essential that the plans are developed in a holistic way by examining not only the plant itself but also the entire system draining to the plant as well. It is also important to ensure that the transfer of pollutants from the water to the sludges (and into the air potentially through sludge incineration) — so-called media transfer — is not an alternative to source reduction and effective treatment. Impacts on the entire ecosystem must be examined.

Management of Household Hazardous Contaminants

Industries are not alone in discharging toxic contaminants to sewer systems. Many households routinely dispose of waste lubricating oils (for example automotive oils), paints, solvents and similar materials by dumping them down basement drains or street gratings, where they enter catchbasins. Even personal products such as deodorants and shampoos, or cleaning products like toilet bowl cleansers, are potentially toxic to aquatic systems.

Most people are simply unaware of the harm they may cause — to sewage treatment plant processes, which rely on biological organisms, to fish and other biota in receiving waters, or to our own drinking water sources — through these seemingly trivial actions. Even if they are doubtful or concerned, they may not know what alternatives are available to use or how to dispose of toxic materials safely.

Programs to control releases of household hazardous contaminants must therefore incorporate both education and disposal components. Generally speaking, the regional municipalities, including Metropolitan Toronto, have responsibility for the collection of household hazardous wastes. Both curbside pick-up programs (for example, in the Region of Peel) and permanent centralized depot systems (for example, in Metro Toronto) are in operation. Metro has established a telephone hotline and "Toxics Taxi" service, for on-request toxics pick-up, on a trial basis. Most successful programs

incorporate public education devices such as newspaper advertising, fact sheets and similar materials, but word of mouth is also a powerful force in increasing the number of participating households.

Fish and Wildlife Habitat

As early as the late nineteenth century, human impacts on the Toronto waterfront had become dramatically apparent. The "beautiful, clear" bay described by residents in the late 1700s had become silt-clogged and debris-choked, its water too foul for human consumption.

In the late twentieth century, we have made significant progress towards the abatement of pollution sources, considerably slowing the rate of environmental degradation. But the legacy of our polluting past is still with us in contaminated sediments, drained wetlands, and aquatic habitats unrecognizable from those of two centuries ago. Clearly, we cannot expect that the modern, urban watershed can or should be restored to presettlement conditions. A sustainable watershed ecosystem, however, can incorporate measures to protect existing habitats and restore those lost through human activities in the past.

Habitat Rehabilitation

For many fish species, the physical nature of the stream bottom — the "substrate" — is very important in providing habitat for spawning and nurturing their young. In many urbanized watersheds, including Metro Toronto's, rocky, gravel or sandy river bottoms have been altered by addition of layers of finer sediments, often from urban runoff, stream bank erosion, construction activities and non-conserving farming practices. Agriculture, deforestation and the construction of golf courses remove natural forest cover and create flat, uniform landscapes susceptible to soil loss by wind and water erosion.

Stream habitat can often be restored by the reduction of fine sediment deposition and reintroduction of coarser materials more attractive to fish. The creation of artificial reefs is being investigated as one approach to restoring waterfront habitat. Other habitat rehabilitation measures include re-establishment of submergent and emergent aquatic plant communities and wetlands to provide improved feeding and spawning habitat for species such as northern pike, smallmouth bass and largemouth bass.

As a first priority, it will be important to protect existing habitats, such as wetlands, coastal reefs and river valleys including upland areas. This may require acquisition of land, or changes in laws governing land use to permit adequate protection. Current thinking suggests that it may be essential to maintain "centres of organization" — areas important for basic ecosystem health — within an existing habitat network. These areas will include human uses as part of their ecosystem function.

A second priority would then be to rehabilitate areas with the greatest habitat potential, such as waterfront parks. Rehabilitation would mean repairing the watershed ecosystems to restore plants and animals characteristic of natural habitats. Ideally, habitat rehabilitation would involve a mixture of waterfront, watershed and headwater sites. Water quality improvement should be pursued concurrent with physical habitat rehabilitation. For example, reef creation projects aimed at creating a sensitive habitat for cold water fish must be tied to water quality improvement such as siltation reduction and stream bank erosion control within the watersheds. Remnant coastal marshes (eg. Rouge Marshes, Toronto Island wetlands) continue to produce native biota within a heavily urbanized waterfront. Restoration of these habitat types (ie. coastal marshes) should be a priority at additional sites throughout the RAP area.

Public Awareness, Education and NGOs

Although many remedial actions are large in scale, important contributions can also be made by individuals. For example, individual action is important in the management of household hazardous wastes, the conservation of water and in roof leader disconnection programs.

A fundamental goal of this and all other remedial action plans is to increase public awareness of environmental issues, and to involve the public in the development and implementation of actions to carry out the plan. While this idea of community-based action is central to all remedial action plans, it is especially important in major urban centres like Metro Toronto, where the majority of problems are caused by dense urbanization and aging systems.

What needs to be done

The following sections suggest a general framework for increasing public awareness and involvement in the evolution of remedial actions for Toronto. It is only a starting point: as trust is built and understanding improves, better approaches to public involvement will almost certainly follow.

Access to Information about Problems and Solutions

Fundamental to the principle of public involvement is public access to information. Several mechanisms are possible; all have value in the RAP process.

First, a formal and ongoing communications plan would establish a permanent framework for information to flow to participants and interested observers. Such a plan should include production of a regular newsletter (such as the one used by the RAP team and PAC in developing the plan) an annual report, news releases, and displays at shows and festivals. A communications manager, either full- or part-time, would ensure consistency and coordination of outreach efforts.

A library and resource centre for water-related topics would be an important adjunct to this communications plan. The library could collect, catalogue and house the huge volume of information already in hand and serve as a clearing house for participants and observers. As more information becomes available, the library would provide a central repository for RAP information, supporting not only educational activities but also further research on the RAP area environment. A stand-alone facility could prove costly and cumbersome to administer. Instead, a RAP resource centre could be "piggy backed" on an existing facility, such as the Ministry of Environment and Energy's Public Information Centre or the Canadian Waterfront Resource Centre.

Interaction with Other Remedial Action Plans

The development of a Remedial Action Plan is a continuing process: information is obtained, a plan developed, actions taken, and their results assessed. The success of the plan is reviewed, a revised plan developed, and the cycle begins again. Each RAP area has its own concerns, priorities and solutions, but each has much to learn from the experiences of others.

Over the past few years, Metro Toronto and Region RAP participants have had opportunities to meet their counterparts from other areas through annual Public Advisory Committee conferences, funded by Great Lakes United (GLU) and the Canada-Ontario (COA) Agreement. Participation is generally limited to two participants from each RAP area. Symposia focused around a region, for example Lake Superior, have also offered opportunities for RAP participants to get together and share ideas. In the future, the Public Advisory Committee members could host their own conferences, setting their own agendas and generating proceedings or briefs related to their findings.

Formal and informal networks have also been instrumental in linking RAP participants from different areas. Public interest networks such as the Ontario Environmental Network and Great Lakes United, and public interest groups like Greenpeace and Pollution Probe provide important mechanisms through which RAP participants can share information. At present, individuals become connected to this network informally, by joining mailing lists or electronic bulletin boards. But modest efforts, for instance to exchange Public Advisory Committee mailing lists and produce a regular RAP program bulletin for all Public Advisory Committees, have already made RAP information available to a wider audience.

BOX 8: THE ENVIRONMENTAL BILL OF RIGHTS

An Environmental Bill of Rights was recently passed in Ontario. It gives the public rights to become advocates for the environment. The Bill:

- acknowledges the public's right to a healthy environment;
- provides the public with more opportunities to participate in environmental decision-making, and at an earlier stage;
- increases government accountability and responsibility for the environment;
- gives the public enhanced access to the courts; and
- gives greater protection for employees who blow the whistle on polluting employers.

The Environmental Bill of Rights was developed in consultation with the public, industry and environmental groups, and places greater emphasis on making the right environmental decisions in the first place.

Linking the Metro Toronto RAP with other Programs

Most of the RAP area's water pollution problems have arisen solely from local sources. A few concerns, however, result from a combination of local sources and lakewide effects. Of these, the most important may be continued protection of our drinking water and contamination of fish tissue with pollutants such as Mirex, much of which is believed to come from leaking landfills near the Niagara River.

To attack certain problems, the RAPs must interact with other initiatives in Lake Ontario and elsewhere. The Lake Ontario Toxics Management Plan, jointly adopted by Environment Canada, the Ontario Ministry of Environment and Energy, the New York State Department of Environmental Conservation and the United States Environmental Protection Agency, is one such initiative. It has been described as providing a "one window" approach to public review and reporting on the many initiatives underway to eliminate toxics in Lake Ontario. Through regular attendance at presentations and conferences, Metro Toronto RAP participants, can keep abreast of developments in standard-setting, data collection and understanding of basin-wide ecosystem function—important information in the context of local RAP priority setting and allocation of resources.

It will also be important to promote linkages with other communities and groups. The Cities of Scarborough and Toronto are currently drafting strategies for Healthy Cities that may have important implications for remedial actions in the watershed. Similarly, the activities of special interest groups such as the Friends of the Don, Save the Rouge Valley System, Action to Restore a Clean Humber and The Black Creek Project will be of continued interest to the RAP and its stakeholders. Experience in one watershed or area may yield important lessons for another part of the RAP area.

Formal Education

In addition to public awareness programs, the formal education system will be vital to achieving the RAP goals. Children must be allowed to develop the necessary skills, attitudes and knowledge to create proper environmental stewardship and sustainability for our watershed. Formal education is also an effective method of achieving public awareness which is essential to achieving the RAP goals. Education and awareness are important in each of the major areas of recommendation presented in the RAP plan. Already, projects such as a storm drain marking program (see Figure 8), FishWays, Adopt-A-Pond and the City of Toronto's water conservation program are working to increase awareness of human impacts on water quality, aquatic life and habitat.

Children will become future leaders in business and government and determine the behaviour of society at large. The formal education system needs to make environmental education a priority in the Metro Toronto RAP area.

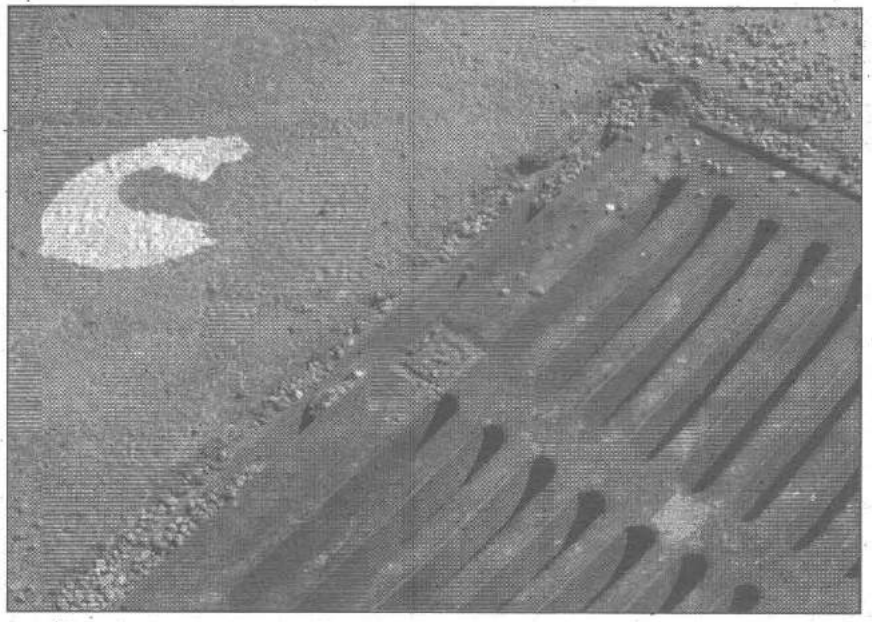


FIGURE 8: STORM DRAIN MARKING: THE LITTLE FISH BESIDE THE CATCHBASIN TELLS PEOPLE THAT THESE DRAINS LEAD TO CREEKS.

A Foundation to Fund Local Projects

Even prior to the establishment of the Metro Toronto RAP, many citizens were active in smaller, local programs for environmental clean-up and habitat restoration. These programs have been, and continue to be, of tremendous value in healing the Metro watersheds. But as their numbers proliferate, so do the opportunities for duplication of effort. These activities are funded by various groups in various combinations and are not linked to or coordinated with other local or regional endeavours.

Under the Metro Toronto RAP, a foundation to fund local initiatives could provide coordinated decision-making, make the best possible use of existing foundations and reduce overlap. Coordination of projects in geographically separated areas would foster public involvement across the whole RAP ecosystem. Such a foundation should be at arms-length from the RAP and from the many agencies now funding local initiatives. It could receive and review requests, raise and allocate funds, audit programs and publish results.

Encouraging Local Clean-Up and Restoration Activities

Stream clean-up programs have made an important contribution to public awareness of stream health and local pride in stream quality. These programs achieve primarily cosmetic improvements by removing debris — either intentionally dumped or blown-in — from stream banks and the watercourse itself. They can offer valuable educational and employment opportunities, particularly for young people who may be contemplating an environmental career.

The Ministry of Skills Development in cooperation with five other agencies has sponsored the Environmental Youth Corps Program, a vehicle by which youth clean-up programs have operated for several years.

These programs could be strengthened in two important, yet inexpensive ways. First, improved advertising of the programs early in the summer could be used to generate public input about problem sites and clean-up needs. And second, earlier hiring of students, in May as opposed to June or July, would allow pre-screening of sites to determine where major clean-up efforts are required. No significant additional costs would be associated with these improvements.

Laws and Policies

Aristotle said "Law is order, and good law is good order," and indeed the laws and formal policies governing the environment provide consistent, uniform structure to our decision-making. Those laws have themselves evolved over many decades, and will continue to evolve as societal expectations change and understanding of environmental processes improves.

The RAP process has identified a number of specific areas where legal frameworks relating to ecosystem-based remedial actions can be improved. The following are some of these areas.

Better Control of Lakefill Quality and Disposal of Dredged Materials

Almost since the founding of the town of York, citizens have used excavated earth and other waste materials to create more land. Probably the first example of this was the filling of marshy areas at the mouth of the Don River, an area which was notoriously difficult to cross with loaded carts or sledges.

Many familiar waterfront features, including the Leslie Street Spit, Ashbridge's Bay, Humber Bay and Bluffers Park recreational areas, and Col. Samuel Smith Park (now nearing completion) are examples of lakefills.

Creation of new areas for development has become even more appealing as waterfront property commands increasingly steep prices (and as new disposal sites must be found for excavated materials). In Metro Toronto, lakefills have created some of the few urban wildlife experiences available to the city resident. But questions have also been raised over many years about the quality of the fill material, the way in which that material is placed in the lake and possible impacts on water circulation. Critics believe lakefills have the potential to transfer contaminated soils, for example from abandoned industrial site excavations, to lake waters, where they release pollutants to surrounding waters. Lakefill structures can also alter water circulation patterns and there is evidence that the placement of fill materials has disrupted aquatic communities in the vicinity. However, in some lakefill locations, increases in the numbers and diversity of fish species have resulted.

A need therefore exists to develop effective and consistent policies controlling the quality and placement of fill material. This includes policies on the pre-disposal inspection of sites and placement techniques (which may vary depending on the quality of the fill). Possible impacts on water circulation patterns (due to location and configuration of the lakefill structure) also need to be considered. In 1989, the Metropolitan Toronto and Region Conservation Authority and the Toronto Harbour Commissioners prepared "Improved Lakefill Quality Control Guidelines," in the absence of provincial guidelines. These guidelines were praised by the Royal Commission on the Future of the Toronto Waterfront, not only because they represented a pioneering effort in a difficult area, but also because testing showed that they were indeed effective in controlling the quality of lakefilling material. The Royal Commission did, however, note that MTRCA had a potential conflict of interest in being both regulator and participator in lakefilling activities, and suggested that the then Ministry of the Environment adopt a more active role in this area.

As a result of these recommendations, on June 15, 1992, the Ministry of the Environment introduced new Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. The Ministry has also drafted Fill Quality Guidelines for Lakefilling in Ontario, and a Policy for Management of Excess Soil, Rock and Like Materials. These draft policies are now under review by the Minister's Advisory Committee on Environmental Standards. Public consultation is an important part of this review process. Additionally, the Waterfront Regeneration Trust will be working on guidelines for the location and configuration and construction of lakefill structures.

Concerns have also been raised about the disposal of materials dredged from lake and river beds. There is no question that the sediments of Toronto harbour were heavily polluted in the 1880s as a result of discharges of untreated sanitary and industrial wastes. Sediment-bound contaminants also arise from sewage treatment plant effluent, combined sewer overflows and storm sewer discharges, and inputs to the harbour from the flows of the Don and Humber Rivers.

Sediments to be dredged are now classified into contaminated or uncontaminated groups based on Ministry of Environment and Energy guidelines. Highly contaminated sediments must be disposed of at certified confined disposal facilities. These policies need to be reviewed and updated as new information becomes available about the presence and impacts of contaminants in sediments. Particular concerns may relate to the presence of trace organic contaminants for which no guidelines presently exist.

A related problem is the restoration of aquatic systems where contaminated sediments are slowly releasing pollutants into overlying waters. Such problems occur in a majority of the Areas of Concern, especially in older industrialized centres like Toronto, Hamilton, Buffalo and Cleveland. Of most concern are contaminants that are not easily eliminated from biological tissues, and thus accumulate in those tissues and can be transmitted up the food chain. Guidelines developed for contaminated sediments — so-called "in-place" pollutants — must therefore consider the risk of contaminants accumulating through the food chain to terrestrial wildlife and humans. Options for restoring degraded sediments must encompass safe removal, handling and disposal of contaminated materials, including technologies to treat the sediments where they lie.

Policies for Sewage Treatment Plants, Stormwater Discharges and CSOs

Ontario's Municipal-Industrial Strategy for Abatement (MISA) program is charged with developing uniform, legally binding standards for industrial and municipal dischargers to surface waters. For municipal systems, it will bring in regulations governing the quality of discharges from municipal sewage treatment plants. But because those discharges can contain heavy metals and trace organics that originated in industrial discharges to sewers, MISA will also require industrial sewer users to meet uniform, sector-specific standards.

An important adjunct to the MISA program will be policies and guidelines for stormwater management and combined sewer overflows. As examples, new residential developments will have to include proven technologies for stormwater storage and treatment, such as infiltration ponds, and older developments may have specified street sweeping frequencies to reduce the road dirts entering storm sewers.

What needs to be done

Master drainage plans and stormwater management plans will be used to incorporate water quality and drainage control requirements for specific planning areas.

Finally, the number of players and policies involved in the control of stormwater and CSOs creates confusion about how best to control this pollution source. A province-wide policy and integrated strategy for urban drainage would go a long way towards resolving overlaps and clarifying roles and responsibilities for this important task. Some steps have already been taken, through the Province's Urban Drainage Policy Implementation Committee, but this work has focused on the control of stormwater quantity. An integrated policy is still required to reduce pollutant levels in stormwater, and appropriate measures must be demonstrated at existing problem sites, particularly in older developed areas.

Water Conservation and Full-Cost Pricing

Ontarians have access to the world's largest reservoir of freshwater: the Great Lakes. The vastness of this resource, and its apparent purity, have led us to take provincial water supplies very much for granted. Traditionally, water has been delivered to the user at little or no direct charge. As a result, our water use is now double or triple that of most European countries, while our water prices are a quarter to a third of theirs.

Our water resources cannot remain clean and abundant forever. Consistent with the concept of a sustainable ecosystem is the idea of sustainable water use. In a sense, we only borrow the water we draw from our lakes and rivers, returning it to those systems for re-use by ourselves or others. Sustainable water use therefore means using as little water as possible, and maintaining the quality of that water at as high a level as possible. Estimates show that by the year 2010, every drop of water in Lake Ontario will have been re-used three times between the time it entered the lake from the Niagara River, and the time it is discharged to the St. Lawrence.

An important first step towards sustainable water use is water conservation—measures such as water-conserving shower heads and toilets—that reduce our water consumption (usually with little or no impact on our lifestyles). Universal installation of water meters will allow municipalities to track water use in each household and industry. Full cost pricing of water means that the full, real cost of operating water supplies and sewage treatment facilities is known and paid by the user. At present, government subsidies to water and wastewater facilities hide the true cost of water use—but increase our property tax bills. Full cost pricing would see the removal of these hidden tax bills, with proportional increases in water rates, so that consumers have an incentive to monitor and reduce water use. Similar systems are now in place for the consumption of electricity in Ontario.

Safe Drinking Water

Many people are surprised to learn that Ontario — and indeed Canada — has no laws guaranteeing the quality of drinking water. (Bottled waters must meet some limited criteria under the federal *Food and Drugs Act*, but these are by no means complete or sufficiently stringent.) Regular surveillance and responsible operation of municipal tap water supplies has ensured that these sources are of high and consistent quality. But legislation setting specific standards for drinking water would enshrine those programs in law. Ontario is now contemplating a *Safe Drinking Water Act*, with the understanding that drinking water standards will be developed in consultation with other agencies (including Health and Welfare Canada), municipalities and the public.

Land Use Planning

The Royal Commission on the Future of the Toronto Waterfront (and to a lesser extent the Greater Toronto Greenlands Strategy), both now complete, had the broad responsibility of developing strategies for development of the Metro Toronto waterfront. The Royal Commission quickly found that the waterfront could not be studied in isolation from its watersheds or its ecosystem. Fundamental premises of the Royal Commission, which are now being carried on by its successor, the Waterfront Regeneration Trust, are the interconnectedness of ecosystem components, and the place of humans in, not separate

from, the ecosystem. These foundations have several implications for land use planning. For instance, environmental considerations must be considered in parallel with land use issues and natural boundaries and borders must take precedence over jurisdictional "turf" and political divisions.

There is an unmistakable linkage between land use planning and the environment. Much of the abuse of our environment including the degradation of our waters has resulted from development in the wrong place or poorly executed.

The Metro Toronto and Region RAP fully supports these views and has identified actions through which remedial actions can be integrated into land use planning and construction approval processes.

Improving Water Resource Inputs to Planning Processes

There is increasing evidence that resource management planning, using the watershed as the basic planning unit, is the best way to integrate land use planning with environmental concerns (see Box 9). This kind of integrated planning uses resource inventories and assessment of potential impacts to develop targets for preservation, protection and enhancement on a watershed basis. Detailed stormwater and CSO plans can be developed for sections of a watershed, sometimes called subwatersheds, and integrated with plans for resource conservation. Physical features, major resources such as wetlands and habitat zones, and open space linkages can be considered simultaneously with concerns such as water quality management, withdrawals of water for private, industrial or institutional use, and fisheries and wildlife.

Other measures are also possible. Changes in the law could require that new development or redevelopment agreements between developers and municipalities include not only proposed density and other physical features, but also existing environmental features and concerns and measures to mitigate any expected impacts of development. A RAP Working Group on Methods for Improving Water Resource Inputs to Planning Processes has developed several specific recommendations, such as maximization of on-site infiltration of runoff, for legal reform and municipal practice.

Liaison with Land Use Planning Activities

As the Remedial Action Plan for Metro Toronto and Region evolves and is implemented, it will be important for RAP participants to keep in touch with other environmental planning initiatives such as the work of the Waterfront Regeneration Trust and the Commission on Planning and Development Reform in Ontario.

Also important are linkages to regional planing activities such as the Greenspace Strategy developed by the Metropolitan Toronto and Region Conservation Authority. The Greenspace Strategy lays out numerous remedial measures for erosion control, flood control and land acquisition for the Metro Toronto area. Although some of its provisions, such as flood control,

Box 9: Watershed and Subwatershed Planning

Land use decisions under the municipal planning process can have a significant impact on the quality and quantity of our water resources. Although municipalities have the legislative authority and political responsibility to undertake comprehensive land use planning which considers environmental issues, a consensus is emerging that current land use planning does not satisfactorily protect the environment. This is of particular concern in the urbanizing area of the RAP watersheds.

Problems have arisen because the environmental effects of developments have traditionally been assessed on an individual basis. This needs to change so that the cumulative effects of land use change over time and over the wider watershed area are considered. That way, the need for future remedial action can be avoided.

To help achieve this, the Ministry of Natural Resources and the Ministry of Environment and Energy (in consultation with the Ministry of Municipal Affairs) have produced three reports to assist municipalities in developing official plan policies. These reports are consistent with the approach of the Commission on Planning and Development Reform in Ontario and the Royal Commission on the Future of the Toronto Waterfront. They provide guidance for developing official plans which consider maintaining water quality and quantity of rivers, groundwater and wetlands, providing protection from flooding and erosion; ensuring the viability of fish and wildlife habitat; protecting valley systems and headwaters; and, ensuring that all Ontario residents have adequate and safe supplies of water.

extend beyond the RAP's mandate, other areas such as water quality improvement are of strong mutual interest. The Plan contains components for the Oak Ridges Moraine, the Metro and region river watersheds, and the waterfront area. Finally, MTRCA has developed plans for public use of conservation authority lands, including strategies to provide recreational opportunities while protecting environmental quality.

Another planning initiative for the Oak Ridges Moraine is discussed in Box 10.

Monitoring and Research

Many government and non-government agencies routinely collect information about the status of the environment (see Table 3). Although there are limitations to the existing networks, the monitoring data collected has been augmented by additional studies undertaken for the development of the Metro Toronto and Region RAP plan.

In order to track progress in the restoration of our environment it is essential that monitoring programs continue. Of particular importance is the need to continue to integrate various data sources and provide regular, integrated analysis and reporting. Only through this integration can a true picture of ecosystem health be drawn.

Our understanding of environmental processes changes constantly, so our strategies for managing water and land resources must also evolve. In the context of the Metro Toronto and Region RAP, several important studies are now underway, or are planned for the future, to fill gaps in our knowledge of key areas.

Studies of Toxic Contaminant Sources and Movement

Metro Toronto's long history as an industrial centre and transshipment point is reflected, almost literally, in the quality of its harbour waters and sediments. Sewers older than Confederation continue to carry wastes from homes and industries. Sewage treatment plants collect those wastes but remove only some of their toxins. Combined sewer overflows, storm sewer discharges, and filter washing wastes from water treatment plants enter the lake without treatment. Contaminated sediments in the harbour slowly release stored toxins back into the water. Contaminated fish die, releasing toxins as their tissues decompose on the lake bed.

With such a multitude of possible sources, the RAP's task is to find and correct the worst offenders first. But which are worst? A study to investigate the contaminants discharged from various sources, including their behaviour in rainy weather and dry weather, will help us identify areas where remedial action is most necessary. The study will entail pipe-by-pipe sampling of selected areas in the watershed, with detailed examination of outfalls where particular problems are found. A parallel study will investigate the contribution of flows from the Don and Humber Rivers whose sediment- (and thus contaminant-) laden waters can be significant contributors to waterfront pollution.

Box 10: The Oak Ridges Moraine

The Oak Ridges Moraine is the headwaters of our major waterways. The protection of this glacial deposit is essential to the health of the Don, Humber, Rouge and other major waterways in the Metro RAP area and beyond. As an important groundwater recharge area we need to ensure that it is properly protected — remediation of groundwater would be very difficult and expensive.

An Oak Ridges Moraine Technical Working Committee (TWC) has been established to develop a long-term strategy to protect and enhance the ecological integrity of the Oak Ridges Moraine while providing for appropriate socio-economic opportunities.

Like the Metro Toronto and Region RAP, the committee brings together a wide variety of viewpoints from government officials, planners, developers, aggregate producers and non-government organizations. They also involve a Citizens' Advisory Committee (CAC) to bring in views from other members of the public.

Many background studies are already complete including a study of natural features which will help determine where development should and should not go. The report and mappings will first be released to local naturalists clubs so that they can specify any important natural features (eg. bogs, botanical or birding hotspots) or concerns which may have been missed.

After evaluating the options for future development and protection of the Moraine, the TWC and CAC are expected to release their final recommendations.

TABLE 3: AGENCIES AND MONITORING

ENVIRONMENTAL COMPARTMENT	MONITORING AGENCIES
Stormwater Runoff and Sewage Treatment Plant Effluent	Regional Municipalities, Ministry of Environment and Energy
Surface Water	Regional Municipalities, Ministry of Environment and Energy, Metro Toronto and Region Conservation Authority, Environment Canada
Sediment and Benthos	Metro Toronto and Region Conservation Authority, Ministry of Environment and Energy, Environment Canada
Aquatic Community Structure	Metro Toronto and Region Conservation Authority, Ministry of Natural Resources
Wildlife Community Structure	Metro Toronto and Region Conservation Authority, Ministry of Natural Resources, Non-Government Organizations
Aquatic and Wildlife Contaminant Body Burdens	Ministry of Environment and Energy, Ministry of Natural Resources, Environment Canada
Habitat	Metro Toronto and Region Conservation Authority, Ministry of Natural Resources, Non-Government Organizations

Complementary to studies of contaminant sources are studies predicting the movement of toxins through water, sediment and biota. Simulations of this type allow estimates of the impacts of specific remedial actions on the receiving environment. Possibilities for the Metro Toronto waterfront include development of a multi-part computer simulation model to investigate responses within different harbour zones or in varying weather conditions.

Sediment Quality Studies

Our knowledge of the distribution of contaminants in Toronto harbour sediments is still incomplete. We know, in general, that sediment transported into and through the harbour is dynamic and strongly driven by weather and seasonal conditions, but the details of transport mechanisms require further investigation. Sediment quality around key pollution sources also needs clearer definition. Particular efforts will centre around sediments in the vicinity of the Main Sewage Treatment Plant, Humber Bay, the Outer Harbour (where lakefilling has been ongoing since at least the early 1950s), and the Col. Samuel Smith Waterfront Park, a recently completed lakefill site.

As a result of these studies, it will be possible to develop a detailed map of sediment contamination in the Toronto waterfront, to serve as a guide for future remedial measures and a baseline against which progress can be judged. Even though sediment quality is impaired, cleaning up the sediment would be futile until the ongoing contamination through active sources such as stormwater runoff and combined sewer overflows are controlled. The potential does exist however, to carry out limited sediment cleanup demonstration projects in areas that were historicaly contaminated and are no longer receiving direct pollution inputs.

What needs to be done

Monitoring of Fish Communities

The fish community in a given area is a good indicator of the health of the aquatic environment in that location. Generally speaking, a more diverse native fish community, containing a greater number of species, indicates increased health within a particular habitat type. The proportion of sensitive species within the fish community is also a health indicator. Other measures can include incidence and success of natural reproduction for various species, and estimates rates and characteristics of population growth. A more comprehensive fish community monitoring program will add to our understanding of the waterfront ecosystem and its response to remediation activities.

The Main STP: A MISA Pilot Site

The Metro Toronto Main Sewage Treatment Plan is the subject of a pilot study on the many potential impacts of STP effluent on receiving waters. Among the components of this study are assessment of the acute toxicity and long-term health impacts of effluent on aquatic biota, studies of bioaccumulation of toxins from the effluent in neighbouring fish and molluscs, and water and sediment quality assays.

Other Studies

Numerous other studies have arisen from the RAP process or in conjunction with it. Provincial Water Quality Objectives and Guidelines give numerical and narrative limits for the protection of aquatic life and recreation. They are continually revised and improved as new information becomes available. Future activities will include assessment of the possible additive or antagonistic effects of complex discharges. New techniques for monitoring contaminant levels in aquatic organisms and new approaches to toxicity testing are also under development.

Concerns also centre around the problems arising from abandoned landfills, many of which line the banks of the Don and Humber Rivers, and the potential effect of new landfill sites on water quality.

Road salt is a major pollutant in the winter landscape, and other studies will investigate methods to reduce salt use or replace it with less toxic alternatives. We must also find better ways of identifying and handling contaminants at snow disposal sites.

Recognizing that urban storm drainage has a major influence on waterfront water quality, studies are also needed to establish design standards for roads and parking areas so that stormwater runoff can be managed effectively and safely.

Viruses are not adequately removed by some disinfection processes. While these are not a problem in drinking water supplies, which are drawn from deep-lake sources, disinfection of wastewaters, for instance from sewage treatment plants, could be improved to reduce or eliminate these organisms.

Finally, we need to find better ways to conserve, restore, and develop new aquatic habitats. It is unrealistic to think that we can return to the conditions present 200 years, but we can improve our efforts to restore damaged ecosystems. New research is needed to guide us in achieving these goals.

Recommendations

This section provides a listing of the recommendations of the Metro Toronto Remedial Action Plan. These actions reflect a consensus of opinion among the members of the RAP Team and its advisory committees. They were first presented in a Draft Options report and were subsequently amended and refined through a series of workshops and reviews. Appendix B provides a listing of the reference documents for each action.

There are three major pathways that contaminants follow in polluting our aquatic resources: stormwater runoff; combined sewage; and sanitary sewage. Polluted stormwater runoff can enter our waters either directly over land or through the storm sewer system. Combined sewer systems, built in older sections of the cities, tend to overflow sewage during wet weather. Sanitary sewers lead to sewage treatment plants which are designed to treat human wastes, but not chemicals. While other avenues (eg. direct air fallout to water and lakewide sources) exist, stormwater and combined and sanitary sewage dominate our local scene.

In examining the size of the loads of contaminants it is quite evident that for a majority of contaminants, stormwater runoff is the primary route. While the other two pathways are significant, they have already received considerable attention. The following discussion on recommendations is presented in a manner representing the relative order of importance of stormwater, combined sewer overflows and sewage treatment plant discharges in order to most effectively achieve ecosystem restoration. While this order of priority can help in allocating resources, implementation of the whole plan is required to achieve all of the RAP goals for protection and restoration of the aquatic ecosystem.

The guiding principles of the RAP provide a basis on which to set priorities for action. The principle that source control should take precedence over end-of-pipe control is particularly important. From that principle follows a hierarchy of environmental management actions (see Box 3, page 15) which have been used to choose the best solution within each major area of action.

Following the discussion of these three main areas are recommendations dealing with fish and wildlife habitat. As water quality continues to improve it is essential that habitats continue to be protected and restored.

The final four areas deal with public awareness and education; laws and policies; planning; and research and monitoring. These areas are essential to the overall success of the plan and are complementary to the first four areas of action.

Because of the complexity of problems in the area, often undertaking just a single action would have a surprisingly small impact on the health of our waters. Implementation of the whole plan is required to achieve all of the RAP goals for protection and restoration of the aquatic ecosystem. Readers should refer to Appendix C which matches each of the RAP actions with the goal(s) it address.

STORMWATER

Stormwater must be viewed as a resource to be managed and used in support of societal benefits. Protection of this resource demands protection or enhancement of the quality of stormwater runoff and, where possible, restoration of the natural hydrologic cycle.

Stormwater runoff **quantity** control to reduce flooding and erosion has been in place for many years. However, **quality** control of stormwater runoff is relatively new in comparison. Both quantity and quality concerns need to be addressed in order to achieve any significant improvemnts in water quality.

Action 1: Improve Industrial/ Commercial/ Institutional (ICI) Best Management Practices (BMPs)

What:

The RAP recommends that more emphasis be placed on the control of discharges to storm sewers through the creation of site-specific best management practice (pollution prevention plans) for industrial facilities, commercial establishments and institutions. These plans are best combined with quantitative controls such as effluent limits and should include procedures for handling, storage and transportation of hazardous materials and spills, and prevention and management of the quality and quantity of on-site surface runoff.

Who:

Development of BMPs should be led by the Regional Municipalities. Local Municipalities, the Ontario Ministry of Environment and Energy, and Environment Canada should also be involved.

When:

Initiation over 1-5 years. Activity should then be ongoing.

Cost:

Costs are related to *Action 15: Use Municipal Sewer Use By-Laws to Reduce Contaminant Loadings.*

Action 2: Improve Spills Response and Prevention

What:

Industrial process upsets or road accidents can result in spillage of chemicals into the storm sewer system. **The RAP recommends that a model spills response program be developed and adopted in the RAP area.** This program should clarify roles and responsibilities, ensure adequate education of emergency response teams and coordinate spills response. Current spills response programs are geared to emergency action, but not all municipalities have enough staff trained and/or designated to respond to spills.

The RAP further recommends that road design be refined to facilitate the containment and management of spills from road accidents. (Also see discussion on Industrial BMPs (*Action 1*) which states that BMPs should incorporate spills response and prevention procedures.)

Who:

The Ministry of Environment and Energy should lead this action in cooperation with Regional and Local Municipalities, the Ontario Ministry of Transportation and Environment Canada. Regional Municipalities in cooperation with Local Municipalities should ensure that staff are available to respond to spills.

When:

Implementation should take place over 1 to 5 years. Activity would then be ongoing.

Cost:

The costs of running a spills response program are estimated at approximately $1 million per year. An additional $100,000 would be needed for the Ministry of Environment and Energy and its partners to develop a standardized program. Other costs are related to the use of municipal sewer use by-laws discussed in Action 15.

Action 3: Improve Controls on Agricultural Practices

What:

The RAP recommends the development of individual farm RAPs that integrate crop, soil, livestock and water management issues and maximize farmers' knowledge of, and access to, financial assistance programs. Stormwater runoff from agricultural operations can carry pollutants from a variety of sources including milkhouse washwater, feedlot runoff and livestock watering locations. Such runoff may contain elevated levels of nutrients, bacteria, pesticides and eroded sediments. Financial assistance programs are often essential to provide farmers with the funds necessary to improve manure storage or barnyard drainage systems.

The RAP further recommends that the Ministry of Agriculture and Food develop improved funding programs in support of individual farm remediation activities.

The RAP further recommends that the Ministry of Agriculture and Food develop an improved educational program to inform the agricultural community about water quality problems and solutions. The development and enforcement of legislation to promote environmentally sustainable agricultural practices should not be considered until the voluntary program has been in place and reviewed.

Who:

Ministry of Agriculture and Food should lead the development of farm RAPs, develop improved funding programs and develop an improved educational program, in partnership with the Ministry of Environment and Energy, the Metro Toronto and Region Conservation Authority, the Ministry of Natural Resources and Agriculture Canada. Farm associations would also be involved in restoration work.

When:

Development of individual farm RAPs and improved financial assistance can be implemented in 1-5 years and should then continue.

Cost:

The development of farm RAPs would cost about $350,000 per year. Improved funding programs should cost about $5 million over 5 years.

Action 4: Reduce Sediment from Construction Activities

What:

The RAP recommends better enforcement of existing guidelines for control of sediment loss from construction activities. Most construction activities result in removal of grass and other vegetation from building sites, exposing topsoil to wind and water erosion. Existing guidelines contain provisions for control of construction-related erosion, for example by using filter cloth to control soil movement.

The RAP further recommends the creation of better educational programs for the development industry and the establishment of improved methods of erosion and sediment control. The RAP does not recommend the development of stricter legislation at this time. Many techniques and avenues to implement the recommendations above exist. The need for new legislation should be reviewed in 5 years time.

Who:

Regional and Local Municipalities, in partnership with the Metro Toronto and Region Conservation Authority (MTRCA) and the Ministries of Natural Resources and of Environment and Energy should lead in the improved enforcement of guidelines. MTRCA should take the lead in improving erosion control techniques and programs. The Ministry of Environment and Energy would develop legislation, if required.

When:

Most element can be in place within 1-5 years, although the introduction of new legislation may take 5-10 years.

Cost:

Total cost not estimated, although it is likely that improved enforcement and guidelines would cost about $200,000 a year.

Action 5: Trace and Disconnect Industrial/ Commercial/ Institutional (ICI) Cross Connections

What:

The RAP recommends that programs be carried out throughout the RAP area to eliminate illegal connections between the sanitary sewer system and the storm sewer system. These so-called cross connections can allow high concentrations of bacteria and other pollutants to enter stormwater. These cross connections should be eliminated so that all such materials can be directed to sewage treatment plants for proper treatment before discharge to surface waters.

The RAP further recommends that such programs continue to focus on priority outfalls. End-of-pipe audit sampling is used to identify priority areas which should remain focused on areas of intensive ICI use.

Who:

This activity should be led by Local and Regional Municipalities in partnership with the Ministry of Environment and Energy.

When:

This action can be implemented in 1 to 5 years.

Recommendations

Cost:

End-of-pipe audits for existing priority areas cost $258,000 per year. Extension to other priority areas would cost $700,000 over 5 years.

Action 6: Trace and Disconnect Residential Cross Connections

What:

The RAP recommends that the inspection of residential properties be expanded to ensure that each property is inspected on a 20 year cycle. Improper connections to the storm sewers (see *Action 5* above) also occur in residential areas. Difficulties arise in gaining access to home for the purposes of conducting inspections.

The RAP further recommends that proof of proper sewer connection be part of conditions of sale for homes in the RAP area.

Who:

This activity should be led by Local and Regional Municipalities in partnership with the Ministry of Environment and Energy. The Ontario Ministry of Municipal Affairs in cooperation with the Ministry of Environment and Energy and Regional and Local Municipalities should institute inspection as a condition of sale.

When:

This is a longer term action with implementation over 1-20 years.

Cost:

Inspection of all houses on 20 year cycle would cost about $3.2 million per year. Inspection as a condition of sale would cost about $1.7 million per year.

Action 7: Construct Pilot Stormwater Ponds and Develop Design Criteria

What:

The RAP recommends the construction of stormwater quality control ponds as pilot projects. Multi-use stormwater quality control ponds (incorporating provisions for water quality control, habitat improvement and recreational opportunities) may offer significant advantages over conventional stormwater treatment options, but we have little information about how to design and operate these facilities. Construction of ponds in selected, highly polluted areas will provide valuable experience that can be applied in future projects.

The RAP further recommends the establishment of a dedicated fund and multi-agency teams for the implementation of multi-objective demonstration projects.

Who:

The Ministry of Environment and Energy should lead this action in partnership with Regional and Local Municipalities, the Ministry of Natural Resources, the Metro Toronto and Region Conservation Authority and Environment Canada.

When:

This action should be implemented in the next 1 to 5 years with monitoring taking place over 5 to 10 years.

Cost:

Costs of funding six demonstration projects are estimated at $11 million over 3 years.

Action 8: Create Wetlands for Treating Stormwater

What:

The RAP recommends the promotion of wetland creation for the purposes of removing nutrients, bacteria and heavy metals from stormwater. Linked to Action 7 above, this recommendation implies the RAP's support for the creation of natural systems to control pollutants. Natural systems require little maintenance and are more aesthetically pleasing than standard stormwater ponds.

Who:

The Metro Toronto and Region Conservation Authority should lead this action in partnership with the Ministry of Environment and Energy, the Ministry of Natural Resources, Environment Canada and Regional and Local Municipalities.

When:

This action should be implemented over the next 1 to 5 years and then be ongoing.

Cost:

Not estimated.

Action 9: Improve Erosion Control to Reduce Sediment

What:

The RAP recommends that existing erosion control programs be upgraded so that they focus on controlling the rate and volume of sediment generation. Erosion adds sediment to lakes and rivers leading to decreased water clarity and loss of fish and wildlife habitat. Many pollutants also bind readily to sediments, so erosion can also be an important pollution transport mechanism.

The RAP further recommends the use of more environmentally sustainable erosion control techniques. Commonly used techniques such as concrete lined channels are often detrimental to aquatic health. Newer techniques are now available to control erosion while providing broader ecological benefits. "Soil bioengineering," the practice of combining live plant material with structural measures, is one example of such techniques.

Who:

The Metro Toronto and Region Conservation Authority should lead this action in partnership with the Ministry of Environment and Energy, the Ministry of Natural Resources, and Regional and Local Municipalities.

When:

This action should be implemented over the next 1 to 5 years and should become an ongoing activity.

Cost:

Upgrading of existing programs is estimated to cost $690,000. Adoption of more environmentally sustainable erosion control techniques is likely to cost $1.4 million.

Action 10: Improve Catchbasin Design and Cleaning Practices

What:

The RAP recommends that municipalities continue their current catchbasin cleaning programs because increased cleaning is unlikely to be cost effective. Road dust and dirt accumulation is washed into catchbasins during rain storms and snowmelt. As catchbasins fill with solids, they hold less water and thus allow sediment-laden stormwater to pass untreated into receiving waters. Solids input can be reduced by cleaning catchbasins and, to a certain extent, by street sweeping.

The RAP further recommends that municipalities investigate better approaches to settling and disposal of catchbasin clean-out.

The RAP further recommends that catchbasins be designed to allow them to collect more water for infiltration into the ground.

Who:

This activity should be led by Regional Municipalities and Local Municipalities.

When:

This action should be initiated in 1 to 5 years and then be ongoing.

Cost:

Existing programs cost about $1.4 million per year.

Action 11: Ensure Proper Handling of Contaminants at Snow Disposal Sites

What:

The RAP recommends that snow disposal practices form part of each snow disposal facility's Best Management Practice plan. Many contaminants are contained in snow stored at snow disposal sites. These contaminants should be dealt with on-site, before discharge of snowmelt to receiving waters.

Who:

This action should be led by Regional Municipalities in partnership with Local Municipalities.

When:

This action should be implemented in 1 to 5 years.

Cost:

Not estimated.

Note:

Other actions contained in this Remedial Action Plan are also expected to result in stormwater improvements. For further information on some of these, please see the Actions listed below:

Action 26: Promote Education on Water Conservation and Other Water Issues

Action 27: Promote Education on the Use of Fertilizers and Pesticide

Action 28: Provide Support to Non-government Organizations (NGOs)

Action 29: Promote Public Involvement in Sediment Reduction Projects

Action 35: Develop a Stormwater Program (Policy/Guideline/Manual)

Action 36: Develop an Implementation Strategy for Stormwater Quality Program

Action 37: Develop Stricter Regulations on Pesticide Use

Action 40: Promote the RAP Goals through Support of Regional Planning Initiatives

Action 41: Include Watershed Perspectives in Planning Process

Action 50: Investigate Methods of Reducing Use of Sodium Chloride

Action 51: Establish Design Standards for Roads/Parking Areas for Runoff Quality Control

Combined Sewer Systems

The discharge of untreated sanitary wastes must be virtually eliminated. Source control actions designed to control stormwater runoff and improve sewage treatment will also help to control pollution from Combined Sewer Overflows.

All municipalities with combined sewers have been working at sewer separation. Activities are now focusing on the use of alternative techniques such as detention tanks. Elimination of combined sewers overflows will be a long term objective for achieving water quality improvements.

Action 12: Reduce and Virtually Eliminate Combined Sewer Overflows (CSOs) to Receiving Waters

What:

The RAP recommends that detailed site-specific plans be developed to control CSOs from each overflow point. Combined Sewer Overflows occur in older parts of Toronto, Scarborough, East York and York, where a single sewer conveys both sanitary sewage and stormwater. Excess stormwater runoff in the system can lead to overflows.

The RAP also recommends that planned sewer separation work continue as sewers are due to be replaced. The development of site-specific plans should consider all options for reducing CSO including source control, further separation and detention and treatment. All four municipalities have programs underway to place a separate storm sewer pipe to convey road drainage. Much of this work was prompted by basement flooding complaints.

The RAP further recommends that, wherever possible, downspouts and foundation drains be disconnected from the sewer system to reduce the amount of stormwater entering the system.

The RAP further recommends that education programs, incentives and by-laws be created to inform the public about the impact of rainwater in combined sewers and encourage movement towards source reduction.

Who:

Regional Municipalities and Local Municipalities should lead this action in partnership with the Ministry of Environment and Energy and Environment Canada.

When:

This action is ongoing, with full implementation occurring over 20 years.

Cost:

Costs are estimated at $430 million - $475 million over 20 years.

Action 13: Construct the Eastern Beaches Detention Tank (Phase 2)

What:

The RAP recommends proceeding with construction of the Eastern Beaches Detention Tank, Phase 2 because of significant environmental benefits. The first Eastern Beaches Detention Tank (2250 cubic meters) retains outflow from 4 storm sewers and one combined sewer. Monitoring has concluded that there has been a measure of protection at the Eastern Beaches. Phase 2 will have a capacity of 8,000 cubic metres and will intercept two storm sewers and one CSO outfall. **The RAP stresses, however, that any such detention facilities should be close to the source of pollution and should be carried out in conjunction with source control measures.**

Who:

The Local Municipality (i.e. The City of Toronto) would take the lead on this action. Implementation should be carried out in partnership with Metro Toronto (the Regional Municipality), the

Ministry of Environment and Energy, and Environment Canada.

When:

This action can be undertaken in 1 to 5 years.

Cost:

The costs of this action are estimated at $7.5 million.

Action 14: Construct the Keele Trunk Relief Sewer

What:

The RAP recommends the construction of the Keele Relief Sewer with sufficient capacity to provide virtual elimination of CSO on the Black Creek sewershed, in addition to the capacity needed for planned development.

Who:

Metro Toronto (the Regional Municipality) should take the lead on this action, with participation by the Ministry of Environment and Energy, and Environment Canada.

When:

The relief sewer should be built in next 5 years.

Cost:

Costs of constructing the trunk relief sewer are estimated at $223 million. This cost includes a significant component to provide sewer services for future growth in the area which does not contribute to CSO control.

Note:

In areas serviced by combined sewers, actions related to Stormwater and Sanitary Sewers will also alleviate CSO problems.

Sanitary Sewers and Sewage Treatment Plants

The discharge of non-treatable contaminants to the sanitary system must be eliminated. The efficiency of the treatment systems must be improved by reducing the amount of wastewater flowing through the system and by optimizing the design and operation of all system components, including sewers and sewage treatment plants.

Routine sewer use controls aimed at improved performance and protection of the sewage treatment plants are being enhanced through pollution prevention efforts such as household hazardous programs. Sewage treatment plant upgrades need to continue on a regular basis as part of an ongoing program and through larger planning studies.

Action 15: Use Municipal Sewer Use By-Laws to Reduce Contaminant Loadings

What:

The RAP recommends increasing Regional Municipality resources dedicated to existing sewer use enforcement.

The RAP further recommends establishing resource commitments for sewer use enforcement in Local Municipalities. Many industries discharge wastes to the sanitary sewer system, for subsequent treatment at a sewage treatment plant. In some instances, these wastes are relatively innocuous and can be accommodated at the STP without disruption of normal treatment processes. In other cases, highly toxic, flammable or even explosive materials are discharged to sewers, with accompanying hazards to STP workers and the receiving environment. Sewer use by-laws allow municipalities to control what types and quantities of pollutants may enter sewer systems.

Who:

Local Municipalities and Regional Municipalities should share the lead in implementation of sewer use by-laws.

When:

Initiation should begin within 1 to 5 years, with ongoing activity.

Cost:

$1.9 million per year existing, plus additional costs of $907,000 for Regional Municipalities and $450,000 for Local Municipalities.

Action 16: Improve Household Hazardous Wastes (HHW) Programs

What:

The RAP recommends that enhanced HHW programs be expanded throughout the RAP area and that neighbourhood depots for waste disposal be established. Most households use paints, solvents, medicines and cleaning products, but few realize the polluting potential of these materials when emptied down the household drain. In a large municipality, household toxic contaminant discharges can constitute a significant fraction of total pollutant loadings to sewers. Through education programs and better disposal options, these discharges can be virtually or entirely eliminated. Different municipalities have approached this problem in different ways but all with some success.

Many municipalities in the RAP area have advertised special-collection days in order to collect HHW materials. The current program in Metro involves a Household Hazardous Waste Hotline and a "Toxics Taxi" to collect material from private homes.

The RAP stresses the importance of education and awareness programs about the use of more environmentally friendly alternatives.

Who:

Regional Municipalities should lead this action with the assistance of the Ministry of Environment and Energy.

When:

This action is ongoing and should continue.

Cost:

$1.8 million per year existing, $700,000 per year additional.

Action 17: Improve Main Sewage Treatment Plant

What:

The RAP recommends changes to processes and operating practices at the Main Treatment Plant to increase treatment efficiency and reduce the environmental impacts of discharges. The plant is located at Ashbridge's Bay and serves Toronto, North York, East York and a portion of Scarborough. The plant serves the largest portion of Metro Toronto. An Environmental Assessment is currently underway to establish the preferred alternative for meeting future treatment needs to the year 2011 and improving the effectiveness of the plant at reducing environmental impacts.

Who:

Metro Toronto (the Regional Municipality) should lead this action in cooperation with the Ministry of Environment and Energy, and Environment Canada.

When:

This action is ongoing and should continue over the next 1 to 10 years.

Cost:

Costs are estimated at $330 million to $650 million.

Action 18: Improve Humber Sewer Treatment Plant

What:

The RAP recommends changes to processes and operating practices at the Humber Treatment Plant to increase treatment efficiency and reduce the environmental impacts of discharges. The plant is located at the mouth of the Humber River and serves the cities of Etobicoke and York and a small portion of North York and Toronto.

Who:

Metro Toronto (the Regional Municipality) should lead this action in cooperation with the Ministry of Environment and Energy, and Environment Canada.

When:

This action should be implemented over the next 1 to 10 years.

Cost:

Costs are estimated at $82 million to $171 million.

Action 19: Improve Highland Creek Sewage Treatment Plant

What:

The RAP recommends changes to processes and operating practices at the Highland Creek Treatment Plant to increase treatment efficiency and reduce the environmental impacts of discharges. The Highland Creek plant is located at the mouth of Highland Creek and serves the City of Scarborough.

Who:

Metro Toronto (the Regional Municipality) should lead this action in cooperation with the Ministry of Environment and Energy, and Environment Canada.

When:

This action should be implemented over the next 1 to 10 years.

Cost:

Costs are estimated at $97 million to $135 million.

Action 20: Improve North Toronto Sewage Treatment Plant

What:

The RAP recommends changes to processes and operating practices at the North Toronto Treatment Plant to increase treatment efficiency and reduce the environmental impacts of discharges. The North Toronto Treatment Plant, located in the Don Valley, serves a population of about 55,000. Any sewage in excess of the plant's capacity is diverted to the Main Treatment

Plant. The future of the North Toronto plant is being studied as part of an Environmental Assessment for the Main Sewage Treatment Plant.

Who:

Metro Toronto (the Regional Municipality) should lead this action in cooperation with the Ministry of Environment and Energy, and Environment Canada.

When:

This action should be implemented over the next 1 to 10 years.

Cost:

Not estimated.

Note:

Other actions contained in this Remedial Action Plan are also expected to result in improvements in sanitary sewage and the sewage treatment plants. For further information on some of these, please see the following sections:

Action 26: Promote Education on Water Conservation and Other Water Issues

Action 34: Finalize and Implement Municipal-Industrial Strategy for Abatement (MISA) Regulations

Action 38: Implement Full Cost Pricing for Water

Action 47: Complete Main Sewage Treatment Plant (STP) Municipal Industrial Strategy for Abatement (MISA) Pilot Site Study

Action 53: Investigate Methods to Reduce/Eliminate Viral Contamination of Wastewater

Fish and Wildlife Habitat

Two hundred years of human activity have altered Metro's waterfront, watersheds and headwaters irrevocably, but many species of plants and animals still inhabit the waters, shoreline and upland areas. Although it is unrealistic to expect restoration of highly urbanized waterfront areas to pre-settlement conditions, we need to protect existing habitat and work to restore degraded areas in conjunction with water quality improvements.

Habitat protection and rehabilitation can best be achieved through proper consideration in planning documents and through the firm and effective enforcement of existing habitat protection policies and guidelines.

While the action discussed below is general in nature, more detailed habitat proptection and restoration activities would be developed in local watershed or subwatershed plans.

Action 21: Protect and Restore Fish and Wildlife Habitat

What:

The RAP recommends that existing fish and wildlife habitats be protected. A comprehensive assessment of aquatic and wildlife habitat should be carried out in order to establish the status of the resource and determine existing priority areas for protection and rehabilitation. Landowners, both private and public, would be encouraged to protect and restore natural areas.

The RAP further recommends that degraded habitat be enhanced. Streams should have sufficient shading using appropriate native plant species. Renaturalization of streams and parkland should be encouraged.

The RAP further recommends the creation of new fish and wildlife habitat. Historically there has been a significant loss of fish and wildlife habitat. Habitat linkages from Lake Ontario to the headwaters should be re-established. Government fish and wildlife habitat creation projects should continue and the public should be encouraged to become involved in the creation of new habitat areas, including wetlands, riparian habitat and fish reefs.

Who:

The Ministry of Natural Resources should lead this action with assistance from the Metro Toronto and Region Conservation Authority. Environment Canada and the Federal Department of Fisheries and Oceans should collaborate in any assessment of habitats and should assist in providing improved funding for implementation. Non-Government Organizations would also be involved in restoration work.

When:

Initiation should take place in 1 to 5 years. Activity would then be ongoing.

Costs:

An overall $440,000 increase in funding would be required over the first 3 years in order to complete the survey of habitats. Starting in the second year $300,000 per year would be required.

Public Awareness, Education and Non-Government Organization Activities

Public participation and formal education on water related issues are needed to ensure long-term restoration of water quality and aquatic habitat. The RAP is a community-based program with links to many partners in government, industry, and the general public. A framework for communication and education would ensure that maximum use is made of RAP findings and that RAP participants can exchange information with others working on similar problems elsewhere. It would also provide a coordinating mechanism for encouraging and funding local clean-up initiatives and restoration activities.

The raising of environmental awareness has become a significant activity in the RAP area. These activities need to continue with an increased emphasis on water quality issues.

Action 22: Establish and Fund a Continuing Communications Plan

What:

The RAP recommends that a continuing communications program be carried out, taking advantage of existing communications channels (community newsletters, media). There is a need to establish a continuing plan to report on the progress of RAP implementation. This is important for the public (to gain support) and for the agencies (to share information).

The RAP further recommends the creation of comprehensive documentation of all actions, research and monitoring consistent with the ecosystem nature of the plan.

Who:

The Ministry of Environment and Energy should lead this action in partnership with Environment Canada, the Metro Toronto and Region Conservation Authority and Regional and Local Municipalities.

What:

This action is ongoing and should continue.

Cost:

Existing programs cost about $150,000 per year. Continuation of these programs into the future is estimated to cost $75,000 per year.

Action 23: Establish a Resource Centre on Water Related Issues

What:

The RAP recommends that a resource centre containing material related to the RAP and water quality be established so that the public has adequate access to pertinent water quality data and RAP program information. Ideally this should be established in conjunction with an existing facility.

The RAP further recommends networking between the facility and other public resource centres in order to make the best possible use of available materials.

Who:

The Ministry of Environment and Energy should lead this action in partnership with Environment Canada.

When:

This action should be implemented in the next 1 to 5 years.

Cost:

It is estimated that the centre would cost $60,000 per year (in staffing costs) to run.

Action 24: Ensure Metro Area Public Participation in Other RAPs

What:

The RAP recommends continued support of local public participation in relevant conferences or meetings outside the Metro area. RAP Goal 9, established by the RAP Public Advisory Committee states: "Opportunities should be created and resources identified...to have input to plans in other areas...which have significant impact on Toronto's water quality.

Who:

The Ministry of Environment and Energy should lead this action, in partnership with Environment Canada

When:

This action is ongoing and should continue.

Cost:

The cost of providing opportunities for attendance at relevant conferences and meetings is estimated at $10,000 per year.

Action 25: Promote Awareness/Participation in the Lake Ontario Toxics Management Plan (LOTMP)

What:

The RAP recommends that Environment Canada give particular attention to monitoring and assessing the effectiveness of the public involvement, information management and resources associated with the Lake Ontario Toxics Management Plan. The LOTMP was adopted in February 1989 by Environment Canada, the Ontario Ministry of the Environment and corresponding agencies in the United States. It describes a wide range of programs which will directly or indirectly reduce loadings of toxics to Lake Ontario (including the Metro RAP area) and provides a framework to monitor progress and make further required commitments for clean-up. Examples of basin-wide actions described in the plan include controls on direct and indirect municipal discharges (MISA), monitoring of waste disposal sites, the Urban Drainage Program and reduction of toxic air emissions by application of regulatory controls and a toxics monitoring network.

Who:

Environment Canada should lead this action in partnership with the Ministry of Environment and Energy.

When:

This action should be implemented in the next 1 to 5 years.

Cost:

Not estimated.

Action 26: Promote Education on Water Conservation and Other Water Issues

What:

The RAP recommends support of public and formal education programs that heighten awareness of water conservation and the sources and fates of environmental pollutants. Education and awareness are especially crucial to the success of source control measures within the Metro RAP area. Awareness that, for example, Lake Ontario, is both the receiving body for wastes and our source of drinking water should encourage more environmental practices. Public awareness and participation in water conservation activities can reduce treatment and infrastructure costs and help protect water quality.

Who:

The Ministry of Environment and Energy should lead this action, with collaboration by Environment Canada, Regional Municipalities and Local Municipalities as well as the Ministry of Natural Resources, the Metro Toronto and Region Conservation Authority and the Ministry of Education.

When:

Some activity has already begun. Actions should be expanded and continue.

Cost:

Not estimated.

Action 27: Promote Education on the Use of Fertilizers and Pesticides

What:

The RAP recommends improved public education programs on the proper use of fertilizers and pesticides and their effects on the environment. For example, excessive use of fertilizers in residential or business areas, on farms or on golf courses can raise nutrient levels in lakes and streams and lead to excess algal growth. Algae blooms can use up dissolved oxygen levels in the stream, making conditions inhospitable for fish and other aquatic life. This action is aimed at discouraging excessive use of fertilizers and pesticides particularly when such use is for strictly aesthetic purposes.

Who:

The Ministry of Environment and Energy and the Ontario Ministry of Agriculture and Food should lead this action with participation by Environment Canada and the Metro Toronto and Region Conservation Authority, Regional Municipalities and Local Municipalities and Agriculture Canada.

When:

This action should be implemented over the next 1 to 5 years.

Cost:

Not estimated.

Action 28: Provide Support to Non-Government Organizations (NGOs)

What:

The RAP recommends that participating government agencies actively encourage and maintain support of partnerships that include non-government organizations (NGOs). Many projects for improving water quality such as tree planting, stream bank improvements or litter clean-up are being carried out by NGOs.

The RAP further recommends the establishment of a foundation to fund local improvement initiatives and provide assistance to NGOs.

Who:

Environment Canada and the Metro Toronto and Region Conservation Authority should lead this project with collaboration by the Ministry of Environment and Energy, Regional Municipalities and Local Municipalities

When:

Some activity has already begun. Actions should be expanded and continue.

Cost:

Not estimated.

Action 29: Promote Public Involvement in Sediment Reduction Projects

What:

The RAP recommends that increased financial support be given to private landowners in order that they may carry out projects to reduce sediment loading from their land. Eroded sediments can degrade fish habitat and the appearance of a stream. Pollutants such as phosphorus and pesticides that are attached to sediment particles can degrade water quality. Private landowners can play an important role in managing lands wisely and reducing sediments exported to streams.

Who:

The Metro Toronto and Region Conservation Authority should lead this action with participation by the Ministry of Natural Resources and Regional and Local Municipalities.

When:

This action should be implemented in the next 1 to 5 years and then continue.

Cost:

Costs of this action are estimated at $100,000 per year beyond existing support levels.

Laws and Policies

Environmental laws evolve over time as they keep pace with changing environmental conditions and societal expectations. Ecosystem-based remedial actions and their implementation must be supported by the adoption and development of appropriate policy and legislation.

Action 30: Finalize and Implement Provincial Lakefill Policy

What:

The RAP recommends that the province complete and finalize a lakefill policy to ensure that any lakefilling will be carried out in an environmentally sound manner.

Who:

The Ministry of Environment and Energy should lead this action in collaboration with the Metro Toronto and Region Conservation Authority, the Ministry of Natural Resources and the Waterfront Regeneration Trust.

When:

This action should be implemented in the next 1 to 5 years.

Cost:

Not applicable.

Action 31: Update Policy on Disposal of Dredged Material

What:

The RAP recommends constant upgrading of provincial guidelines for the disposal of dredged material, so that the most up-to-date scientific information is constantly applied to the management of dredging operations. Disposal options for dredged sediments are based on the amount of contaminants contained in the sediment, with the most contaminated material disposed of at special confined disposal sites. Less contaminated sediment can be used on land, while material that is uncontaminated (as defined by provincial guidelines) can be used for open water disposal.

Who:

The Ministry of Environment and Energy should lead this action.

When:

This action should be implemented in the next 1 to 5 years. Upgrading of policy should then continue.

Cost:

Not applicable.

Action 32: Continue Programs for Quality Control of Fill Material

What:

The RAP recommends that the Metro Toronto and Region Conservation Authority maintain increased inspection requirements and ongoing increases in operational efficiency in its assessment of the quality of material accepted for lakefilling. Quality controls to restrict material accepted for lakefilling have been in place since 1982 and were improved in 1989. The latter program, operated by the Metro Toronto and Region Conservation Authority, involves site histories and chemical testing of material from large sites (greater than 200 cubic metres of fill).

The RAP further recommends ongoing improvements in education about the lakefill quality control program for developers, truckers, consultants and others.

The RAP further recommends the use of a database containing municipal zoning map information to identify potentially contaminated sites (for instance by their proximity to industry).

The RAP further recommends that the lakefill quality control program be computerized to allow more efficient operation and more effective use of equipment and staff resources.

Who:

The Metro Toronto and Region Conservation Authority should lead this action. The Ministry of Environment and Energy and Environment Canada should help to improve operational efficiency, educational activities and to develop a database. Regional Municipalities should also be a partner in the development of educational opportunities and a database.

When:

All elements should be in place in 1 to 5 years.

Cost:

In 1989, the inspection program cost $415,000 with all funds generated from tipping charges. No additional costs are anticipated in maintaining inspection requirements. Operational and educational improvements have not been estimated, but it is estimated that database development would cost about $100,000. An additional $50,000 would likely be required to upgrade equipment and staff.

Action 33: Develop Strategy and Options for Dealing with Contaminated Sediments

What:

The RAP recommends that the Provincial Sediment Quality Guidelines be used to develop a strategy for dealing with contaminated sediments in the area. These guidelines incorporate concerns about the effects of contaminated sediments on benthos and the potential for movement of contaminants into the food chain and the overlying water.

Who:

The Ministry of Environment and Energy should lead this action in partnership with Environment Canada and the Metro Toronto and Region Conservation Authority.

When:

This action should be implemented over the next 1 to 5 years.

Cost:

Not estimated.

Action 34: Finalize and Implement Municipal-Industrial Strategy for Abatement (MISA) Regulations

What:

The RAP recommends that finalization of MISA regulations be accelerated. The MISA (Municipal Industrial Strategy for Abatement) program is aimed at developing legally-binding standards for discharges from industrial and municipal facilities in Ontario. Both direct and indirect (through a sewage treatment plant) discharges are to be controlled. The RAP supports MISA as a move toward zero discharge of contaminants and notes that the MISA program may provide incentives for industry to control their own discharges.

The RAP further recommends that the Ministry of Environment and Energy prepare a formal policy statement requiring municipalities to adopt the Ministry's model sewer use by-law, as an interim measure until MISA municipal regulations are in place.

Who:

The Ministry of Environment and Energy should lead this action with participation by Regional and Local Municipalities.

When:

This action should be implemented over the next 1 to 10 years.

Cost:

Not estimated.

Action 35: Develop a Stormwater Program (Policy/Guideline/Manual)

What:

The RAP supports the development of a coherent set of policies, guidelines and manuals addressing water quality control. Stormwater quantity control has been widely practiced in the Metro RAP area, but control of stormwater quality is a relatively new concept. The policies should reflect an ecosystem approach to water management.

The RAP further recommends the development of guidelines for dealing with combined sewer systems and overflows.

Who:

The Ministry of Environment and Energy should lead this action with participation by the Ministry of Natural Resources, Environment Canada the Metro Toronto and Region Conservation Authority and Regional and Local Municipalities.

When:

This action should be implemented in the next 1 to 5 years.

Cost:

Not estimated.

Action 36: Develop an Implementation Strategy for Stormwater Quality Program

What:

The RAP recommends that implementaion guidelines for the Provincial Stormwater Policy be developed for the RAP area. They should have provision for new development, redevelopment, infill development and retrofit work.

The RAP further recommends that a pollution prevention control plan study or equivalent (eg. watershed plan) should be carried out in the RAP area to determine priority sites.

Who:

The Ministry of Environment and Energy, the Metro Toronto and Region Conservation Authority and the Ministry of Natural Resources should lead this action.

When:

This action should be implemented over the next 1 to 5 years.

Cost:

Additional costs are estimated at $2 million.

Action 37: Develop Stricter Regulations on Pesticide Use

What:

In addition to improved education on the use of fertilizers and pesticides (see *Action 27*), **the RAP recommends that stricter regulations on the use of pesticides be investigated and developed.** Excessive use of pesticides can lead to contamination of water bodies and waterways and persistent toxics can accumulate in the food chain.

Who:

The Ministry of Environment and Energy should lead this action in cooperation with the Ontario Ministry of Agriculture and Food, Agriculture Canada and Environment Canada.

When:

This action should be implemented over the next 1 to 5 years.

Cost:

Not estimated.

Action 38: Implement Full Cost Pricing for Water

What:

The RAP recommends that full cost pricing for water be implemented in all municipalities and that incentives be given to use water conservation devices. Combined with water conservation education (see *Action 26*), a realistic pricing program for both industry and household, such as increased block rates and metering of water use, should help achieve water conservation objectives for the Metro RAP area.

The RAP further recommends that revenue generated from water supply be used to upgrade the system.

Who:

Regional Municipalities should lead this action in partnership with Local Municipalities.

When:

This should be implemented over the next 5 years.

Cost:

Not estimated.

Action 39: Promote Legislation to Ensure Safety of Drinking Water

What:

The RAP supports legislation to ensure the safety of our drinking water supplies. The quality of drinking water in the Metro RAP area is not considered to be impaired. Nevertheless there is public concern about drinking water quality and there is a critical need to protect the quality of our resource.

Who:

The Ministry of Environment and Energy should lead this action in collaboration with Regional Municipalities and Local Municipalities.

When:

This action should be implemented within 1 to 5 years.

Cost:

Not estimated.

Land Use Planning

The RAP Goals and applicable remedial actions must be integrated into land use planning and construction approvals. Resource management planning, using the watershed as the basic planning unit, allows integrated planning for land use and environmental protection.

Many opportunities exist to incorporate water quality concerns related to development into planning documents. These include local and regional official plan updates and planning initiatives by Metro Toronto and Region Conservation Authority and the Waterfront Regeneration Trust.

Action 40: Promote the RAP Goals through Support of Regional Planning Initiatives

What:

The RAP recommends that RAP goals and applicable actions be incorporated into regional planning activities. Such planning activities include the planning work of the Waterfront Regeneration Trust, and Metro Toronto and Region Conservation Authority's (MTRCA's) Greenspace Plan and Valley and Stream Corridor Management Program. Regional planning initiatives need to ensure protection and/or rehabilitation of headwater areas, valley and stream corridors and waterfront lands. There is a need to balance the protection of the region's natural resources and outdoor recreation demands. Passive recreation such as trail systems should be encouraged.

Who:

The Metro Toronto and Region Conservation Authority should lead this action, in partnership with the Ministry of Environment and Energy, Environment Canada, the Ministry of Natural Resources, Regional Municipalities and Local Municipalities.

When:

Some action has begun and will take place over a 20 year period.

Cost:

Not estimated.

Action 41: Include Watershed Perspectives in Planning Processes

What:

The RAP recommends that the RAP goals, and especially Goal 1 on ecosystem approach, should be incorporated into appropriate municipal plans to ensure that ecosystems outside of political boundaries are given consideration in land use planning decisions. In the RAP's view, this action is essential to ensure that proper consideration is given to water resource issues during development and redevelopment.

The RAP further recommends that the documents: Subwatershed Planning; Watershed Management on a Watershed Basis; and Integrating Water Management Objectives into Municipal Planning Documents be used as guides to ensure watershed perspectives are considered in planning decisions.

Pending development of watershed plans, the RAP further recommends the incorporation, into appropriate planning documents, of interim statements. These statements would discuss:

(a) protection of natural streams and riparian habitat,
(b) maximization of on-site infiltration of runoff,
(c) protection of sensitive aquatic ecosystems,
(d) no impact on fisheries from temperature of retained stormwater discharged to receiving water,
(e) minimization of sediment loss during construction,

(f) spill control devices in storm sewer, infrastructure (where appropriate), and
(g) minimization of the number of storm sewer outfalls to avoid impact on sensitive aquatic environments.

The RAP further recommends changes to the Planning Act to consider the cumulative environmental impact of planning decisions on an ecosystem basis and the need for a mechanism for addressing land use planning issues beyond political boundaries.

Who:

The Ministry of Environment and Energy and the Ministry of Municipal Affairs should lead this action, in partnership with Regional Municipalities and Local Municipalities and the Ministry of Natural Resources.

When:

This action will require 1 to 10 years to implement the proposed changes.

Cost:

Not estimated.

Research and Monitoring

Remedial actions must be supported by an integrated and coordinated program of environmental monitoring and reporting of progress. Many contaminants move freely through the environment, from sediment to water and from water to plants and animals. As a result, an assessment of environmental quality at any point in time must bring together information from all parts of the aquatic environment, including physical forces such as transport phenomena and the impacts of particular pollutant discharges on the system.

Many of the actions listed below are ongoing. There is a need to complete ongoing work and integrate the monitoring and the reporting of data. This will help reduce duplication, make data available and accessible, and build a more complete picture of our ecosystem.

Action 42: Continue Environmental Monitoring Programs and Integrate Results

What:

The RAP recommends that existing monitoring programs continue, and that all monitoring agencies confirm their commitment to the collection and reporting of data to the public. Environmental monitoring is an essential component for ongoing tracking of improvements in the environment as remedial actions are implemented. As well, monitoring allows the evaluation of the effectiveness of remedial actions and thus the reevaluation of the overall plan.

The RAP further recommends that efforts to integrate data results continue and expand, and that regular reviews of the overall monitoring effort be carried out to produce an integrated monitoring and surveillance plan. Traditionally, environmental monitoring has relied on monitoring in many different compartments, such as water, sediment and biota. In order to truly support the use of the ecosystem approach in ongoing planning, the analysis of environmental monitoring data must be further integrated to allow for a complete analysis.

Who:

The Metro Toronto and Region Conservation Authority should lead this action in partnership with the Ministry of Natural Resources and the Ministry of Environment and Energy. Environment Canada and Regional Municipalities should assist in this action.

When:

This action is ongoing and should continue.

Cost:

Not estimated.

Action 43: Complete Studies of Toxic Contaminant Sources and Biomonitoring

What:

The RAP recommends the sampling of additional priority outfalls and continued sampling of tributary loadings, as part of ongoing studies of toxic contaminant sources and impacts on biota. The purpose of the Toxic Contaminants study is to assess loadings of toxic contaminants to the waterfront from storm sewers, combined sewer overflows, sewage treatment plants and water filtration plants.

The RAP further recommends that the Toxic Contaminants study be completed as soon as possible because its results will help to set priorities for abatement actions at pollution sources. The study will complement other ongoing nearshore modelling activities aimed at estimating the relative impacts of storm

and CSO loadings to Lake Ontario water quality, sediments and biota in comparison to other sources.

Who:

The Ministry of Environment and Energy should lead this action in partnership with Environment Canada and Regional and Local Municipalities.

When:

This project is ongoing.

Cost:

1992 costs for the Toxic Contaminants Study were approximately $65,000.

Action 44: Complete Fate and Transport Modelling Study

What:

The RAP recommends completion of the Ministry of Environment and Energy's current study of pollutant fate and transport in the Metro Toronto Waterfront ecosystem. The purpose of this study is to determine the impacts of discharges to the Metro Toronto Waterfront on nearshore Lake Ontario, specifically the effects of several contaminants of concern on biota of the Metro waterfront; the relative contributions of various sources to the waterfront; and the reductions required to meet the Provincial Water Quality Objectives (PWQOs).

Who:

The Ministry of Environment and Energy should lead this action in partnership with Environment Canada, Regional Municipalities and Local Municipalities.

When:

This project is now ongoing and will take from 1 to 5 years to complete.

Cost:

$40,000 was spent in 1992. An additional $200,000 will be needed to complete the study.

Action 45: Initiate Waterfront Sediment Study

What:

The RAP recommends that further detailed studies of sediment quality in the waterfront area be undertaken before a full-scale cleanup is initiated.

Historical surveys of sediment quality have provided a generic picture of sediment quality across the waterfront. While several areas appear to have significantly elevated levels of contaminants, the rather coarse sampling grid and ongoing contamination suggest that further detailed sampling occur to clearly define potential clean-up areas once contamination controls are in place. The purpose of this study will be to investigate variations in sediment quality through various seasons, to evaluate the extent of sampling required to define sediment quality at any one point and to carry out a detailed evaluation of sediment composition in the vicinity of the Main STP, Humber Bay, Outer Harbour and Colonel Samuel Smith Park.

The RAP further recommends that as results from study become available, a comprehensive grid survey be established to provide a detailed picture of spatial variation in waterfront sediment quality.

Who:

The Ministry of Environment and Energy should lead this action in partnership with Environment Canada and the Metro Toronto and Region Conservation Authority.

When:

This study should be initiated and completed in 5 to 10 years.

Cost:

$68,000 is required to complete the study.

Action 46: Continue Long-Term Fish Community Monitoring

What:

The RAP recommends a continued, comprehensive evaluation of fish communities along the waterfront in order to establish a baseline for measuring fish community response to implementation of remedial measures and to identify components of fish habitat to be rehabilitated.

A fish community in a given area is a good indicator of the quality of the aquatic environment at that location. Previous studies along the waterfront have identified species composition of the fish community at different locations, but information on population dynamics, spawning sites, reproductive success of individual species is lacking.

Who:

The Ministry of Natural Resources should lead this action with assistance from the Metro Toronto and Region Conservation Authority and the Ministry of Environment and Energy.

When:

This project is ongoing. A baseline should be established in 1 to 5 years.

Cost:

Current costs for fish community monitoring programs are $50,000 per year.

Action 47: Complete Main Sewage Treatment Plant (STP) Municipal-Industrial Strategy for Abatement (MISA) Pilot Site Study

What:

The RAP recommends that the current MISA pilot study underway at the Main Treatment Plant be completed as soon as possible because its results will be helpful in designing a long-term monitoring program to gauge progress under the RAP. This study is intended to produce information on the impact of the STP on adjacent nearshore areas. Its results will be used to derive effluent limits based on receiving water considerations.

Who:

The Ministry of Environment and Energy should lead this action, in partnership with Environment Canada and Metro Toronto (the Regional Municipality).

When:

This action is now underway and should be completed in 1 to 5 years.

Cost:

Not estimated.

Action 48: Continue Development of Contaminant Residue in Biota (CRAB) Guidelines and Provincial Water Quality Objectives (PWQOs)

What:

The RAP recommends that additional research be conducted on the effect of contaminants on biota and their predators. There is considerable concern over the accumulation of trace contaminants in aquatic biota. The CRAB guidelines will be a set of numeric and narrative guidelines that define allowable concentrations of contaminants in aquatic biota. These guideline concentrations are aimed at protecting the organism and its predators (excluding humans) from harmful effects. The RAP similarly endorses research for the revision of PWQOs, which are numeric and narrative ambient water quality values for the protection of aquatic life and recreation.

Who:

The Ministry of Environment and Energy should lead this action.

When:

This action is ongoing and should continue.

Cost:

Not estimated.

Action 49: Assess Problems Arising from Deep Well Waste Disposals, Landfills and Hazardous Waste Sites

What:

The RAP recommends that research be carried out to assess potential water quality problems arising from deep well waste disposal, landfills and hazardous waste sites. Historic records of former landfill sites vary considerably in the amount of information available. Although the locations of many former landfill sites are known, it is not know wether or not they are contributing leachate to groundwater or surface water. Targeted monitoring of leachate from former and active landfill sites is important.

Who:

The Ministry of Environment and Energy should lead this action with assistance from the Metro Toronto and Region Conservation Authority, Regional Municipalities and Local Municipalities.

When:

This action should be implemented within 1 to 5 years.

Cost:

Not estimated.

Action 50: Investigate Methods of Reducing Use of Sodium Chloride

What:

The RAP recommends the use of methods to reduce the total amount of sodium chloride and other chemicals used on area roads.

The RAP further recommends additional research into alternatives to sodium chloride.

Who:

The Ministry of Environment and Energy should lead this action with participation from the Ministry of Transportation, Regional Municipalities and Local Municipalities.

When:

This action should be implemented within the next 1 to 5 years.

Cost:

Not estimated.

Action 51: Establish Design Standards for Roads/Parking Areas for Runoff Quality Control

What:

The RAP recommends that a study be initiated to establish design standards for roads and parking areas so that those areas can be adequately drained while preserving the quality of stormwater runoff and maintaining or restoring the natural hydrologic cycle.

Who:

The Ministry of Environment and Energy should lead this action with assistance from the Ministry of Transportation.

When:

This action should be implemented over the next 1 to 5 years.

Cost:

Not estimated.

Action 52: Encourage Research on Protection and Rehabilitation of Aquatic Habitats

What:

The RAP recommends that further scientific research be conducted to provide the information and technology necessary for conservation, restoration and development of aquatic habitats.

Who:

The Ministry of Natural Resources should lead this action in cooperation with Environment Canada and the Metro Toronto and Region Conservation Authority.

When:

Some work is ongoing in the Metro area. These activities should continue.

Cost:

Not estimated.

Action 53: Investigate Methods to Reduce/Eliminate Viral Contamination of Wastewater

What:

The RAP recommends the investigation of methods to reduce or eliminate viral contamination of wastewater and associated health effects. There is concern that some viruses are present in wastewater even after the waters have received disinfection treatment. These viruses have the potential to cause illness in workers at sewage treatment plants and others exposed to treated effluent.

Who:

The Ministry of Environment and Energy should lead this action, in partnership with Regional Municipalities and Local Municipalities, Health and Welfare Canada and the Ontario Ministry of Health.

When:

This action is expected to take 1 to 5 years to complete.

Cost:

Not estimated.

Getting it done

The Remedial Action Plan is a community-based plan. Without public involvement, from planning to implementation, the plan has little chance of success. The Metro Toronto and Region Remedial Action Plan has created several mechanisms for public participation, all of them designed to be responsive to changing circumstances and resources, and all of them intended to bring the community closer to the RAP process.

A major consideration in developing mechanisms for public participation was linkage to other water quality processes and organizations in the RAP area — in a sense, part of a water issues network. This linkage to other programs and processes is a theme that runs through all the RAP's public outreach efforts.

The immenseness of the RAP area, as well as the innumerable competing messages and causes in the area, continues to present a significant challenge to the communication and consultation process. Although the subject of water quality is widely supported among the public, there still is very little public awareness about how individuals contribute to water pollution problems. While successes have been moderate, the focus of activities will continue to be directed at the community level.

The Public Advisory Committee

The Public Advisory Committee (PAC) is the centre of the RAP public participation process. The PAC has been involved in the RAP since its inception, ensuring that all planning stages reflect a consensus of stakeholder views. An important responsibility of the PAC has been to work with the RAP Team in developing other components of the public participation process. These other activities were designed to raise public awareness of water quality issues, the RAP process, and opportunities for individuals to participate in the development of a remedial action plan. Public participation activities also offered an opportunity to collect information about what members of the public and other organizations in the RAP area felt should be included in the plan.

Public Consultation Activities

Impairment of the Toronto ecosystem touches most residents of the watershed, whether through beach closures, unsightly weeds and debris, loss of fishing opportunities or other impaired uses. The RAP Team, in cooperation with the PAC, undertook many activities to raise public awareness of water quality issues and their solutions. Among these were distribution of brochures and other promotional materials, newspaper and subway advertisements, a series of newsletters, a RAP telephone information line and media releases around RAP milestones. RAP staff also prepared free-standing and table-top displays that

were used in malls, schools, city halls, libraries, conferences and other public locations, and provided speakers at community events, workshops, conferences and public meetings.

These activities were begun soon after initiation of the RAP in 1988 and continue to be provided by the RAP program. RAP public involvement activities have been tailored to each stage of the program. In the initial stages of the RAP, public outreach emphasized information about what the RAP was doing and how people could become involved in the process. As the program has developed, public consultation activities have changed, with increasing emphasis on linkage of and information about existing efforts.

As the RAP moves from Stage 2 into implementation, public involvement activities will probably change again, with the RAP becoming a focus for community involvement and implementation of remedial actions. The decisions, including those about guiding principles, specific goals and remedial actions, presented in this Stage 2 Remedial Action Plan represent a consensus of the views of many stakeholders. Additional input was obtained through public meetings and conferences. To date, numerous workshops have been held, attended by members of the RAP Team and all their advisory committees.

The format at these workshops has been small-group discussion centering around specific topics of interest or draft discussion documents. At the end of each workshop, comments from the groups have been pooled and summarized for further review by the larger group.

Consensus emerged early in the process, particularly that preventive measures were to be preferred over end-of-pipe controls. In this way, the participants have come to trust each other and work effectively toward consensus, even though the issues have become tougher as the RAP has evolved. The broad base of support reflected in the PAC and other advisory committees will be an important element in carrying the RAP from planning into implementation.

Chapter 1 in this report talked about the work of the RAP over the past five years. In Stage 1, the RAP identified problems in the Metro area ecosystem and established guiding principles for clean-up. In Stage 2, discussed in this report, the RAP set specific clean-up targets and selected the best actions to meet those targets. To date, the entire RAP administrative structure, with its advisory committees and public outreach activities, has been designed to support this planning exercise.

Now, the RAP faces its most difficult challenge: putting the plan to work. Implementation will involve the following five key components:

1. ***recognition of existing and ongoing actions***, including elements such as:
   - watershed plans for the Don, Humber and Rouge River Basins,
   - municipal actions such as the City of Toronto Sewer System Master Plan,
   - the Municipal-Industrial Strategy for Abatement (MISA) Program, and
   - habitat restoration work by MTRCA and MNR,
2. ***identification of responsibilities, timetables, and price tags*** for new actions,
3. development of mechanisms to ***integrate remedial action plan activities with land use planning*** for the basin,
4. creation of mechanisms to ***track progress and develop new remedial actions***, and
5. creation of a framework for ***ongoing public education and consultation.***

To meet this new challenge, the main focus of the RAP — and its administrative structure — will need to change. Increasingly, the RAP must encourage the sharing of information, the support and formation of partnerships among government, the private sector, and the public. The task of implementation will also demand flexibility to adapt as the needs of the RAP itself change over time.

Guiding Implementation

Putting clean-up measures in place is a task that will be shared by many players. In fact, it is the number and variety of possible clean-up measures that will make implementation difficult. As well, the many layers of agencies working in the area further complicates matters. Just as the *planning* activity was guided by key players, so should implementation of the plan have careful oversight.

Several recent and ongoing studies (such as those done by the Royal Commission on the Future of the Toronto Waterfront) have examined the many overlapping layers

and jurisdictions involved with environmental management. While no clear picture of an ideal ecosystem management structure has emerged, several key concepts have been identified. Most notable is that any new initiative should not create additional layers of management and there must be better interaction among the agencies involved. To date the Metro Toronto and Region RAP process has not established a new structure to carry out implementation of the plan. It will take some time in the process to develop this new structure, which must remain open to change.

During this phase of change it is recommended that the existing team structures be used to facilitate change and establish a new workable structure. Some of the existing administration should change, so that the RAP can improve its focus on seeking and seeing through commitments for clean-up actions. Another important role will be regular review of the plan, perhaps every five years, and annual "update" reporting of environmental conditions in the Metro Toronto RAP area.

The Public Advisory Committee

The PAC is currently considering how it can be most useful through the plan's implementation stage. It is likely that its future role will be twofold: as a focus for community education and communication and as an ongoing "watchdog" over the process as a whole.

The Technical and Scientific Advisory Committees

These advisory committees were essential in the planning phases of the RAP, but should have a different focus as recommended actions are put in place. The Scientific Advisory Committee should become more involved in tracking environmental conditions and planning future research efforts. As the scientific centre of the RAP, it could also serve an important role in sponsoring an annual conference of waterfront research of relevance to the Metro Toronto RAP. Its role could therefore change from a scientific advisory body to an **Integrated Monitoring and Assessment Committee.**

The Technical Advisory Committee should also take on more responsibility for overseeing action, especially for stormwater, combined sewer systems, sanitary systems and land use planning. It could host a conference each year, providing an opportunity for exchange of technical information on municipal systems and their impact on the environment.

The RAP Team

The RAP Team, as the key decision-making body in the program, can continue to guide RAP activities through the implementation stage. One of the key activities will be the delivery of this plan to all relevant agencies in the Metro Toronto and Region RAP area and asking them to commit themselves to the RAP action plan. Its membership should be expanded to improve representation from upper watershed areas, particularly the Regions of York and Peel. It will continue to take direction from its advisory committees and provide a central forum for developing consensus on program direction.

Other Watershed Partnerships

As clean-up proceeds, it will be especially important to secure the support of political representatives at all levels of government. The Waterfront Regeneration Trust should play an important role in this, with actions ranging from participation in RAP discussions, to hosting special consultation activities designed to inform, and seek support from, politicians.

A Central Coordinating Office

During planning stages of the RAP, a RAP Coordinator, with an administrative assistant, provided centralized support for project planning and coordination. As the RAP moves into its long-term cycle of action, review and new action, it will need more formal central coordination. This role could be filled by a central RAP Coordination Office, which would compile and track information of interest to all RAP participants, identify opportunities for funding and technical assistance and could organize round-table discussions for project planning and coordination.

Ongoing Actions and Future Implementation

Much of the work of the RAP will be accomplished through ongoing activities and actions recently completed. In some cases, years of planning and research have already been accomplished; in others, remedial actions are already well underway. In all such cases, the ongoing action provides a focus for local implementation that will be of tremendous benefit to the RAP.

Many of these projects are still in progress or under development. Some of the most important are:

- watershed plans for the Don, Humber, and Rouge Rivers,
- the Don Watershed Task Force (see Box 11),
- ongoing surveillance and monitoring programs through Environment Canada, the Ontario Ministry of Environment and Energy, the Ontario Ministry of Natural Resources, the Ontario Ministry of Agriculture and Food, the Metropolitan Toronto and Region Conservation Authority and the many local and regional municipalities who have contributed to development of the RAP,
- the Ministry of Environment and Energy's MISA Program which is developing legally-binding standards for discharges from industrial and municipal wastewater treatment facilities, and
- activities directed at reforming Ontario's land use planning process, such as the Commission on Planning and Development Reform in Ontario.

Appendix D provides more information on several ongoing activities to improve water quality in the Metro Toronto RAP area.

While existing structures can guide us through the period of change to implementation, there is a need to review these structures in detail and develop new structures as commitments to action are made. A key idea is that the watershed area should be used as the basic unit for environmental planning and thus implementation. As demonstrated by the work of the Don Watershed Task Force (Box 11) this is the level where most action will be directed. The Task Force presents a potential model for implementing watershed action.

The RAP process should not try to duplicate these efforts on a larger scale, but must be a complimentary activity. A dynamic RAP process can provide a strong link across the watershed activities. Given the RAP's more regional focus it should continue to offer a mechanism in six major areas:

- ongoing tracking and assessment of remedial actions,
- monitoring and reporting of progress towards ecosystem restoration,
- ongoing regional planning and review of actions,
- coordination of scientific and technical studies,
- facilitation of action and partnership where required, and
- ongoing public education and consultation.

It is recommended that these points form the basis for developing a new team structure within the next year.

Box 11: The Don Watershed Task Force

The Metro Toronto and Region RAP area is a large and politically complex area encompassing six river watersheds. Many of the recommendations made in this Stage 2 Report relate to the area as a whole. To do more detailed planning for water quality improvement, however, it is necessary to translate more general recommendations into action plans for local areas, such as a single watershed or sub-watershed area. The Don Watershed Task Force is one example of how this detailed planning is now underway.

The Task Force, which is supported by the Metro Toronto and Region Conservation Authority, is made up of citizens, municipal representatives, politicians and members of other interested groups. These members reflect a wide range of interests and backgrounds. Together, the Task Force members are developing a detailed strategy for regeneration of the Don Watershed, expected for release in early 1994. Although the strategy will study the watershed as a whole, it will also provide detailed plans for sub-watershed areas. It is at this level that the general goals of the RAP will be translated into specific actions for improving water quality and wildlife habitat.

TIMETABLES AND RESPONSIBILITIES

Appendix E provides a summary of proposed responsibilities and anticipated starting dates for key RAP actions for the major **lead** agencies and partners involved. The following section describes those responsibilities in more detail.

Regional Municipalities

The regional municipalities should carry the majority of responsibility for reducing pollution from point- and non-point sources. Some of these actions would involve changes in management and operation of facilities; others, such as improvements to the sewage treatment plants, would require many years and high costs. These agencies are essential to implementation, because of their excellent knowledge of sewer and treatment systems and the customers — industrial, residential, commercial, or institutional — that use them.

Local Municipalities

Local municipalities are also important in implementation, although their actions may not incur the high costs that the regional municipalities may bear. On many actions, the local municipalities would share lead responsibility with their regional counterparts, reflecting the close ties between these two levels of government.

The Ontario Ministry of Environment and Energy

The Ontario Ministry of Environment and Energy should play a continuing role in the development of legislation and abatement procedures for the control of pollution from urban and agricultural sources. It would also carry out demonstration projects for new technologies such as multi-use stormwater ponds. Like Environment Canada, the MOEE would be central in program communications and education, for instance by establishing a resource centre and continuing communications plan. MOEE would maintain important links to land use planning functions and the Waterfront Regeneration Trust, and would lead research into new technologies and the behaviour of toxic contaminants in receiving waters, sediment and biota.

Other Provincial Agencies

Several other provincial agencies would be involved in certain actions. The Ministry of Agriculture and Food would play an important role in several agriculture-related initiatives, while the Ministry of Natural Resources would work on assessment of fisheries and wildlife resources and habitat issues. The Ministry of Transport and the Ministry of Municipal Affairs would have responsibilities related to actions in their areas of interest.

As well, the Provincial Government as a whole has a significant role to play in supporting the major actions by the Regional and Local Municipalities.

The Federal Government

Environment Canada should have a key role in certain communication and education activities, particularly those that link the Metro Toronto RAP to other RAP areas and to other programs inside and outside government. Environment Canada should also assist in establishing a foundation to fund local initiatives in support of RAP clean-up measures. The Federal Department of Fisheries and Oceans would play a key role in habitat restoration.

The Federal Government, as a whole also should directly support major actions by Regional and Local Municipalities and support the application of new technologies.

Metro Toronto and Region Conservation Authority

Since MTRCA is organized on a watershed basis and represents a unique partnership with the municipal and provincial governments, it can play a significant role in RAP implementation. Their commitment to watershed/subwatershed plan development and to in-field watershed regeneration work, both in the watershed and along the waterfront, would contribute greatly to RAP implementation.

The Public and Non-Government Organizations

Individual citizens and non-government organizations will play an essential role in three major areas. First, through direct action in and around their homes and second, as participants and partners in all remedial actions. Third, the public and non-government organizations can act as advocates to ensure that political enthusiasm and commitment are generated and maintained throughout the implementation phase.

Costs and Benefits

Clearly, a central question in the Stage 2 RAP is "what will it cost?" The RAP has identified many actions for eventual implementation, and these actions will require both money and administrative support if they are to succeed. Careful staging is important. When money is short, as it is for taxpayers and governments alike, it is essential to set priorities so that the most important actions are done first. Similarly, a long-term action plan will give municipalities the information they need to plan for major capital outlays over the next twenty years.

The significance of the cost figures presented in this section is that they represent society's historical belief that environmental degradation was an acceptable cost of prosperity and progress. The recommendations presented in this plan will help to restore the local ecosystem and will also contribute to the restoration of the Great Lakes ecosystem. These investments will provide us with new economic opportunities in environmental remediation, development of new technologies, enhanced recreational opportunities, sustainable resource use and waterfront redevelopment. Communities redeveloping their urban waterfronts around the Great Lakes are taking a lead role in integrating environmental quality with economic activity. They have recognized that development with respect for the ecosystem provides the essential ingredient to renewed economic activity as well as community pride and well-being.

Of the many actions proposed in Chapter 3, some are highly effective but also very expensive. Others are relatively inexpensive, but will likely have a less significant impact on improving ecosystem conditions. Some actions, such as work on new laws and policies, can be considered part of government's normal responsibilities. Such actions may require diversion of resources from one area to another, but may not need much in the way of new money or administrative support to succeed. Finally, some actions will take many years to complete, while others can be done in a year or so.

What is the best way to compare these various actions, with their different costs, time frames and impacts? One method that is often used in environmental management is to assign dollar values to all action "costs" and to all "benefits" associated with each action. Estimating total costs, including both capital and operation and maintenance costs, is usually fairly straightforward. Estimating a dollar value for benefits, particularly where they include intangible or invisible effects such as improvement in aesthetic appeal, is much more difficult. Environmental economists have developed a number of methods to assign costs to environmental benefits, and those methods are continually re-examined and refined. Examples of such methods include estimation of the public's "willingness to pay" (as judged from surveys and interviews) for specific benefits such as open bathing beaches or better fishing opportunities, and considerations such as higher property values where the environment is cleaner.

Once costs and benefits for a project have been calculated, it is possible to determine how many dollars in "benefits" are obtained from the expenditure of a single dollar in "cost." On the assumption that most major projects will be financed over many years (rather like a mortgage), costs and benefits are usually amortized over the same time period at a constant interest rate. The following RAP analysis used a planning period of 20 years and an interest rate of 10%. Although the appropriateness of these values can be debated, they are useful in providing a common basis on which to compare actions of different kinds and costs.

The Total Costs

Table 4 is a summary of the total costs estimated for major classes of RAP actions. These costs are estimated at between $1.67 billion and $1.74 billion. Operating and maintenance costs are expected to add another $28.5 million annually to the total bill.

Costs for some actions were not estimated, either because we don't have enough information about their true costs or because they may in fact incur very little additional cost beyond existing expenditures. In any case, it is likely that the costs for these actions are very small compared to the three major thrusts of RAP activity: stormwater management, combined sewer system improvements and modifications to the sanitary sewage systems.

The estimated total **annual** clean-up cost is approximately $214 million to $222 million over a twenty year period. Spread out over the population of the RAP area, this would amount to approximately $75 to $80 per person per year (for 20 years).

TABLE 4: TOTAL COSTS FOR RECOMMENDED ACTIONS

ACTIONS	CAPITAL COST ($MILLION)	OPERATION & MAINTENANCE COST ($MILLION)
Stormwater	827 - 855	5.5
Combined Sewage	430 - 475	0
Sanitary Sewage	410	6.9
Habitat	Not Estimated	Not Estimated
Education	Not Applicable	0.4
Policy	Not Applicable	Not Estimated
Planning	Not Applicable	15.3
Research	0.4	0.5
TOTAL	1,667 - 1,740	28.5

Source: Metro Toronto and Region RAP, Draft Discussion Paper on Remedial Options

Measuring the Benefits

In the beginning of this section, we talked about the practice of comparing environmental clean-up costs to the benefits that result from clean-up actions. Quantifying benefits is no easy task. In the first place, although project costs are often clear-cut, it can be difficult to anticipate all the possible direct and indirect benefits of a given project. Even a complete understanding of the nature of the benefits doesn't necessarily lead to an accurate estimate of their value.

Benefits generally fall within the following categories:

- **Sustainability Benefits** from maintaining environmental functions such as climate regulations, productivity and biodiversity.
- **Use and Non-Use Benefits** resulting from increased use or appreciation of resources. Use benefits include increased recreational activities such as swimming, fishing, boating, hiking and birding. Aesthetic or non-use benefits include benefits derived from improved health and from simply knowing that the water is cleaner for current and future generations.
- **Avoided Cost Benefits** can include reduced health care costs resulting from a cleaner environment or delaying the need for end-of-pipe pollution control through water efficiency and pollution prevention activities.
- **Economic Inputs (Direct, Indirect, Induced)** are measured in terms of economic expenditures and employment that result from remedial actions. These can be direct benefits that result from the initial investment in remedial activities. Indirect and induced benefits include increased activity resulting from greater use (eg. fishing, tourism) and new economic opportunities (eg. waterfront re-development, marketing of environmental technologies).

Each of the major recommendation areas identified in this plan will result in a variety of benefits as illustrated in Table 5. For instance:

- Stormwater controls reduce loadings of suspended solids, lead and other contaminants which contribute to improved water quality and reduced contamination of fish, resulting in benefits such as enhanced swimming and fishing opportunities.
- Corrections of combined sewer overflows will reduce bacterial loadings which contribute to improved water quality and result in benefits such as enhanced swimming opportunities and avoided health costs.
- Sewer use controls and improved sewage treatment will reduce loadings of phosphorus and other contaminants which contribute to improved water quality and result in benefits such as enhanced recreational activities.
- Protection and restoration of fish and wildlife habitat will result in an increased quantity and diversity of fish and wildlife habitat and provide benefits such as enhanced fishing and birding opportunities.
- All remedial activities will result in direct, indirect and induced economic benefits. The magnitude of these benefits depends on the size of the initial investment.

The potential range and magnitude of the benefits of implementing the recommendations in this plan could be quite large.

Table 6 presents the results of a study undertaken on behalf of all the RAP areas to compare the capital and operating costs of proposed measures, and the direct and indirect benefits of implementation. (Note that these costs and benefits are provided for comparison only and were not calculated in the same way as the costs given in Tables 4 and 5 above.) The figures for non-use and indirect benefits incorporate province-wide considerations that are expected to result from RAP expenditures. As above, "use and non-use benefits" include "use benefits" such as increased recreational opportunities (eg. fishing or swimming) and "non-use benefits" such as the benefit of simply knowing that our water is cleaner. "Economic

TABLE 5: POTENTIAL BENEFITS OF RECOMMENDED ACTIONS

BENEFIT TYPE	STORMWATER CONTROLS	COMBINED SEWER OVERFLOW CORRECTIONS	SEWER USE CONTROLS & STP UPGRADES	HABITAT RESTORATION	LAND USE PLANNING
I. Sustainability Benefits	•	•	•	•	•
II. Use and Non-Use Benefits					
Swimming	•	•	•		
Fishing	•	•	•	•	
Other (i.e.hiking, boating)		•	•	•	•
Human Health		•	•		
Aesthetic	•	•	•	•	•
III. Avoided Costs					
Health care		•	•		
Deferral of capital costs			•		
IV. Economic Impacts					
Direct	•	•	•	•	
Indirect/induced	•	•	•	•	•

TABLE 6: REMEDIATION COSTS AND BENEFITS

	COST		BENEFITS					
			Use and Non-Use		*Economic Inputs*			
	Capital $M	Operation & Maitenance $M	Use $M	Non-Use $M	Implementation Phase		Post Implementation Phase	
					$M	person years employment	$M	person years employment
All RAP Sites	150	150	46	90	—		—	
Across Ontario	150	150	46	220	1,230	27,400	205	5,700
Metro Toronto	62-67	56-67	17	55	—		—	

* adapted from "Overview Economic Assessment of RAPs for Great Lakes AOCs"

Inputs" consist of indirect benefits resulting from increased activity such as fishing and tourism.

This analysis concluded that the benefits of clean-up actions will be approximately equal to their costs. It is important to note, however, that this analysis used traditional techniques to estimate economic benefits, an approach that may not be adequate to address the large-scale economic changes expected as a result of major remediation expenditures.

Are These Costs Affordable?

Typically, municipal projects such as sewer improvements are paid for from tax revenues, user fees, grants and development fees. More and more there is a trend to raise money for environmental protection and restoration by charging users, beneficiaries and polluters rather than raising taxes. In addition to increased use of specific charges (eg. water bills) there are a number of other initiatives including:

- fines and penalties,
- compensation payments,
- public or private environmental funds,
- public/private sector partnerships, and
- non-profit/charitable organizations.

Fines and penalties are imposed on polluters and are designed to promote positive incentives rather than generate revenue. Compensation payments are moneys taken from polluters through legal action, which are then dedicated to environmental projects. Private or public environmental funds can be financed through lottery funds, or voluntary contributions by individuals or corporations. Private/public sector partnerships are contract arrangements that commit both parties to providing environmental service. Non-profit/ charitable organizations sometimes initiate fund-raising activities to support local remedial actions.

To decide whether estimated RAP costs are affordable, we must look at what money would be needed from each source to finance a particular action. Improvements to sewage treatment plants provide a simple example, because Metro Toronto has sole authority over this area. The following paragraphs discuss several ways that such improvements might be funded.

Finding the Money from Taxes Only?

From 1985 to 1991, Metro Toronto's spending on capital works, plus operating and maintenance costs, rose from $2.0 billion to $3.6 billion, or approximately 80%. These costs rose, in part, because of inflation, but also because the costs of many urban services, particularly health and social costs (see Figure 9), increased substantially during this period. Adjusting the estimates to remove the impacts of inflation, we find that the actual spending increase is more on the order of 40% or 5.8% per year. To find this money, municipalities like Metro Toronto have had to raise taxes (in Metro's case, about 3% per year in real costs), increase the amount coming in from grants and user fees, or reduce services. Each municipality develops its own approach to this complex financing problem.

In 1991, taxation in Metro Toronto averaged about $448 per capita or $1344 per household. To recover the costs of sewage treatment plant improvements proposed in this plan, these amounts would have to increase by 4 to 14%, assuming that the municipality was unable to contribute any other funding but that provincial subsidies would be available for the work.

Full Cost Pricing of Water and Sewer Services?

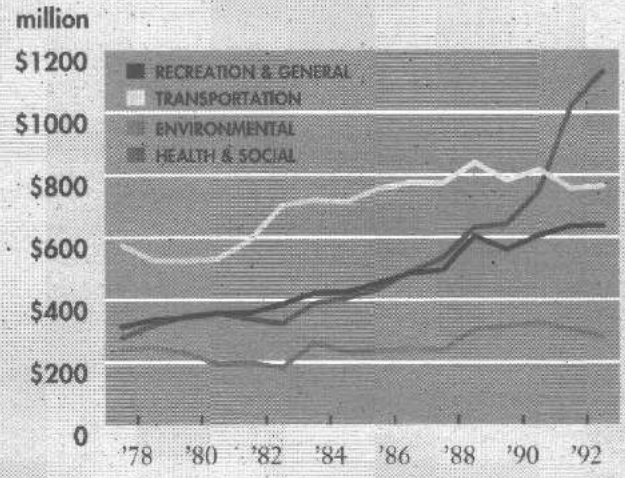
An *Environics* poll conducted in the Greater Toronto area in June 1991 showed that 66% of those responding would be willing to pay for environmental clean-up, but only 25% favour doing this through increased taxes. On the other hand, almost three-quarters of respondents said they would be willing to pay double their current water rate (now about $250 a year) for better water quality.

If we adopted an approach like this, Metro Toronto's rates would be similar to those now charged in Edmonton ($376 a year) and Ottawa-Carleton ($361). In fact, municipal water rates in Ontario are not only lower than many other places in Canada, but much lower than the actual costs of supplying water and sewerage services. In most Ontario municipalities, water rates average 65% of the true costs of service, the balance coming from provincial subsidies, property taxes and subdivision charges. It might make sense to show consumers the true costs of services, giving an incentive to conserve water and removing hidden water treatment costs from property taxes. Many people believe that such a "user-pay" system provides the fairest, most equitable basis for water pricing.

Within the Greater Toronto Area the water supply and wastewater treatment systems operate on a user-pay basis. The user charges however, do not necessarily reflect the full cost of building and operating the various systems. There is a wide range of complimentary services between the Regional Municipalities, such as Metro Toronto and Local Municipalities, such as East York, leading to a wide range of cost recovery methods.

Table 7 shows how a user-pay system could be used to generate some funds for improvements for stormwater, sewage treatment plants and combined sewer systems. Estimated extra costs per household range from $34 to $67 beyond the average $247 per year currently charged. Assuming an average Metro Toronto household income of about $60,000, the new water bill of about $314 would still be only about 0.5% of household income. This compares well with current energy costs of about 2.6% of family income.

FIGURE 9: METRO TORONTO REAL CONSOLIDATED EXPENDITURE



Source: Metro Toronto's Financial Information Returns (1977-1992)

TABLE 7: COST ALLOCATION UNDER USER-PAY — STORMWATER, STP AND CSO COSTS

Capital Cost	$840 to $1,740 million
Total Annual Cost	$106 to $206 million
Household Share of Total Annual Cost	45%
Household Cost	$48 to $93 million
Estimated Municipal Water Use Per Household	352 m^3
Number of Households	1,387,351
Cost/Household	$34 to $67
Current Cost/Household	$247
Average Metro Toronto Household Income	$59,450

One benefit of full-cost pricing is that by recognizing the true value of water and sewage services, water conservation efforts may increase (see Box 12).

Refocus Existing Funds?

Another way to raise funds for remediation is to change the way existing funds are spent. For example, municipalities traditionally spend most of their capital works budgets on improvements to the sanitary system. In this Stage 2 RAP document, we have identified pollution prevention as a high priority, followed by system control. Chapter 2 demonstrated that stormwater runoff is a major contributor of pollutants in receiving waters. Although spending on stormwater controls has traditionally been low, it would make sense to place more emphasis on control of this source because of its importance in the overall system.

Increase the Payoff of Existing Spending?

If we decide that the existing distribution of spending is appropriate, it may nevertheless be possible to increase the environmental benefits of that spending with only modest additional cost. Economists call this an increase in spending efficiency. The City of Etobicoke is currently engaged in stormwater management practices that incorporate this idea of increased efficiency. Box 13 provides details of the Etobicoke experience.

Box 12: Water Conservation: Saving More Than Just Water!

Living by a large freshwater lake, it is understandable that some people in the Metro area might not see the need for saving water. Water conservation, however, means more than just saving water. It can reduce the costs needed for treatment of water and wastewater, and save money by extending the use of existing infrastructure such as sewers and treatment facilities.

A 1991 study for Metro Toronto recommended changes to the plumbing code, promotion of use of water-saving devices like low-flow showerheads, water audits for businesses and a full user-pay policy for water use as ways to save water. The Metro RAP endorses the study recommendations as fundamental to restoring the health of our water supply.

You can save money by saving water at your house. A low flush toilet costs around $240 and uses 6 litres of water for each flush versus the conventional 19 litre toilet. This can reduce water use by approximately 68% or about $56 per year - a pay back time of four and one-half years. Similarly, low flow showerheads can pay for themselves in about one year.

If everyone does a little bit it can make a big difference! Assuming Metro had full metering of water use, it is estimated that equipping all the houses in the area with low-flush toilets and water efficient showerheads could reduce water use by 24% to 28% (45-52 million cubic metres). This translates to a significant financial saving for individual homeowners and for municipalities in the form of reduced energy and chemical requirements or delays in capital spending for upgrades for water and wastewater treatment. Savings by a municipality would free up funding which could be allocated to other restoration activities. Additional savings could also be realized by targeting commercial, industrial and institutional organizations.

It is being done elsewhere. The City of New York has already committed $300 million to replace 1.5 million toilets with ultra low flush toilets. The City offers $240 for the first toilet in each home and $150 for the second. Interestingly, the need to conserve is driven more by the need to reduce sewage treatment costs than by water shortages. This strategy could save the City about $800 million annually in pumpage costs alone. However it is hoped that these measures will save New York about $7 *billion* in sewage treatment expansion costs.

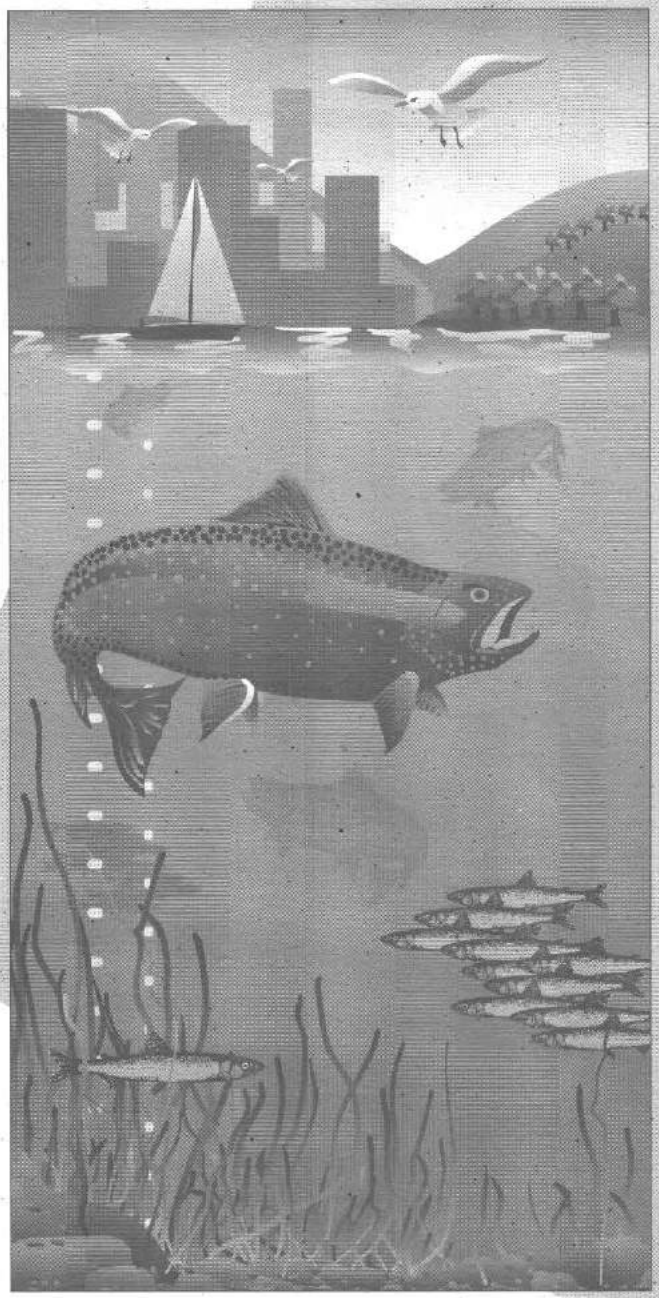
Box 13: Taking Advantage of a Situation The Re-Naturalization of Berry Creek

The current poor economic situation in Metro Toronto and elsewhere will certainly have an effect on the speed at which water quality improvements are carried out. Large, costly projects may be less attractive in a society struggling to make ends meet. Sometimes, however, it is possible to achieve significant environmental progress by spending little or no extra money than is already in a municipality's capital works budget.

In the City of Etobicoke, for example, existing plans to build a sanitary sewer were recently augmented to include re-naturalization of Berry Creek.

Due to structural failures and root problems, the residents near Berry Creek were subject to sanitary back-ups. In 1991, the City had planned to reconstruct the existing sanitary trunk located in Berry Creek. The proposed plans called for a diversion of the existing gabion creek and, upon completion of the sanitary works, to restore the same gabion channel. At the request of the Ministry of Natural Resources, the City looked at the possibility of rehabilitating the creek to a more natural function.

The final plans for the creek called for 1.2 km of meandering flow, pools and riffles instead of a gabion-lined channel. Wild flower seedlings, shrubs and trees were to be planted to re-naturalize the area. There was no additional cost for this rehabilitation work as restoration of the gabion channel was included in the original plan. This change to a re-naturalized stream was enthusiastically endorsed by the local residents. Residents organized a celebration in the fall of 1993, to announce the adoption of the creek by the local ratepayers.



HISTORY AND CONTEXT

The RAP watersheds in the past

The history of the Toronto watersheds provides many insights into the pollution problems we confront today. Decisions that were made a hundred years ago were, in their time, progressive and protective. But, in solving some older problems, some newer problems also were created, or developed with the growing size of the population. This chapter traces the history of settlement, industrialization and pollution control in the RAP area, from the advent of European settlers to modern times.

Early Settlement

From earliest times, Toronto's accessibility from lake and shoreline made it an important gathering point and staging area. From the deep, clear bay up the Humber River ran a Huron trading corridor between Lake Ontario and Georgian Bay, much of it linked by water routes. This *passage de Toronto*, or Toronto Trail, was well known to the French explorers, trappers and missionaries and the early English traders who travelled through the area in the early seventeenth century.

In 1787-88, Lord Dorchester, governor of Upper and Lower Canada, purchased land from the Mississauga natives for a military base and settlement along the shore. In the first sketches of the town site, a shallow beach area gradually rises to hillsides thickly covered with mixed forest and cut by fast-flowing rivers and streams. Fallen trees lay in the thick leaf mould, a natural sponge for rain and groundwater. The trees themselves, and their underlay of rotting vegetation, were a living reservoir for the watersheds' abundant waters, trapping and holding rainwater and creating a gentle, steady flow to creeks and ponds.

Governor-General John Graves Simcoe, appointed by Dorchester in 1791, oversaw the construction of a log fort and garrison near the harbour's Western Gap. Simcoe also laid out a town site of ten blocks, backed by 100-acre park lots running up to the present location of Bloor Street. On August 27, 1793, Simcoe christened the settlement York, in honour of the British Commander-in-Chief, the Duke of York.

The Growing Population

The new town grew quickly. The watersheds' deep ravines allowed access to upland areas for the establishment of farms, sawmills and gristmills, particularly along the Don River and in the upland plains. By 1795 a small, log- and timber-built hamlet was established at the centre of the town site.

The RAP watersheds in the past

From these modest beginnings, York's expansion as a commercial and political centre was steady. With its growth came diversification of its economic base. By 1812, the town (now 703 strong) could boast a variety of craftsmen and services. This urban population was nevertheless dwarfed by Upper Canada's scattered rural population of about 15,000. As the town grew, the balance of population was to shift gradually towards the urban centre as farmers in the hinterland sought properties closer to the settlement. With settlement came clearance of the local watersheds and, over time, gradual reduction of the moisture-holding capacity of their soils.

By 1810, York had a public market near the waterfront and the harbour was an important transshipment base for goods moving east and west along the Lake Ontario shoreline, or north into inland areas and Georgian Bay.

Between the Don and the Humber, six streams flowed. All have now been diverted into sewer systems, but despite efforts to fill their ravines and erase their existence, those streams still emerge when new buildings are constructed today. Figure 10 shows the location of these and other lost streams in Toronto.

In 1830, a storm opened a small gap in the eastern side of the peninsula, passable by small boats in good weather. In 1858, more violent storms broke a larger opening in the hard sand bar, and thereafter a fifty-metre Eastern Gap offered more favourable winds and sheltered entry to the harbour. The opening of the Eastern Gap permanently separated the sand spit from the mainland and created Toronto Island, from its inception a place for sport and recreation, as it remains today.

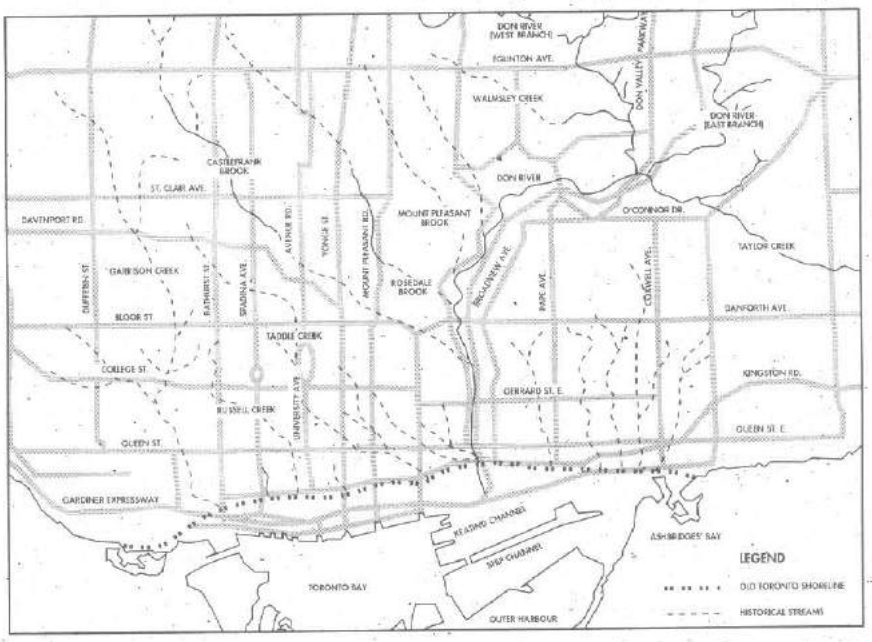


FIGURE 10: HISTORICAL STREAMS OF TORONTO: MANY TRIBUTARIES HAVE NOW BEEN DIVERTED INTO UNDERGROUND PIPES

An 1803 sketch (Figure 11) shows the shoreline cleared of trees from the Don west to the harbour entrance and back as far as the present Queen Street, where thick woods can still be seen. But, despite this evidence of progress, and the town's now-flourishing economic base, its physical infrastructure remained primitive. The first brick residence was not built until 1809,

FIGURE 11: YORK IN 1803: A VILLAGE SPREADING ALONG THE SHOREBANK. THE DON RIVER IS AT THE RIGHT SIDE OF THE PICTURE (COURTESY OF THE ROYAL ONTARIO MUSEUM, TORONTO, CANADA.)

and "Muddy York" was notorious for the poor quality of its roads. The freezing and thawing of the land surface posed construction problems that were difficult to overcome for the next hundred years, and many residential streets remained unpaved as late as 1912 (see Figure 12).

The drainage and pavement of street surfaces was a continuing concern in the growing city. Earth roads could become impassable in rainy weather, and log-built corduroy roads were easily dislodged by constant traffic. In 1828, the first gravel was laid on a few main streets. In the last quarter of the century, cedar block paving provided a less dusty and more even surface than earth or gravel — although travellers reported grass and weeds growing six inches high between the paving blocks on a residential street! After 1915 asphalt and concrete surfaces, impervious to rain and weeds were used.

In the earliest days of the town, sanitary arrangements were primitive. Privies and cesspools served for the disposal of human wastes, and drinking water was simply hauled from the nearest creek. Most households had cisterns — barrels or tanks to collect rainwater — to supply water for washing, although a few had wells dug on their property. Some wealthy citizens paid carters to haul water to their homes, but home delivery carried no guarantee of quality — the source was still a local stream. Garbage was not collected, although in 1802, a magistrate's order required that waste lumber and carpenter's shavings be burnt on Wednesdays and Saturdays at sunset, and butchers' offal be buried or removed from the town. Householders could burn their refuse on their own property or cart it away to be dumped or buried.

From Town to City

By the 1830s, the city was thriving, but with prosperity came increasing pressure to improve public services. In 1822, the first public well was dug on the site of the market near the waterfront. In 1832 and 1834, cholera epidemics caused hundreds of deaths and prompted urgent measures to clean up rotting garbage and sewage, believed to be the cause of "miasmas," or foul air. Among these measures were daily garbage and sewage collection and the building of small drains in the dirtiest areas.

In 1834, York changed its name to Toronto and became incorporated as the first city in Upper Canada. Its population in 1834 grew to 9,252, which was attributable, in part, to extensions in the city boundaries two years earlier. The clearly urban landscape was now solidly built up in the downtown

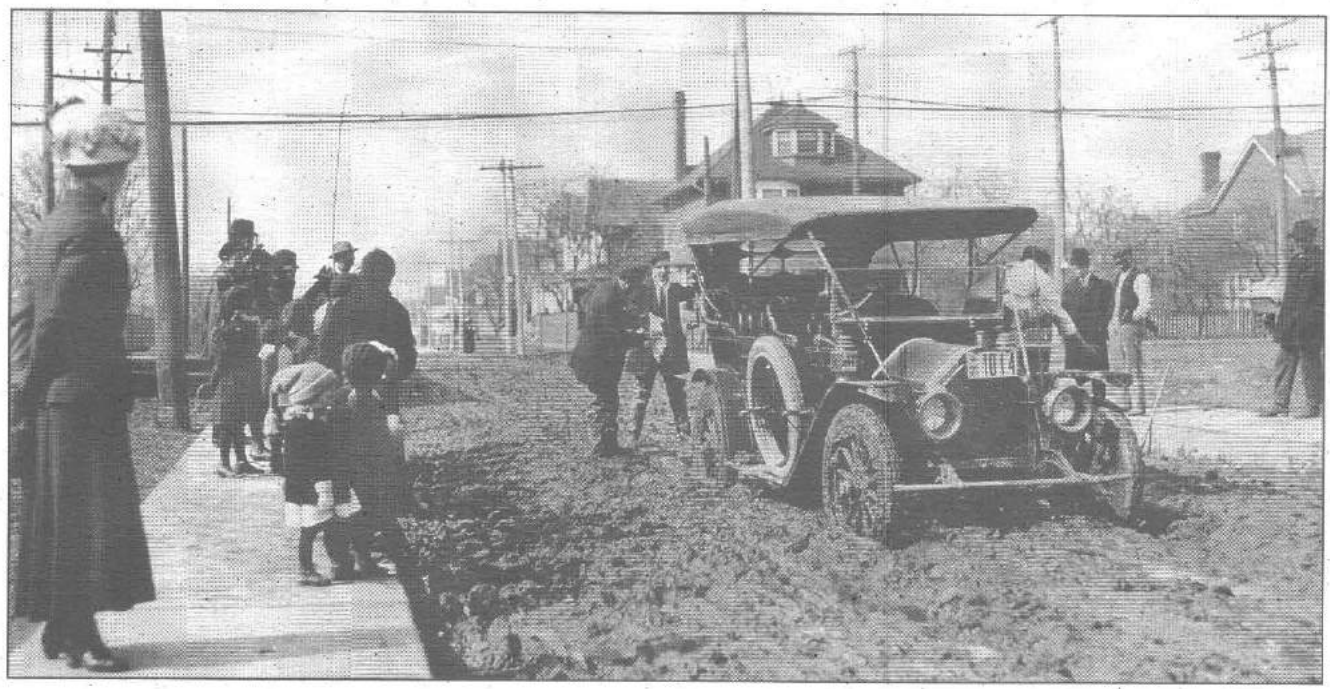


FIGURE 12: THE STATE OF A RESIDENTIAL ROAD IN 1912. SUCH ROADWAYS WERE NO LONGER EVIDENT IN PAVED DOWNTOWN TORONTO. (COURTESY OF THE CITY OF TORONTO ARCHIVES.)

core, with broad boulevards, some paved with gravel, and generous footpaths. Ambitious road and sewer building projects and other improvements were undertaken through the prosperous 1840s.

By 1871, the census recorded more than 56,000 residents. With Toronto's increasing population came new waves of disease. Typhus and cholera continued as serious threats to the public health and, although the true cause of the problem — contamination of drinking water sources by human sewage — was still unknown, citizens found their harbour and stream waters increasingly unpalatable.

The middle of the century saw the advent of the railway in Canada with rail lines spreading rapidly to major centres in Canada and the United States, linking water traffic (including that from the Erie Canal, opened in 1825) with upland routes. For Toronto, the railway brought improved communications and accelerated economic growth. It also opened up access to rural areas to the north allowing the rapid establishment of farm communities with Toronto as the economic core for the flourishing region.

The railway had three important impacts on the rate and pattern of settlement. First, railway access greatly increased the rate at which trees could be brought out of nearby logging areas and transported to Toronto for shipment elsewhere, thus vastly accelerating the rate at which the watersheds were stripped of trees. Second, the establishment of the railway network encouraged the development of industrial centres close to rail and water routes for the efficient distribution of goods and services. And third, railways cut the town off from its waterfront — enabling citizens to put it out of sight, and out of mind.

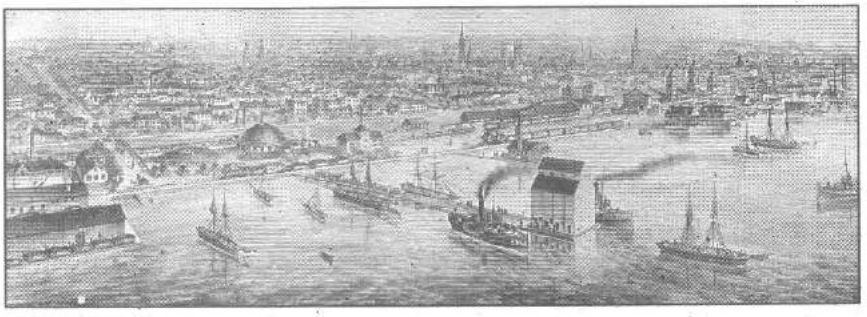


FIGURE 13: THE TORONTO WATERFRONT IN 1880 (COURTESY OF THE METRO TORONTO REFERENCE LIBRARY)

THE INDUSTRIAL CITY

As a railway centre in the 1860s, Toronto stretched from Dufferin Street in the west, to the Don River in the east, and from the waterfront, now lined with railway tracks, to what is now Bloor Street. While streets were often still unpaved, development was increasingly dense in the downtown area and natural drainage patterns were diverted to suit human convenience.

A Building Code was developed, following the Fire of 1849, to govern the construction of buildings in the city centre, but the city's water supply and sewage services continued to lag behind more visible improvements. City Council imposed limits on unfenced livestock and wastes from slaughterhouses, but had not come to grips with the larger problems of human waste and garbage in the city. By the 1860s the harbour was clearly showing the effects of development, with widespread pollution by sanitary wastes and debris. The city pumped water from the lake, but this service primarily supplied industry and firefighting rather than residences. Steam-powered pumping equipment, located at the foot of Peter Street, was installed but little modified over the decade. Most homes still did not have piped water supplies, but continued to draw water directly from streams or from private wells. As the population increased, so did the number of backyard privies and leaking cesspools, and thus the contamination of wells and water supplies throughout the town.

Better conditions were achieved with drainage and paving of street surfaces and walkways. A sketch from 1880 (Figure 13) shows a bustling waterfront lined with wharves and public buildings. Only in the far distance can trees be seen, dwarfed by the sprawling city. Smokestacks dot the shoreline near the Esplanade, revealing the presence of major factories.

So ardent was the pursuit of industrialization that development of factories on the waterfront was allowed to take precedence over maintenance and sanitation. Decaying structures and debris accumulated in the harbour waters, sometimes obstructing ship passage and forcing ships to be towed to

their berths. Repeated dredging and the construction of breakwaters provided some improvement, but no permanent remedy. This dredging, and associated filling of wetlands, was a significant force of habitat modification and degradation throughout the waterfront area. From the 1840s well into the twentieth century, natural fish habitat, including spawning areas and wetlands, was gradually drained and filled to provide new lands for development in the valuable urban core area. Dredging of coastal gravel, rocks and boulders was carried out by "stone hooking" ships. This material was used for aggregate and construction during the 1800s, and may have depleted coastal spawning shoals and reefs. Stone hooking began about 1820 and continued until about 1920.

In 1886, William Holmes Howland was elected mayor and faced strong pressure to improve the city's street system and outdated water supply, now inadequate and heavily polluted by industrial discharges. In 1872, a Water Works Commission was established to design and manage an updated system, and five years later the privately-owned utility was transferred to the city. In 1874, the city numbered 1,375 homes with piped water supply; by 1877 there were more than 4,100, and by 1883 more than 16,000.

The new system had better, higher capacity pumping equipment for water supply and a reservoir north of the city to accommodate storage. More sewers provided better drainage of wastes to the harbour. Nevertheless, citizens continued to question the quality of their drinking water, which was still drawn from the harbour near sewage outfalls: "drinkable sewage," as the *Globe* called it in 1882.

As the number of small, local sewers increased, the need for a large trunk sewer became more apparent. Many drains did not have sufficient slope to carry away wastes. Sewage gases were not vented and drains opened directly into homes. The Howland administration supported a proposal to build a sewer east to Ashbridge's Bay, but public outcry about costs delayed the project. Instead, the drinking water intake pipe was extended farther into the harbour in the late 1880s, but the new pipe suffered problems with leakage and structural damage.

Road improvements had progressed steadily since the 1870s, when cedar block paving became more widespread. Cedar paving gradually gave way to asphalt, introduced in 1887, a far superior surface and one less prone to splitting and heaving. The new asphalt surfaces were entirely impervious to rainwater, so as paving increased, so did the diversion of stormwaters into an increasingly complex sewer system.

In rural areas, the Industrial Revolution had brought the mechanization of farming and the rural landscape was now an almost unbroken carpet of fields and pastureland. Modern patterns of farmland interspersed with woodlots have developed only recently. The primeval forests of a hundred years before were gone, replaced by tidy farmlands and the debris of logging.

The Twentieth Century Metropolis

In 1904, Toronto's Great Fire destroyed nearly twenty acres of downtown buildings, at an estimated cost of over $10 million. Despite the fast response of a well-organized fire brigade, water pressure proved, once again, inadequate for the task of fire fighting.

The fire finally and conclusively demonstrated the inadequacy of Toronto's municipal services. As a direct result of the fire, the city brought in stricter building codes and a new high-pressure water system, approved by public vote and completed in 1909.

Other improvements followed rapidly, following a plan first developed in 1896 but never completed. By 1910, a new drinking water intake extended well out into the lake, where water quality was unimpaired by the city's industrial activities, and drinking water passed through a new filtration plant on the Island before being pumped into reservoirs for storage. A sewage disposal plant was opened in 1911 near Ashbridge's Bay, where its effluent would be well separated from the drinking water intake. The long-awaited trunk sewer was thus constructed, effectively diverting all sanitary waste to the sewage treatment plant. As a direct result of the introduction of sewage treatment, typhus, formerly a leading cause of death in the city, was essentially eliminated in Toronto.

FIGURE 14: SEWER EXCAVATION ON ELIZABITH STREET (1910) (COURTESY OF THE CITY OF TORONTO ARCHIVES.)

In theory, only storm runoff now entered the lake without treatment, either directly overland or through separate storm sewer pipes. However, as late as the 1960s combined sewers (see Figure 7, page 19) carrying both sanitary and storm drainage were being built and connected to the sewage treatment plant. These sewers can overflow during storms releasing untreated sewage into local rivers or the lake.

In 1913, a sprinkling filter, or percolation, system was built in New Toronto to treat sewage. The system involved screening of the sewage stream, then liquification and finally sprinkling through filters over a bed of rocks coated with bacterial slimes which fed on organic matter in the sewage.

Many homes, especially poorer ones, were still served only by backyard privies, however, and sewers did not exist in many areas of the city. By 1916, Dr. Hastings (in his tenure as Toronto's Medical Officer of Health) had encouraged the city to adopt extensive powers over sanitation on private property. Throughout the early years of the twentieth century, Toronto's modest sewer system was greatly expanded to include even the poorest areas (see Figure 14).

These ambitious public works, and the asphalting of roads and electrification of the city, placed heavy demands on the city's finances, especially in view of the limited tax base available to generate revenues. Chlorination of drinking water, one of the cheapest and most effective measures available to control bacterial contamination, had been known for at least a decade, although it was not until the late 1920s that Toronto adopted this technology.

Much of the impetus for better water and sewage treatment came through the activities of the International Joint Commission, an organization established under the 1909 *Boundary Waters Treaty* between the United States and Canada. Under this treaty, the two countries agreed to cooperate and share information in protecting the quality of their boundary waters, and particularly the Great Lakes. The Commissioners' first task was to conduct a survey of pollution in the boundary waters. This study, completed in 1912, revealed widespread pollution in the nearshore areas of the Great Lakes, much of it attributable to uncontrolled discharges from municipal sewers and industrial operations. They concluded that drinking water drawn from these areas was unsafe for human consumption unless it was treated. The report recommended daily testing of drinking water for bacteriological contamination, treatment of all potable water supplies, and universal treatment of sewage.

By the mid-1920s, activated sludge plants, which essentially duplicate and accelerate natural degradation processes by encouraging bacterial digestion of wastes, had replaced sprinkling filters in many centres. Few rural areas could boast such advanced technology. Most farms were served by wells for drinking water and privies for sewage disposal. Animal manures were simply stored in heaps, open to the action of rain and snow. These primitive waste management practices had little impact when the human population was widely scattered through the countryside, but

as the rural population grew, so did the degradation of wells and streams by bacteria and nitrogen compounds. Throughout the countryside, agricultural mechanization and intense farming practices had also taken their toll on the once-fertile soils. Erosion and soil loss became serious problems in some areas where the natural structure of the soil had been degraded by over-use. This problem continues to be one of the most serious facing agricultural areas today.

Into the Modern Era

Not surprisingly, construction of sewage and water works slowed considerably during the Depression years, the 1930s, when public funds were directed more to social services than the improvement of municipal infrastructure. The war years, however, brought special challenges and opportunities to Toronto. Shortages of materials and labour for non-military uses were obstacles for the major capital projects still needed by the growing city. On the other hand, wartime demand for chemicals, foodstuffs, armaments and other supplies created new opportunities for industrial operations. Where once the city's drains had carried mostly human waste and water, now the wastes of countless factories, processing plants and other industries flowed into the sewers too. The sheer volume of these wastes was staggering: a 1946-49 study conducted by the IJC showed that, in the Great Lakes overall, the oxygen demand (a measure of the decaying organic matter) of industrial wastes discharged into municipal sewers was equal to the oxygen demand of the untreated sanitary sewage from a population of four million people.

Clearly, new measures were needed to combat this problem. In 1943, the Ontario *Municipal Act*, was amended to allow municipalities to charge users directly for the use of water and sewage services. (Previously, all revenues had been drawn from taxes, but the tax base was no longer sufficient to support necessary improvements.)

By the mid-1950s, it was clear that water pollution control needed to be standardized at a provincial level. The growth of industrial centres such as Toronto and Sarnia and increases in capital costs and interest rates combined to put critical pressure on a resource Ontario — and Toronto — had always taken for granted. In 1956, the Ontario Water Resources Commission (OWRC) was established to oversee water supply and sewage treatment in the province. Through the 1960s, the Commission was instrumental in funding approved municipal projects, the costs of which could then be recovered by the OWRC through service charges to users. It was not until the late 1960s, when the impacts of phosphorus and nitrogen enrichment on lakes and rivers became clear, that the OWRC turned its attention to non-bacterial contaminants.

Nutrient problems had become especially serious in agricultural areas, where post-war use of fertilizers had increased phosphorus and nitrogen applications to, and losses from, farmland. In smaller tributary streams, warm summer temperatures combined with high levels of these nutrients, encouraging unsightly algae growth, whose thick mats clogged fish-spawning areas and lay rotted and stinking on river banks. Soil loss from farmland was also increasing, and farmers were forced to replace valuable topsoil lost to downstream waters or to wind erosion.

A province-wide phosphorus removal program was set up by the OWRC in 1971, along with other measures to reduce nutrient enrichment. As nutrient levels dropped, nuisance algae growth, which had been fed by the nutrients, also declined. The reduction in algae blooms also reduced the amount of oxygen-demanding decaying plant material in nearshore areas and allowed oxygen cycles to return to normal levels. Fish kills, once a common feature in oxygen-poor waters, were thus also reduced.

In 1972, the OWRC was integrated into a new Ministry of the Environment, which continues to work with the federal government, the International Joint Commission, and municipalities, to monitor water quality and reduce environmental contamination in the Great Lakes and elsewhere.

The RAP watersheds today

Ecosystem Processes

The Metro Toronto area of today is a sprawling, cosmopolitan place, almost unrecognizable as the tiny cluster of buildings that was York in 1793. According to a 1993 report — *The Outlook for Population and Employment in the Greater Toronto Area (GTA)* — about three and a half million people now live in the regions of Metro, York and Peel. Much of the Metro RAP area is contained in these regions, an area that was once natural beach, gently-sloping wooded hillsides and vast marshes. In many places, streets and buildings lie where streams once flowed to the lake — their waters long since diverted to convenient pipes and channels underground.

One hundred and fifty years ago, the greatest threat to the waterfront was nature itself: storms to break and recreate the shoreline, and fire to level and clear the forest. Now our greatest challenge is people: their transportation, their housing, their workplaces, and their wastes. The GTA reports, estimates that population in Metro, York and Peel Regions will exceed four and a half million by the year 2011 — a far cry from the 681 residents noted in the 1801 census. And, the ecosystem itself has changed dramatically, from its cycling of water and nutrients, to its physical and biological structure.

Physical Structure of the Ecosystem

Unquestionably the greatest of the changes sustained by the watershed have been in its physical structure: the replacement of a massive forest, with its dark shadows and muffled sounds, with hard surfaces of glass, steel, asphalt and concrete. The physical changes development has brought to the RAP area ecosystem are most obvious in the transformation of the watershed from a porous, naturally cycling system to a landscape of impervious roofs and pavement. Even in rural areas of much of the watersheds, human influences have changed the natural flow of nutrients and energy. Unlike the primeval forest, the solar energy and soil nutrients stored in agricultural fields are regularly removed from the field ecosystem to feed humans. To maintain the high levels of production, humans often subsidize nature, through additions of concentrated energy in the form of fertilizers and pesticides.

These changes, in turn, bring changes in the "micro-climate" of an urban centre. Some such changes were already apparent in the nineteenth century. The high water levels maintained by the spongy forest floor have dropped, and with them have gone the stagnant pools and marshes that so plagued the early settlers. Water levels in the harbour still fluctuate on a natural cycle, but now those water levels are also influenced by human control of dams at the eastern end of Lake Ontario.

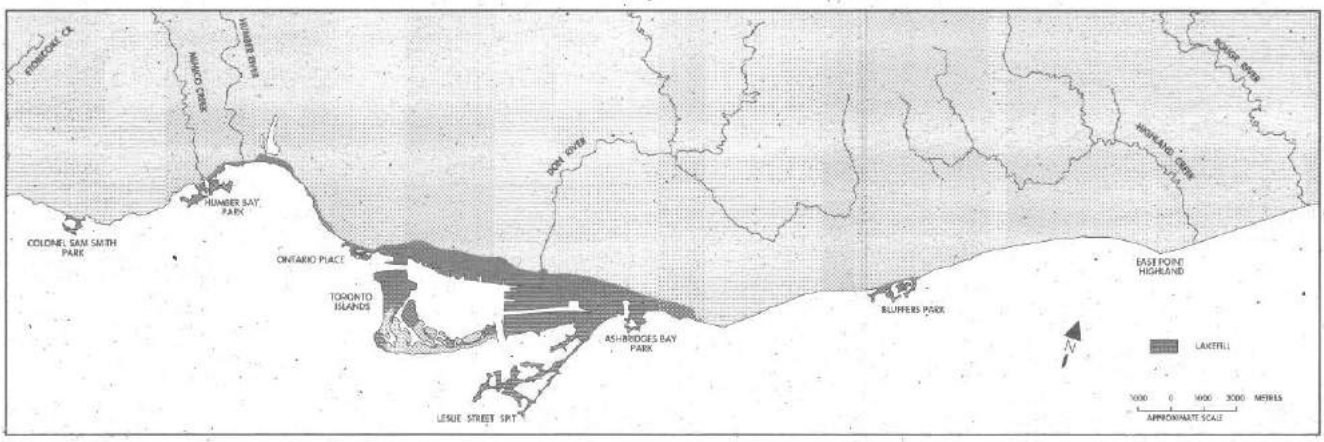


FIGURE 15: WATERFRONT LAKEFILLING: MUCH OF THE LAND ALONG THE WATERFRONT HAS BEEN FORMED BY LAKEFILLING.

The shoreline and curve of the original Toronto "Island" archipelago are also greatly changed (see Figure 15). Where once there was only a Western Gap near Gibraltar Point, now the busy harbour has both Eastern and Western Gaps, thanks to a combination of natural and human forces. The long curve of the Eastern Headland, or Leslie Street Spit, completely artificial, was not part of the 1793 landscape. Residents of the mid-nineteenth century had difficulty stabilizing shoreline areas on the Island and elsewhere and, although the storm-driven currents that move those shorelines still exist, now breakwaters, groynes and barriers protect the urbanized shoreline.

Water and Sanitation

In the modern city it is unthinkable that houses could function without running water or flushing toilets, yet only 75 years ago these amenities were uncommon. Now virtually all of our toilet, sink and washing waters are carried to a sewage treatment plant before they reach the lake. Rough but permeable roads have now been replaced by smooth, impermeable surfaces and rapid storm drainage. A vast network of roads, parking lots and rooftops — all effectively drained by sewers — now blocks rainwater from filtering into the earth's surface.

The combined sewers — the "drains" — that a hundred years ago served the sanitary needs of some residences and the storm drainage needs of main roads still exist in older parts of the urbanized watershed. These pipes were designed for the modest flows of an incompletely serviced population of 50,000 and are now much too small for the full sanitary and storm drainage of a population of 2.5 million. In older parts of the RAP area where these combined sewers are still in operation, basement and street flooding occasionally occur because the pipes are too small to handle all the flows at one time. This also results in overflows of untreated sanitary sewage into the lake and streams.

The Countryside

The primeval forests of the watershed are now long gone, but so are the endless agricultural fields of the 1880s. The rural landscape, once an unbroken mosaic of fields in cultivation, now looks quite different from a hundred years ago. Here and there, woodlots have been allowed to re-grow into impressive stands of timber. Industrial developments creep out onto what was once prime farmland. New housing developments advance steadily east, west, and north of the city. The tiny rural hamlets and villages that once linked farm owners throughout southern Ontario are slowly disappearing, replaced by the urban sprawl of cities. The farms themselves remain, but there are fewer of them, and the ones remaining are often large, commercial operations rather than small family farms.

Rural privies have mostly been replaced by septic systems. If these systems break down, human wastes can enter groundwater and contaminate drinking water drawn from wells. Groundwater can also receive leached wastes if livestock manures

are poorly managed or if fields are over-fertilized with natural or chemical fertilizers. In turn, groundwater seepage can affect the quality of surface waters in lakes and rivers. And in the country, as in the city, every time the earth is turned for construction or ploughing, some soil is lost to the air and the water.

The Health of the Watershed Ecosystem

The Metro Toronto and Region Remedial Action Plan Stage 1 Report: *Environmental Conditions and Problem Definition*, examined the nature and causes of ecosystem degradation in considerable detail. The interested reader is referred to that document for a more detailed discussion of environmental health.

Water Movement

Throughout the watershed ecosystem, flowing water carries discharges from human activities, resuspends and transports sediments, and provides habitat for fish and other biota. Understanding the patterns of water movement therefore helps us to understand how pollutants move through, or accumulate in, the watershed ecosystem.

Many factors influence the volume of water moving in the system, and the speed at which it moves. In the modern Metro watersheds, water movement in rivers and creeks is strongly influenced by rainfall and snowmelt. The effects of rain and snow occur not only through precipitation falling on the rivers, but also through discharges of stormwater drained from streets and parking lots. In the early days, the dirt roads and small area of settlement meant that most rainfall filtered gradually into the land surface, so that natural surface and groundwater drainage patterns remained largely unchanged. In the modern urbanized watershed, most stormwater flows and snowmelt are drained away from roads and rooftops as surface runoff. This runoff is diverted to storm sewers, for subsequent discharge to receiving waters. As a result, much less water re-enters the groundwater system through the land surface, while much more enters directly into rivers and the lake. The reduction in groundwater recharge is of concern in parts of the watershed that rely on groundwater as their supply of water and where the goundwater systems impacted represent a significant source of baseflow in streams. Groundwater discharge, or seepage, zones also form the basis for a diversity of vegetation communities including localized wetland ecosystems.

In a heavy storm, rainwater falling on hard surfaces is quickly drained away to receiving waters. Natural drainage patterns are therefore replaced by much faster storm flows. This causes river flooding, and rapid transport of street dirts and pollutants to the aquatic environment. In some areas, streams have been diverted to sewers to improve drainage and allow development in areas that would otherwise be wetlands. In others, stream channels have been artificially lined with concrete to control erosion or otherwise channel flows; these "channelized" streams typically have much smoother stream beds, and thus much faster flows, than are present in natural channels.

Water movement along the waterfront is influenced by many factors, but primarily by wind conditions, seasonal temperatures, and the shape of the shoreline itself. Water movements are as variable as the weather conditions they reflect, and the patterns observed one day may be strikingly different on the next. Generally speaking, however, water circulation along the waterfront is from east to west in the summer and from west to east in the winter. Most areas along the shore are protected from lake currents by natural or artificial structures. In these areas, it is not unusual to find slower water movements and accumulations of finer sediments, and with them higher concentrations of pollutants.

During the summer months, warm air temperatures heat the surface waters of the lake, while deeper waters remain cool. In the winter, the reverse is true: the lake surface may be frozen while bottom waters remain somewhat warmer. The different temperatures create lake layers with different densities, and thus different mixing potential. An effluent discharged into cool, dense waters may not mix as effectively as one entering warmer, less dense waters.

Water Quality

Surface and groundwater quality throughout the Metro Toronto watersheds reflects the considerable human use of adjacent watershed lands. In older areas, close to river mouths, pollutant concentrations tend to be higher than in upland areas, mostly because of the dense population, the presence of sewage treatment plants, and more numerous combined sewer overflows.

Water quality data from the 1980s shows that the rivers are often turbid, or murky, and have high levels of nutrients such as phosphorus and nitrogen. These nutrients can encourage nuisance weed and algae growth, if suitable habitat is present. This increased biological activity in turn causes an increase in demand for oxygen in the stream. In some areas, for example in some locations in the lower Humber River, night time oxygen levels can drop below those needed to support fish life.

Fish life is also affected by toxic discharges of ammonia, a natural constituent of human sewage, and chlorine, used to kill bacteria in sewage treatment plant discharges. Toxic organic pollutants and heavy metals such as copper and lead are also present, sometimes above desirable levels, but their long-term impact on fisheries is not well understood.

Near combined sewer overflows and storm sewer discharges, high levels of bacteria are sometimes also present. These sources are strongly influenced by rainfall conditions, so instream bacterial levels are observed to rise during a storm, gradually returning to normal once the rain has stopped. It may take 24 to 48 hours for normal conditions to be restored.

Water quality samples from the waterfront, not surprisingly, show strong linkages to river water quality. Bacteria and nutrients (phosphorus and nitrogen) are often above desirable levels across the waterfront area. Sewage treatment plant discharges are the major contributors of nutrients, while storm sewers and combined sewer overflows (whether discharging to the waterfront directly or via its tributary streams) contribute most of the bacteria. Phosphorus concentrations have declined steadily over the past twenty years and although they still exceed desirable levels in many locations, algae blooms and nuisance aquatic weed growth are seldom observed along the modern waterfront.

The impacts of bacterial contamination are more serious and immediate. Bathing beach closures are now commonplace in Toronto. Generally speaking, beaches are posted as unsafe for swimming when the number of bacteria in the water reach a threshold level (in our area, 100 *Escherischia coli* organisms per 100 millilitres of water). Beach closures are also a problem in rural areas of the watersheds, where the Ministry of Environment and Energy operates a program called Clean Up Rural Beaches (CURB). Many factors can influence the bacterial levels observed on a particular day, including wave action, water currents, combined sewer overflows, storm sewer discharges, direct storm runoff and warm temperatures. Combined with varying sampling procedures and a change in the standard used in recent years, it is practically impossible to track improvements or declines in water

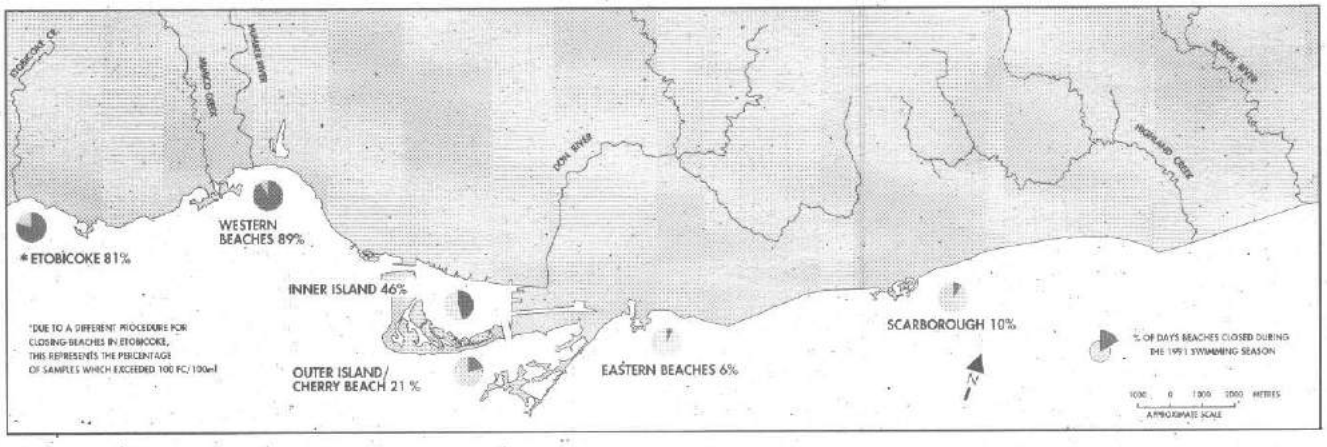


FIGURE 16: 1991 BEACH POSTINGS ALONG THE METRO WATERFRONT (AS A PERCENTAGE OF SWIMMING SEASON)

Box 14: The Eastern Beaches Detention Tank

Over the years, the Metro waterfront has seen a steady decline in the quality of water at bathing beaches. Beach closures now seem more frequent than open bathing days. Even though many remedial measures are underway in the watershed, most areas have seen little improvement in beach pollution.

One exception is the Eastern Beaches. In 1990, the City of Toronto constructed a detention tank to collect discharges from several storm sewers and overflows from one combined sewer in the western portion of the Eastern Beaches. Part of the project involved monitoring the beaches to verify the effectiveness of the tank. This monitoring has shown that Woodbine Beach and Beaches Park, which are protected by the tank, have more open bathing days than do unprotected beaches in the same area. The City of Toronto plans to build another detention tank in the same area if the first tank continues to be effective in limiting beach pollution.

quality over the short-term. Figure 16, however, indicates the seriousness of the beach posting problem across the Metro waterfront, particularly in the Western Beaches area. The Eastern Beaches have been afforded some protection from the Eastern Beaches Detention Tank (see Box 14).

Elevated concentrations of heavy metals and trace organic compounds are also found in some areas of the waterfront, particularly near the river mouths, sewer and sewage treatment plant discharges, or areas where water circulation is poor. Away from these sources, water quality is generally good, and improves with increasing distance from the shore. In areas where water circulation is restricted, for example in Humber Bay and the Toronto Inner Harbour, contaminant levels are generally higher (see Figure 17).

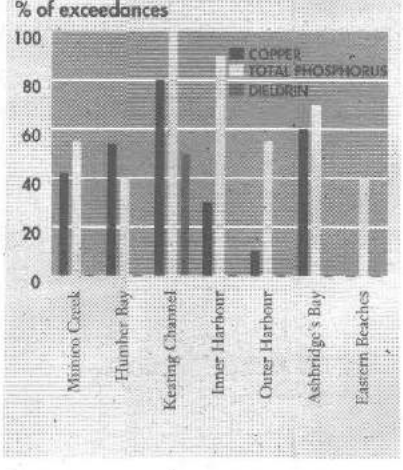
Routine monitoring of untreated lake water drawn from drinking water intakes shows the occasional presence of mercury, barium, copper, zinc and nickel at levels well below drinking water objectives. Traces of the pesticides lindane, atrazine and DDT or their breakdown products are also found on rare occasions. No polychlorinated biphenyls (PCBs) or polynuclear aromatic hydrocarbons (PAHs) were detected in untreated water supplies at any Toronto drinking water treatment plant. Treated water supplies are also of excellent quality, although, again, trace quantities of certain heavy metals and organic contaminants are occasionally found. Rarely has treated drinking water been found to exceed any guidelines for organic or inorganic substances; however guidelines do not exist for all the substances found. As shown in Table 8 on pages 82-83, the drinking water quality in the Metro Toronto RAP area is not impaired.

Lake Sediments

Just as the patterns of water circulation vary across the waterfront area, so do patterns of sediment accumulation, and thus the levels of pollutants associated with those sediments. Major influences on sediment quality include discharges from the sewage treatment plants into Ashbridge's Bay and Humber Bay, and from the Don and Humber Rivers. As with water quality, sediment quality tends to be poorest where water circulation is restricted, such as in the Inner Harbour and Humber Bay. By contrast, areas with good water circulation, such as the eastern portions of the waterfront, have the cleanest sediments, while the Outer Harbour shows zones of moderate contamination.

Comparison of observed sediment quality with new provincial guidelines suggests that the most sensitive uses may be affected in depositional areas, but that severe effects are only likely in a few locations in the Inner Harbour, and portions of Ashbridge's Bay and Humber Bay. Figure 18 shows the distribution of sediment contamination across the waterfront area.

Figure 17: Copper, Total Phosphorus and Dieldrin Exceedances of the Provincial Water Quality Objectives



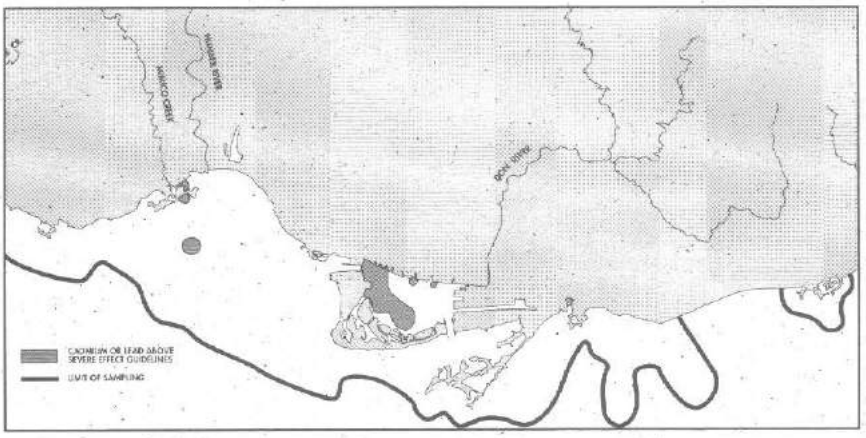


FIGURE 18: SEDIMENT CONTAMINATION ACROSS THE METRO TORONTO WATERFRONT

Aquatic Life

A healthy aquatic ecosystem contains several types of organisms. Certain species are more pollution-tolerant than others, so systems that contain those species and few others suggest polluted conditions. The particular species mix of each system therefore provides important clues as to the health of the system and its potential for recovery.

Figure 19 illustrates a food web (made up of many interrelated food chains) typical of aquatic environments such as the Metro Toronto waterfront. At the base of a food chain are the floating algae or *phytoplankton* — microscopic plants suspended in the water that provide food for tiny herbivorous animals. These tiny animals — the *zooplankton* — graze on the phytoplankton and therefore take up any toxins present in the water or in phytoplankton tissue. Since some toxins cannot be easily eliminated from body tissues, they gradually accumulate in the bodies of these prey species until they are eaten by the next level in the food chain, in this case mainly fish, but also including humans who eat fish and shellfish. Organisms at the lower levels in the food chain must eat many zooplankton organisms to survive, thus ingesting still larger doses of accumulated toxins. There may be several tiers in a food chain: minnows feeding on zooplankton, perch feeding on minnows, and trout feeding on smaller fish. Each level feeds on the one below, receiving a concentrated dose of the accumulated pollutant. At the top of a food chain are humans or fish-eating birds, who catch and eat the largest, oldest fish such as salmon and trout, and with them take up contaminants that have accumulated progressively through several feeding levels. What may have been a dilute and innocuous concentration of contaminants in water or phytoplankton tissue can be a significant health risk to a larger organism.

The aquatic food web also contains bottom dwelling detritus feeders, generally classed as *benthic (bottom dwelling) invertebrates*. Because they live in or on the sediments, this group of organisms can be particularly valuable in assessing the impact of pollution sources on aquatic ecosystem health.

Historic records show that phytoplankton levels showed a gradual increase in number of organisms, coupled with a decrease in number of species, over the past 70 years. Although conditions have improved somewhat in recent years, the species mix still contains many types that favour nutrient-enriched conditions, particularly in the Inner Harbour and where temperature layers in the lake limit the dispersion of nutrients. Zooplankton studies show more stable zooplankton populations, despite the introduction of programs such as lake-wide phosphorus reduction initiatives and fish stocking. Water movements induced by wind and weather conditions clearly have a strong influence on the distribution of species through the water at any point in time.

Benthic invertebrates, because they are less influenced by water movements and lake-wide effects, provide valuable insights into ecosystem impairment in the waterfront. Areas showing the highest levels of contamination occur inside Toronto Harbour, at Ashbridge's Bay, and in Humber Bay. Once again, the Outer Harbour and Eastern Headland areas are intermediate in apparent impact. Deeper waters off Humber Bay and the Toronto Islands contain communities more typical of uncontaminated environments.

Young-of-the-year fish studies use small fish less than a year old — usually minnow species — to assess contaminant uptake in local areas. The small size of these animals, and

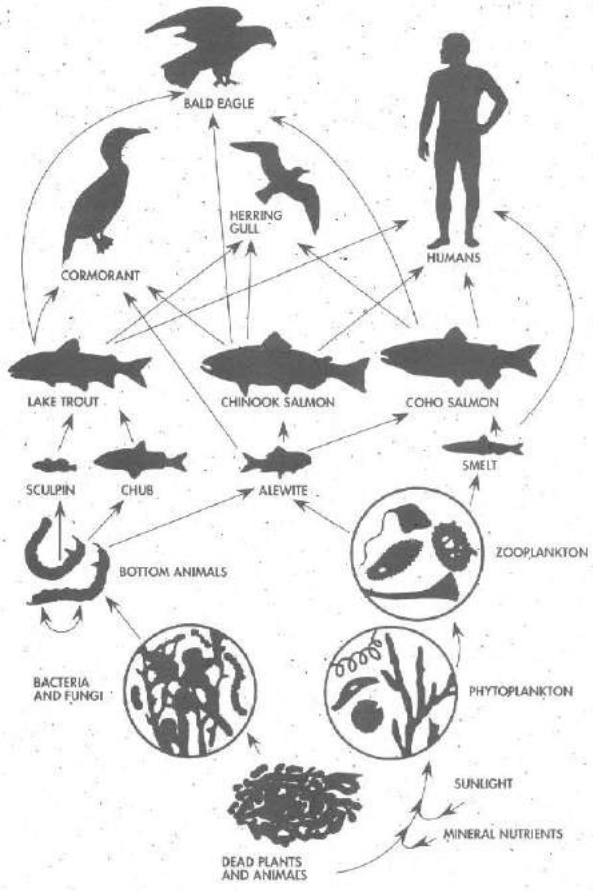


FIGURE 19: TYPICAL AQUATIC FOOD WEB: TOXINS TEND TO ACCUMULATE AT EACH LEVEL OF THE CHAIN (SOURCE: *Great Lakes, Great Legacy?*, THE CONSERVATION FOUNDATION)

their limited movement, makes them useful as indicators of the presence of local pollution sources. Data from 1977 to the present show highest contaminant uptake to be occurring in Humber Bay, with the lowest off Bluffers Park and in the Rouge River. Residues of PCB, DDT, lindane and chlordane have declined significantly in all areas since the 1970s.

Contaminant levels in sport fish have been monitored for almost 30 years in Ontario. Although humans are still advised not to eat the larger sizes of some fish species taken from the Toronto waterfront because of mercury, PCB and Mirex contamination, contaminant concentrations in fish tissue have dropped dramatically over the past ten years. These large fish travel long distances over their lifespans, making it difficult to separate the influence of local pollution sources from lake-wide effects. Figure 20 illustrates declines in PCB levels found in white suckers from 1975 to 1992.

Fisheries Resources

Two hundred years of human activity have greatly changed the waterfront fish community. The impacts have arisen from the combined effects of overfishing, habitat destruction, and water pollution from rural, industrial and urban sources. At least 50 species of fish were present in the harbour before the arrival of European settlers; at least eleven more have been introduced since then. By the end of the 19th century, Atlantic salmon was extinct in the area, and muskellunge, walleye and sturgeon were locally extinct or rare, and lake trout, lake herring and whitefish populations were considerably reduced. Native fish populations have also been affected by the introduction of foreign species, such as alewife, smelt, carp, salmon and rainbow trout. In some cases, these exotic species were introduced intentionally, in an effort to improve local fishing opportunities; in others, the introduction was accidental, but may nevertheless have had far-reaching impacts on the fish community.

Over the past decade, several activities have helped to reverse the decline of the fisheries. Reductions in pollutant discharges from sewers and sewage treatment plants, fish stocking programs and fish habitat protection and rehabilitation are helping to offset losses in fish populations. Remnant cold water fisheries have been protected in several headwater streams and seasonal migrations of coho and chinook salmon, brown and rainbow trout occur in both the Humber and the Rouge Rivers. In some areas, smaller streams such as Etobicoke Creek,

FIGURE 20: 1975-1992 MEAN PCB LEVELS IN WHITE SUCKERS FROM HUMBER BAY

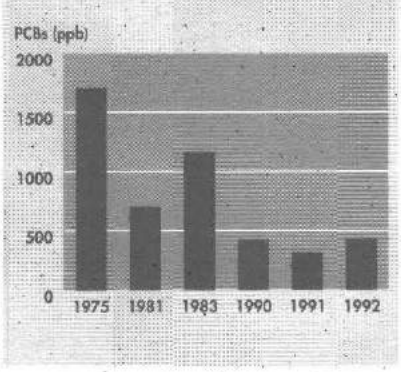
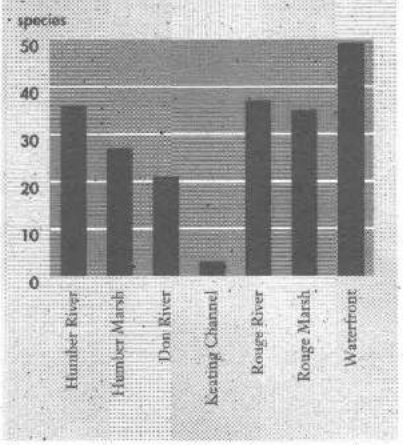


FIGURE 21: NUMBER OF FISH SPECIES
Based on: Metro Toronto and Region RAP Stage 1 and J. Buchanan, MNR (personal communication)



Mimico Creek and Highland Creek, support a limited number of warm water fish species. Figure 21 shows the number of fish species present in different parts of the Metro RAP area based on similar sampling efforts in each area.

River mouths and bays and their associated wetland areas continue to provide important spawning and rearing habitat for many cool and warmwater species (such as northern pike and bass). The Humber Marshes and the Rouge Marsh along with the Toronto Islands sustain native species despite numerous urban stresses.

Historically, open coast shorelines contained important coldwater spawning beds but some of these have been degraded as a result of shoreline alterations. Coldwater spawning beds have also been degraded by water quality problems, in particular increased sedimentation and algal blooms resulting from high levels of phosphorus and nitrogen. Coldwater fishes such as trout and salmon are no longer self sustaining in our area and are maintained by stocking programs. Open coast shorelines also support forage fish (alewife, smelt), an important food source for the coldwater fishery.

Some fish species are present in all parts of the Metro Toronto waterfront, even in the seriously degraded Keating Channel at the mouth of the Don River. These areas support pollution tolerant species such as white sucker and carp.

Birds

Although much of the original marsh habitat has now been drained or altered, areas of the Metro Toronto waterfront and neighbouring areas of the Lake Ontario shoreline remain important for waterfowl breeding, staging and overwintering.

Of particular importance is the Eastern Headland (also known as Leslie Street Spit or Tommy Thompson Park), which provides breeding territory for more than 40 species of birds, including 5 colonial nesting species. This site is also an important staging area for migrating birds and is part of one of the major migrational corridors through the Metro Region. In total, 290 bird species have been observed at Tommy Thompson Park. (The following section "Fish and Wildlife Habitat" contains further information about the history of the Headland and its role in providing habitat.)

Among the most frequently sighted bird species along the waterfront are Canada geese, whose large numbers and aggressive behaviour now pose a nuisance in many public areas. The potential for water quality impacts of faecal material from these large birds, and from the roughly one hundred thousand ring-billed gulls that breed in the area is a matter of some concern. The limited data available suggest that impacts on bathing beaches are probably small, but further research would be required to determine the importance of this pollution source.

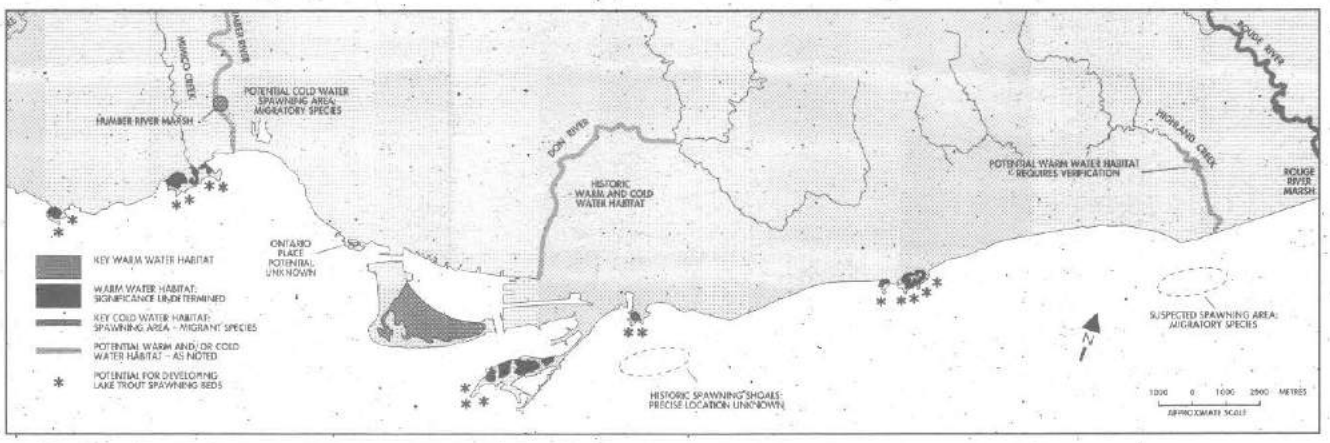


FIGURE 22A: FISH HABITAT ALONG THE METRO WATERFRONT (FROM: METRO WATERFRONT ENVIRONMENTAL STUDY, 1992)

As top predators, fish-eating birds are especially vulnerable to the effects of toxins that have accumulated through the food chain. Concentrated levels of pesticides such as dieldrin and DDT have been linked to eggshell thinning and related reproductive failure in herring gulls, for example. Congenital abnormalities have also been observed in fish-eating birds from Lake Ontario, although the incidence rates for most species have shown a marked decrease since the early 1970s.

Fish and Wildlife Habitat

The watershed and waterfront areas contain much habitat that has been altered or degraded from its natural condition. In upper watershed areas, agricultural activities have led to widespread clearance of the forest and drainage of wetland areas. Some forest and marshland habitat remains, and many opportunities exist for protecting and restoring potential habitat sites.

In the lower watersheds, urban influences have been more important than agricultural impacts, at least in the last hundred years. One of the most important impacts has been fragmentation of natural stream valley habitats that once provided corridors for wildlife movements. Recently, the Metropolitan Toronto and Region Conservation Authority (MTRCA) introduced a Valley and Stream Corridor Management Program, designed to restore the habitat and continuity of Metro Toronto's river valley systems.

Aquatic habitat has also suffered degradation and destruction throughout the watersheds and waterfront. In many areas, naturally occurring marshes have been drained and filled to support development or farming. River sands and gravels, important spawning habitat

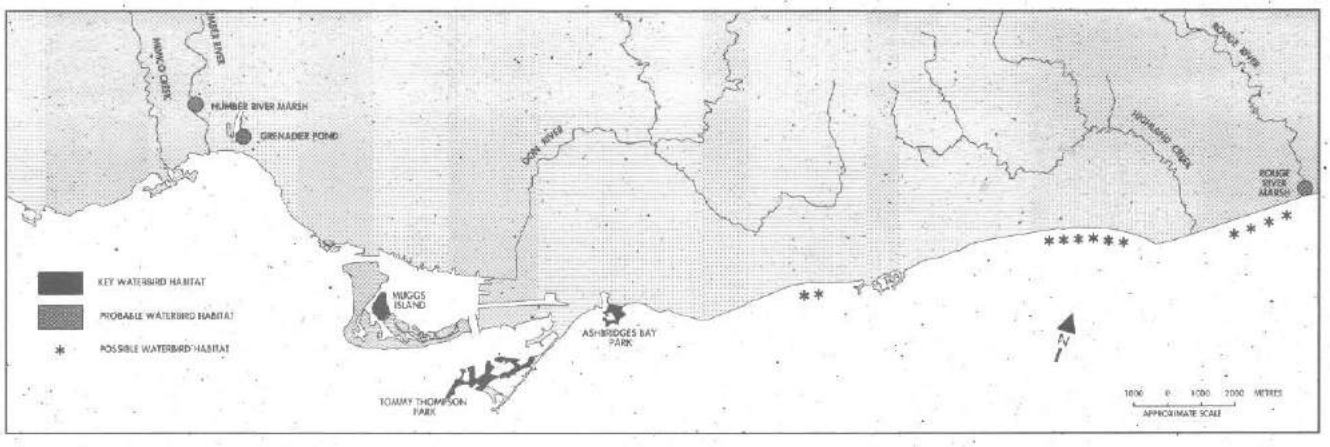


FIGURE 22B: AQUATIC BIRD HABITAT ALONG THE METRO WATERFRONT (FROM: METRO WATERFRONT ENVIRONMENTAL STUDY, 1992)

for some fish species, have been coated with finer sediments from construction activities, stormwater flows, and similar sources. MTRCA and the Ontario Ministry of Natural Resources have several programs (eg. Fishways, aquatic habitat inventories, Community Fisheries Involvement Program) geared to habitat restoration, in both terrestrial and aquatic systems. Groups such as the Don Watershed Task Force, Save the Rouge Valley System, and Action to Restore a Clean Humber are tackling habitat issues throughout particular watershed systems.

Some relatively natural habitat areas remain. The Rouge Marsh and the Toronto Islands habitats are examples of such natural areas, as are some areas of the Scarborough Bluffs and the deep water habitat off East Point. Figure 22 shows existing and potential fish and aquatic bird habitat along the Metro waterfront. Headwater areas such as the Albion Hills, located in the Oak Ridges Moraine, have large continuous tracts of forest and high quality streams. These areas provide a diversity of habitat and wildlife, having received limited human impact relative to other parts of the watershed.

New habitat has also been created in the waterfront area. One of the most important of such areas is the Toronto Eastern Headland (Tommy Thompson Park). The Headland is an artificial structure composed of material excavated from area construction sites. It was begun in the late 1950s with the purpose of creating an Outer Harbour for commercial shipping purposes, and also to provide a disposal site for fill during one of the city's fastest periods of growth. Although it was not originally envisioned as a wildlife refuge, it has proved highly attractive to numerous species of birds and mammals, some of them rare. The Eastern Headland provides important nesting space and a migration stop over for wide variety of birds. The area supports nesting colonies of common terns, double-crested cormorants, black-crowned night-herons and herring gulls along with a large ring-billed gull population. The Headland also supports at least 17 species of mammals including red fox, beaver, coyote, mink, raccoon and muskrat.

Impaired Uses

Table 8 provides a summary of the state of the environment across the Metro RAP area based on the 14 beneficial water uses that may be endangered or impaired as defined in the Great Lakes Water Quality Agreement. It is the restoration of these uses, through the clean-up of the area, which will restore a healthy aquatic ecosystem.

TABLE 8: IJC USE IMPAIRMENTS IN THE METRO TORONTO AND REGION RAP AREA

POTENTIAL IMPAIRED USE (AS DEVELOPED BY THE IJC)	STATUS	SIGNIFICANCE TO METRO TORONTO & REGION
Restrictions on fish or wildlife consumption	I	Local and lake-wide influences have led to contamination of tissues with mercury, PCB and Mirex; consumption restricted
Tainting of fish and wildlife flavour	NI	No reports of tainting
Degradation of fish and wildlife populations	I	Historic degradation and loss of species dating back to the 1800s, continued impact from urbanized area today

The RAP watersheds today

POTENTIAL IMPAIRED USE (AS DEVELOPED BY THE IJC)	STATUS	SIGNIFICANCE TO METRO TORONTO & REGION
Fish tumours or other deformities	RFA	Recent studies are limited in scope; while tumours are occasionally found in sampling programs, their significance and cause is unknown (may be local or lake-wide effects); tests of the Main STP effluent have shown it to be non-mutagenic
Bird or animal deformities or reproductive problems	RFA	Reproductive rates of several species are normal; incidence of deformities and pesticide residues in gulls' eggs have declined
Degradation of benthos (bottom dwelling invertebrates)	I	High densities of pollution-tolerant species (some improvement noted recently); benthos accumulate metals and organics and may transmit them up the food chain
Restrictions on dredging activities	I	Sediments in most bays exceed disposal guidelines; dredging subject to environmental assessment in the past and probably in future
Eutrophication (nuisance algae blooms)	I	Phosphorus often exceeds desirable levels; algal and weed problems limited to western beaches
Restrictions on drinking water consumption	NI	No restrictions, based on current monthly sampling for 160 parameters; no reported taste or odour problems
Beach closings	I	Frequent beach closings as a result of stormwater- and combined sewer overflow-related bacterial contamination
Degradation of aesthetics	I	Debris and litter reduce aesthetic value; turbidity a problem near river mouths and lakefilling operations; weed growth a concern in western area
Added costs to agriculture or industry	NI	No evidence of impairment
Degradation of phytoplankton and zooplankton populations	RFA	Communities affected by lakewide factors, water circulation and pollution; significance of local sources unknown
Loss of fish and wildlife habitat	I	Historic and continuing loss of habitat; contamination of existing or newly created habitats a concern

LEGEND:
I = IMPAIRED NI = NOT IMPAIRED RFA = REQUIRES FURTHER ASSESSMENT

Sources of Pollution

There are many ways that pollution gets to the lake and its tributary streams. The most important of these are:

- contaminated urban and rural stormwater runoff, either directly overland or through the storm sewer system,
- combined sewer overflows, and
- contaminated discharges from sewage treatment plants.

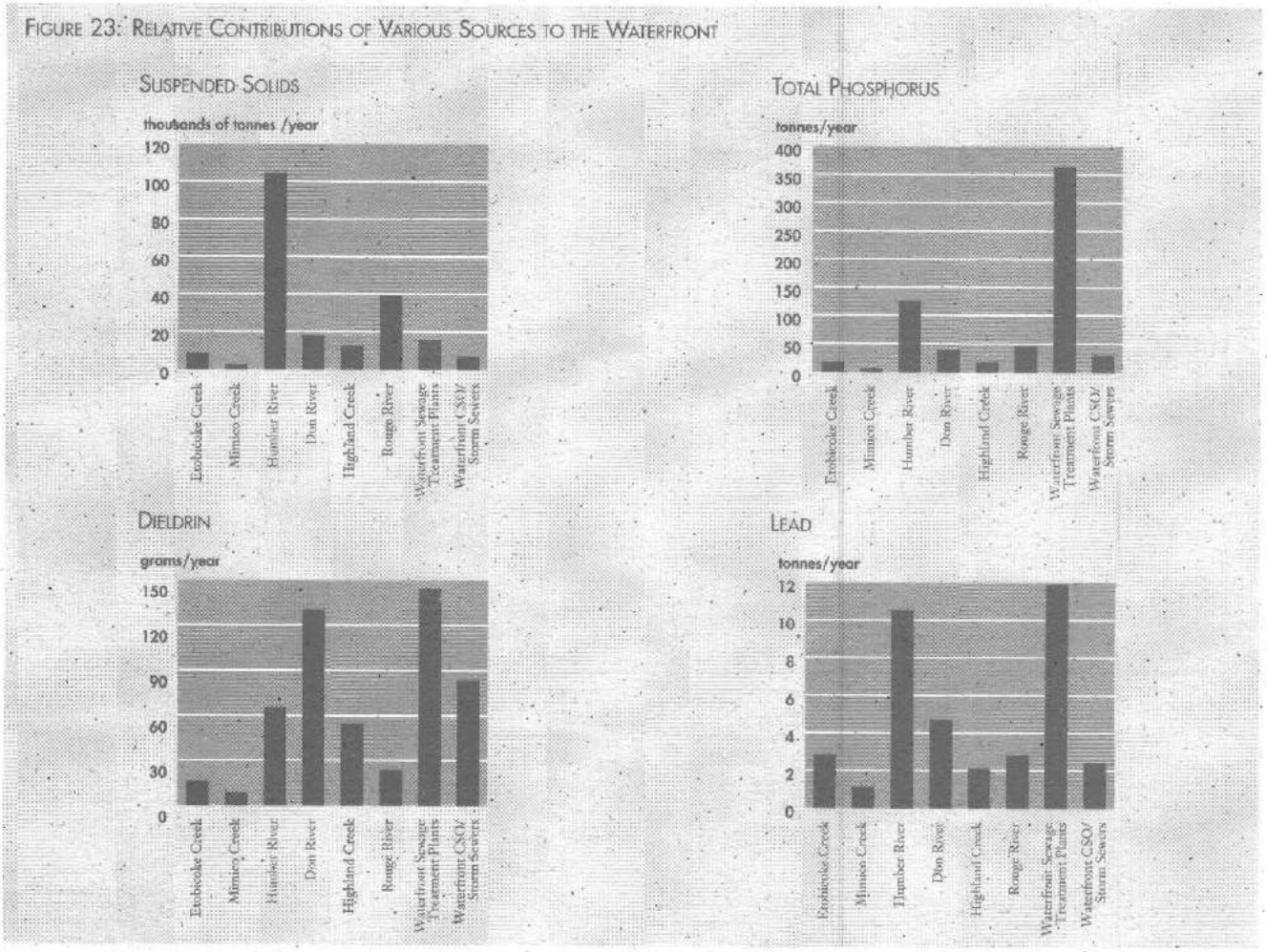
Other pathways include:

- direct fallout from air,
- resuspension of contaminated sediments, and
- lakewide sources.

At present, there are no direct discharges of industrial wastewaters to the lake or rivers in the RAP area. Although many industries operate within the boundaries of the watershed, all of them discharge wastes through the municipal sanitary and combined sewer systems. These "indirect" pollution sources are important contributors of heavy metals and trace organic substances to municipal sewage. Sewage treatment plants are not designed to remove these so-called "priority pollutants," which can therefore pass through the treatment process and be discharged with effluents into receiving waters. Combined sewer overflows and storm sewer discharges can also contribute industrial chemicals to the waterfront, although these sources are thought to be much smaller than loads from the treatment plants and the rivers. Household hazardous wastes — waste solvents, paints, cleaning fluids and similar materials — also enter receiving waters via the sanitary and combined sewer systems.

Figure 23 shows the relative contribution of watersheds; sewage treatment plants; and storm and combined sewers to the Metro

FIGURE 23: RELATIVE CONTRIBUTIONS OF VARIOUS SOURCES TO THE WATERFRONT



waterfront for four typical pollutants. Although the importance of these various sources differs by pollutant, several important patterns are apparent.

First, watershed contributions are the largest component of the total loads for suspended solids. Watershed loadings are dependent on the size of the watershed and the amount of human activity in the area. For example, while the Humber delivers over twice as many solids to the waterfront than the Don, it is also over twice the size of the Don watershed.

Loadings of phosphorus to the waterfront are dominated by the discharges from the sewage treatment plants. As expected, these parameters are more related to municipal sewer use, and thus a greater fraction of the load is delivered through the sewage treatment plants.

Loadings of lead and dieldrin (a trace organic contaminant) are mostly attributable to the larger and more developed watersheds and the sewage treatment plants. These contaminants are associated with heavy human activity and enter the environment through several pathways.

The loading of pollutants from waterfront storm and combined sewers illustrates the significant impact of this highly developed area. Although this area is much smaller than the Rouge Watershed, it delivers an equivalent or greater load of pollution to the waterfront.

Several watershed studies within the Toronto area, including the Strategy for Improvement of Don River Water Quality (see Box 15) have examined pollutant loadings within the watersheds.

Figure 24 shows how loadings to the Don River are affected by rainfall conditions. In both sections of the watershed, pollutant loading is highest during larger storm events. The heavily urbanized lower Don watershed produces significantly higher pollutant loads than the upper Don watershed. Urban runoff from the Don River watershed is a major contributor of suspended solids, lead and other contaminants. High faecal coliform loadings in the lower Don are also a result of combined sewers overflows, particularly in larger storm events.

As noted earlier, the majority of the information presented in this chapter was drawn from the RAP Stage 1 Report: *Environmental Conditions and Problem Definition*. Detailed technical studies to update information in the Stage 1 Report have been underway for some time. Several technical reports have been completed and include:

- *Dry Weather Discharges to the Metropolitan Toronto Waterfront*
- *Metro Toronto Waterfront Aquatic Habitat Rehabilitation*
- *Partial Characterization of the Metropolitan Toronto Nearshore Aquatic Environment: A G.I.S Approach*
- *Toronto Main Sewage Treatment Plant MISA Pilot Study Site Study Component Report: Water Quality*

These reports can be obtained from the Metro Toronto and Region RAP office. The RAP is also leading the development of an update to the Stage 1 Report, to provide an update on the status of the environment and provide a more integrated analysis of ecosystem health. The report, which will provide technical support to this plan, is expected to be completed within the next year.

Box 15: Don River Water Quality

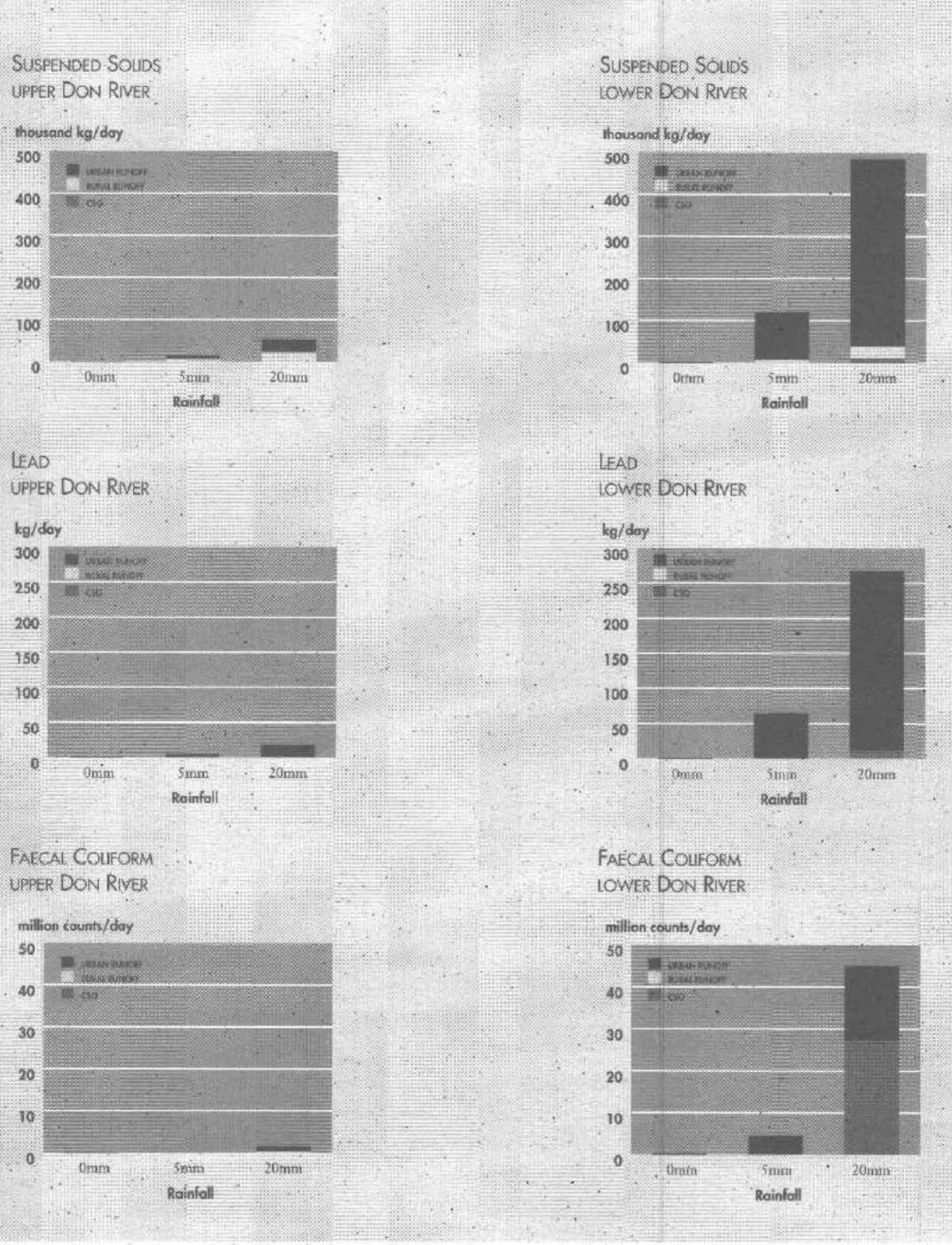
The Don River has long been the focus of development for the growing community and its thriving industrial base. Not surprisingly, the modern Don is a somewhat sorry sight. In its lower reaches, combined sewer overflows and storm sewer discharges line its banks. A sewage treatment plant discharges into its waters. Snow dumps add road salts and grit in the winter months.

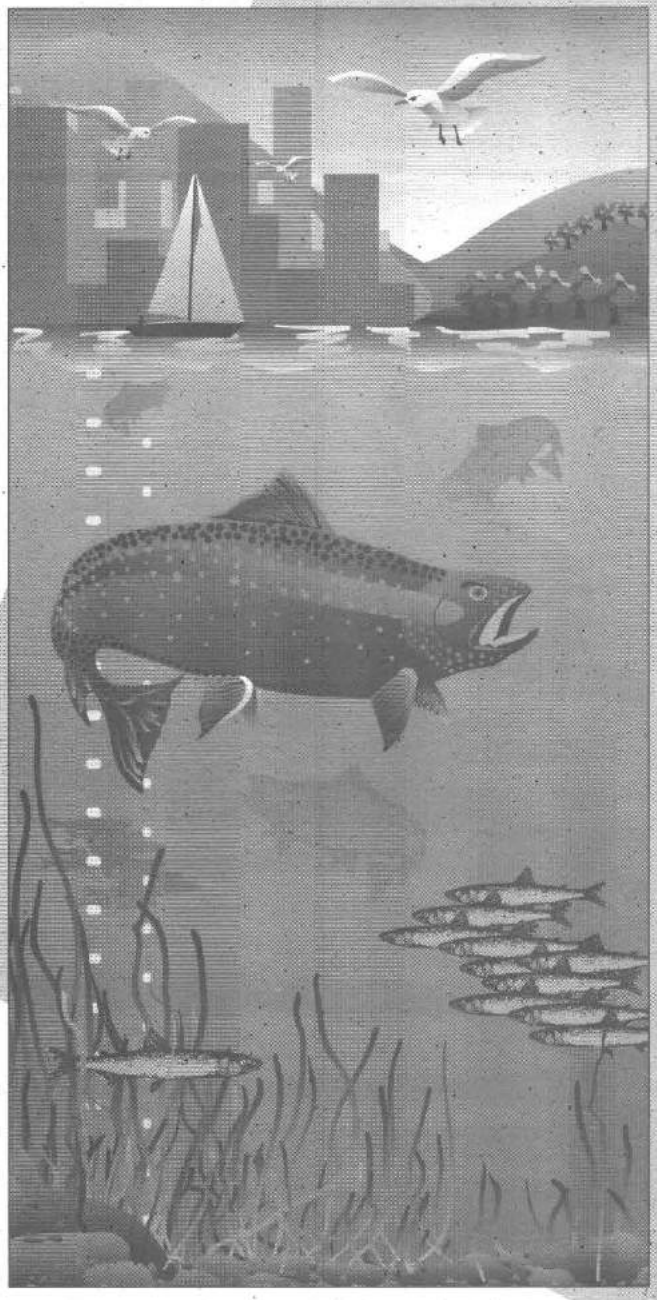
But perhaps because it is so valued by Toronto residents, the Don has also been the focus of considerable research and planning over the years. Most recently, studies by the Toronto Area Watershed Management Strategy Study yielded extensive information on water quality in dry weather and during rainfall events. Several computer models have been used to simulate river flows and examine the potential for pollution reduction under different remedial measures.

In September, 1989, the Ministry of the Environment released its ***Strategy for Improvement of Don River Water Quality***, a comprehensive set of studies that identify the sources of Don River water pollution, possible control options, their effectiveness, and their cost. The Strategy presents a three-phase plan for restoring river water quality, including immediate, short term (5-10 year time frame), and longer term actions.

The Don River Study, like many other ongoing actions in the study area, provides an important foundation on which to build the larger Metro Toronto and Region Remedial Action Plan.

FIGURE 24: POLLUTANT LOADINGS TO THE DON RIVER: LOADINGS ARE SIGNIFICANTLY HIGHER IN THE LOWER (A) VERSUS THE UPPER (B) DON RIVER WATERSHED. LOADINGS INCREASE DURING WET WEATHER EVENTS.





APPENDICES

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How to find more information on specific actions

Most of the actions listed in Chapter 3 appeared originally in the *Draft Discussion Paper on Remedial Options*. The options have undergone considerable review as a result of workshops and written or verbal comments received. The results of two major reviews were contained in the *Technical Advisory Committee Synopsis* and the *Public Advisory Committee Review*. Further information on specific actions may be obtained by referring to the sections indicated in the following documents. Page numbers are listed in [ ] brackets.

1. Metro Toronto & Region Remedial Action Plan, *Draft Discussion Paper on Remedial Options*, September 1988.
2. *Technical Advisory Committee Synopsis*
3. *Public Advisory Committee Review*
4. *MTRCA/MNR Rewrite of Options 4.1.4, 5.4.1,2,3,4*

These reports are available from the Metro Toronto and Region RAP Office.

ACTIONS	DRAFT DISCUSSION PAPER	TECHNICAL ADVISORY SYNOPSIS	PUBLIC ADVISORY REVIEW	MTRCA/ MNR REWRITE
STORMWATER				
1. Improve Industrial/Commercial/ Institutional (ICI) Best Management Practices (BMPs)	Sect. 3.1.3 [3-16—3-23]	Sect. 3.1.3 [35—37]	Sect. 3.1.3 [16,29—30]	
2. Improve Spills Response and Prevention	Sect. 3.1.2 [3-9—3-15]	Sect. 3.1.2 [33—35]	Sect. 3.1.2 [29—30]	
3. Improve Controls on Agricultural Practices	Sect. 3.3.1 [3-30—3-40] & 4.1.5 [4-25—4-34]	Sect. 3.3.1 & 4.1.5 [39—42]	Sect. 3.3.1 [31—32]	
4. Reduce Sediment from Construction Activities	Sect. 4.1.3 [4-14]	Sect. 4.1.3 [51]	Sect. 4.1.3 [10,17,35]	
5. Trace and Disconnect Industrial/Commercial/ Institutional (ICI) Cross Connections	Sect. 3.1.1 [3-1—3-9]	Sect. 3.1.1 [32—33]	Sect. 3.1.1 [28—29]	
6. Trace and Disconnect Residential Cross Connections	Sect. 2.2.2 [2-50—2-63]	Sect. 2.2.2 [28]	Sect. 2.2.2 [25—26]	
7. Construct Pilot Stormwater Ponds and Develop Design Criteria	Sect. 4.3.2 [4-80—4-88]		Sect. 4.3.2 [40—41]	
8. Create Wetlands for Treating Stormwater			Sect. 4.3.2 [17,40]	
9. Improve Erosion Control to Reduce Sediment	Sect. 4.1.4 [4-19—4-25]	Sect. 4.1.4 [46—47]	Sect. 4.1.4 [34—35]	Sect. 4.1.4 [1—8]
10. Improve Catchbasin Design and Cleaning Practices	Sect. 4.1.1 [4-2—4-9]	Sect. 4.1.1 [42—43]	Sect. 4.1.1 [34—35]	
11 Ensure Proper Handling of Contaminants at Snow Disposal Sites			Sect. 4.1.1 [17,34—35]	

How to find more information on specific actions

ACTIONS	DRAFT DISCUSSION PAPER	TECHNICAL ADVISORY SYNOPSIS	PUBLIC ADVISORY REVIEW	MTRCA/ MNR REWRITE
COMBINED SEWER SYSTEMS				
12. Reduce and Virtually Eliminate Combined Sewer Overflows (CSOs) to Receiving Waters	Sect. 2.2.1 [2-40—2-49]	Sect. 2.2.1 [27—28]	Sect. 2.2.1 [25]	
13. Construct the Eastern Beaches Detention Tank (Phase 2)	Sect. 1.1.1 [1-3—1-6]	Sect. 1.1.1 [17—18]	Sect. 1.1.1 [20]	
14. Construct the Keele Trunk Relief Sewer	Sect. 1.2.1E [1-9—1-14]		Sect. 1.2.1E [19—20]	Sect. 1.2.1 [21]
SANITARY SYSTEM				
15. Use Municipal Sewer Use By-Laws to Reduce Contaminant Loadings	Sect. 2.2.3 [2-64—2-75]	Sect. 2.2.3 [30—32]	Sect. 2.2.3 [26—27]	
16. Improve Household Hazardous Wastes (HHW) Programs	Sect. 3.2.1 [3-23—3-29]	Sect. 3.2.1 [37—39]	Sect. 3.2 [30—31]	
17. Improve Main Sewage Treatment Plant	Sect. 2.1.1 [2-4—2-20]	Sect. 2.1.1 [25—27]	Sect. 2.1.1 [7,23—24]	
18. Improve Humber Sewage Treatment Plant	Sect. 2.1.2 [2-21—2-27]	Sect. 2.1.2 [25—27]	Sect. 2.1.2 [7,24]	
19. Improve Highland Creek Sewage Treatment Plant	Sect. 2.1.3 [2-27—2-34]	Sect. 2.1.3 [25—27]	Sect. 2.1.3 [7,24]	
20. Improve North Toronto Treatment Plant	Sect. 2.1.4 [2-34—2-39]	Sect. 2.1.4 [25—27]	Sect. 2.1.4 [7,24]	
HABITAT				
21. Protect and Restore Fish and Wildlife Habitat				Sect. 5.4.3
EDUCATION/NGO				
22. Establish and Fund a Continuing Communications Plan	Sect. 5.1.1 [5-2—5-7]		Sect. 5.1.1 [42]	

ACTIONS	DRAFT DISCUSSION PAPER	TECHNICAL ADVISORY SYNOPSIS	PUBLIC ADVISORY REVIEW	MTRCA/ MNR REWRITE
23. Establish a Resource Centre on Water Quality Issues	Sect. 5.1.2 [5-7—5-10]		Sect. 5.1.2 [43]	
24. Ensure Metro Area Public Participation in Other RAPs	Sect. 6.1.1 [6-2—6-4]		Sect. 6.1.1 [46]	
25. Promote Awareness/Participation in Lake Ontario Toxics Management Plan (LOTMP)	Sect. 6.2.1 [6-8—6-13]		Sect. 6.2.1 [47]	
26. Promote Education on Water Conservation and Other Water Issues			Sect. 3.2 [30—31]	
27. Promote Education on the Use of Fertilizers and Pesticides			Sect. 3 [27—28]	
28. Provide Support to Non-Government Organization (NGOs)	Sect. 5.2.1 [5-12—5-15] & 5.3.1 [5-16—5-22] & 5.3.2 [5-22]		Sect. 5.2.1 [43] & Sect. 5.3.1 [12,44] & 5.3.2. [13,44]	Sect. 5.4.2
29. Promote Public Involvement in Sediment Reduction Projects				Sect. 5.4.1 & 5.4.2
LAWS/POLICY				
30. Finalize and Implement Provincial Lakefill Policy	Sect. 1.4.2 [1-39—1-44]	Sect. 1.4.2 [22—23]	Sect. 1.4 [21]	
31. Update Policy on Disposal of Dredged Material	Sect. 1.4.3 [1-44—1-47]	Sect. 1.4.3 [23—24]	Sect. 1.4 [21]	
32. Continue Programs for Quality Control of Fill Material	Sect. 1.4.1 [1-31—1-39]	Sect. 1.4.1 [20—22]	Sect. 1.4 [21]	
33. Develop Strategy for Dealing with Contaminated Sediments	Sect. 1.4.4 [1-47—1-52]	Sect. 1.4.4 [24—25]	Sect. 1.4 [21]	
34. Finalize and Implement Municipal-Industrial Strategy for Abatement (MISA) Regulations	Sect. 2.3 [2-75] & 7.2.1 [7-25—7-26]		Sect. 2.3 [27], & 7 [49—50]	

How to find more information on specific actions

ACTIONS	DRAFT DISCUSSION PAPER	TECHNICAL ADVISORY SYNOPSIS	PUBLIC ADVISORY REVIEW	MTRCA/ MNR REWRITE
35. Develop a Stormwater Program (Policy, Guideline, Manual)	Sect. 4.3.1 [4-71—4-80]		Sect. 4.3.1 [40]	
36. Develop an Implementation Strategy for Stormwater Quality Program	Sect. 4.3.4 [4-92—4-104]		Sect. 4.3.4 [41]	
37. Develop Stricter Regulations on Pesticides Use			Sect. 3 [27—28]	
38. Implement Full Cost Pricing for Water			Sect. 3.2 [30-31]	
39. Promote Legislation to Ensure Safety of Drinking Water			Sect. 6 [46]	
PLANNING				
40. Promote the RAP Goals through Support of Regional Planning Initiatives	Sect. 6.4.1 [6-21—6-28]		Section 6.4.1 [14,47—48]	
41. Include Watershed Perspective in Planning Processes	Sect. App.A [A-1—A-7]	Sect. App. A [49-51]	Sect. App. A [50]	
RESEARCH/MONITORING				
42. Continue Environmental Monitoring Programs and Integrate Results				
43. Complete Studies of Toxic Contaminant Sources and Biomonitoring	Sect. 7.1.1 [7-4—7-8] & 7.1.4 [7-14—7-16]			
44. Complete Fate and Transport Modelling Study	Sect. 7.1.2 [7-8—7-11]			
45. Initiate Waterfront Sediment Study	Sect. 7.1.3 [7-11—7-14]			
46. Continue Long-term Fish Community Monitoring	Sect. 7.1.6 [7-19—7-22]			

Actions	Draft Discussion Paper	Technical Advisory Synopsis	Public Advisory Review	MTRCA/ MNR Rewrite
47. Complete Main Sewage Treatment Plant (STP) Municipal-Industrial Strategy for Abatement (MISA) Pilot Site Study	Sect. 7.2.2 [7-26—7-27]			
48. Continue Development of Contaminant Residue in Biota (CRAB) Guidelines and Provincial Water Quality Objectives (PWQOs)	Sect. 7.2.3 [7-27—7-29] & 7.2.4 [7-29—7-30]			
49. Assess Problems Arising from Deep Well Disposal, Landfills and Hazardous Waste Sites			Sect. 3 [27-28]	
50. Investigate Methods of Reducing Use of Sodium Chloride			Sect. 4.1.1 [34-35]	
51. Establish Design Standards for Roads/Parking Areas for Runoff Quality Control			Sect. 4.1.3 [35—37]	
52. Encourage Research on Protection and Rehabilitation of Aquatic Habitats			Sect. 5.4 [45]	
53. Investigate Methods to Reduce/Eliminate Viral Contamination of Wastewater			Sect. 7 [69—70]	

Meeting the RAP goals

The actions described in Chapter 3 are designed to meet the goals of the RAP. The following table indicates which goal(s) are met by each of the recommended actions. Only those goals which indicate a specific end-point (eg. improved stormwater quality) are listed in this table. Goals that indicate how to carry out the plan (eg. using an ecosystem approach) have not been included. Due to space restrictions only the letters from the goals are included in the table. Key words from the goals are listed below and a complete listing of the RAP goals appears in Box 1 (pages 5-6).

2a) indigenous fishes returned to area
2b) fish and wildlife habitat protected/created
2c) wetlands protected/created
2d) fish safe to eat
2e) beaches safe for swimming
2f) drinking water safe
2g) aesthetics quality of area improved
2h) opportunities to observe healthy ecosystem provided
2i) no hazardous debris in water
3a) good stormwater quality
3b) combined sewers virtually eliminated
3c) no adverse impacts from sewage plant effluents
5) waterway/waterfront access improved
6) sediment quality improved
7) lakefilling restricted
8) no adverse impacts from local air
10) navigable waters

LEGEND

● = Strongly Helps to Achieve Goal ▒ = Helps Somewhat to Achieve Goal

STORMWATER ACTION\GOAL(S) ADDRESSED	2A	2B	2C	2D	2E	2F	2G	2H	2I	3A	3B	3C	5	6	7	8	10
1. Improve ICI Best Management Practices	▒			▒		▒	▒			●		▒		▒			
2. Improve Spills Response and Prevention	●			▒		▒	▒			●				▒			
3. Improve Controls on Agricultural Practices	▒				●	▒	▒			▒				▒			▒
4. Reduce Sediment from Construction Activities	▒						▒			▒				●			▒
5. Trace and Disconnect ICI Cross Connections	▒			▒		▒	▒			●				▒			
6. Trace and Disconnect Residential Cross Connections					●					●							
7. Construct Pilot Stormwater Ponds and Develop Design Criteria	▒			▒	●		▒			●				●			
8. Create Wetlands for Treating Stormwater	▒	●	▒				▒	▒		●				▒			
9. Improve Erosion Control to Reduce Sediment	▒						▒			▒				●			▒
10. Improve Catchbasin Design and Cleaning Practices	▒						▒			●				▒			
11. Ensure Proper Handling of Contaminants at Snow Disposal Sites	●						▒			▒							
COMBINED SEWER SYSTEM ACTION\ GOAL(S) ADDRESSED																	
12. Reduce and Virtually Eliminate CSOs to Receiving Waters	▒			▒	●	▒	▒				●			▒			
13. Construct the Eastern Beaches Detention Tank (Phase 2)					●					●	●						
14. Construct the Keele Trunk Relief Sewer					●						●						

Meeting the RAP goals

SANITARY SYSTEM ACTION\GOAL(S) ADDRESSED	2A	2B	2C	2D	2E	2F	2G	2H	2I	3A	3B	3C	5	6	7	8	10
15. Use Municipal Sewer Use By-Laws to Reduce Contaminant Loadings												•					
16. Improve Household Hazardous Wastes Programs										•		•					
17. Improve Main Sewage Treatment Plant											•	•					
18. Improve Humber Sewage Treatment Plant											•	•					
19. Improve Highland Creek Sewage Treatment Plant												•	•				
20. Improve North Toronto Sewage Treatment Plant												•					
HABITAT ACTION\GOAL(S) ADDRESSED																	
21. Protect and Restore Fish and Wildlife Habitat	•	•	•														
EDUCATION/NGO ACTION\GOAL(S) ADDRESSED																	
22. Establish and Fund a Continuing Communications Plan																	
23. Establish a Resource Centre on Water Quality Issues																	
24. Ensure Metro Area Public Participation in Other RAPs																	
25. Encourage Awareness/Participation in LOTMP																	
26. Promote Education on Water Conservation and other Water Issues												•					
27. Promote Education on Proper Use of Fertilizer and Pesticides										•							

EDUCATION/NGO ACTION\GOAL(S) ADDRESSED (CONTINUED)	2A	2B	2C	2D	2E	2F	2G	2H	2I	3A	3B	3C	5	6	7	8	10
28. Provide Support to Non-Government Organizations		•					•										
29. Promote Public Involvement in Sediment Reduction Projects														•			
LAWS/POLICY ACTIONS\GOAL(S) ADDRESSED																	
30. Finalize and Implement Provincial Lakefill Policy															•		
31. Update Policy on Disposal of Dredged Material																	•
32. Continue Programs for Quality Control of Fill Material															•		
33. Develop Strategy for Dealing with Contaminated Sediments														•			
34. Finalize and Implement MISA Regulations for All Sectors										•		•					
35. Develop a Stormwater Program (Policy/Guideline/Manual)									•	•	•						
36. Develop an Implementation Strategy for Stormwater Quality Program										•	•						
37. Develop Stricter Regulations on Pesticides Use	•			•		•											
38. Implement Full Cost Pricing for Water												•					
39. Promote Legislation to Ensure Safety of Drinking Water						•											

Meeting the RAP goals

PLANNING ACTION\GOAL(S) ADDRESSED	2A	2B	2C	2D	2E	2F	2G	2H	2I	3A	3B	3C	5	6	7	8	10
40. Promote the RAP Goals through Support of Regional Planning Initiatives		■					■						■				
41. Include Watershed Perspectives in Planning Processes	■	■	■				■	■					■				
MONITORING/RESEARCH ACTION\GOAL(S) ADDRESSED																	
42. Continue Environmental Monitoring Programs and Integrate Results	■	■	■	■	■	■	■			■	■	■		■	■	■	
43. Complete Studies of Toxic Contaminant Sources and Biomonitoring				■		■				■ •	■ •	■ •		■			
44. Complete Fate and Transport Modelling Study				■		■				■ •	■ •	■ •		■			
45. Initiate Waterfront Sediment Study	■			■										•			
46. Continue Long-Term Fish Monitoring along Waterfront	■ •	■ •													■		
47. Complete Main STP MISA Pilot Site Study	■			■								■ •					
48. Continue Development of CRAB Guidelines and PWQOs	■			■		■	■			■	■	■		■			
49. Assess Problems Arising from Deep Well Disposals, Landfills and Hazardous Waste Sites	■			■ •		■ •				■							
50. Investigate Methods of Reducing Use of Sodium Chloride	■	■ •								■							
51. Establish Design Standards for Roads/ Parking Areas for Runoff Quality Control	■						■			■ •				■			
52. Encourage Research on Protection and Rehabilitation of Aquatic Habitats		■ •	■ •														
53. Investigate Methods to Reduce/Eliminate Viral Contamination of Wastewater					■ •	■ •						■					

Ongoing actions

The following is only a partial listing of ongoing water quality improvement projects that are occurring within the Metro Toronto and Region RAP area. This excerpt is based on the Metro Toronto and Region RAP *Water Quality Improvement Projects* document, June 8th, 1993. This document lists innovative water quality initiatives and ongoing activities and culminated in an information exchange for the public and agency representatives on June 8th, 1993.

STORMWATER

Farm RAP Demonstration/Livestock Access (Metro Toronto and Region Conservation Authority)

A remedial plan for a livestock farm in the City of Vaughan will integrate soil, crop, livestock and water management issues, reduce bacterial and nutrient loadings to Cold Creek and increase public education and awareness. Remedial measures will include livestock access restriction to Cold Creek and revegetation of the watercourse. Water quality will be monitored throughout the duration of the project.

Trace and Disconnect of Illegal Connections (Metro Toronto)

Remediation of chemical contamination from priority storm outfalls, identified in the 1983 Toronto Area Water Management System (T.A.W.M.S.), is in progress. Remedial actions up to and including 1989 on the Humber River have eliminated 26 out of 30 priority storm outfalls originally identified as discharging chemical contaminants. Remedial actions on the Don River have eliminated 15 out of the 31 storm outfalls identified as discharging chemical contaminants by the 1984 T.A.W.M.S.

Contaminated Sediment Removal and Treatment Technology Demonstration (Environment Canada)

A sediment removal and treatment demonstration project for the inner harbour of the Parliament Street Slip is complete. Soil was removed using a dredging bucket and "washed" using the Toronto Harbour Commissioners' soil treatment facility. Treatment of the sediment consisted of a washing step, metal removal step, and a biological treatment step for organic contaminants. The treated sediment was disposed of at the Toronto Harbour Commissioners' confined disposal facility.

Ongoing actions

Downspout Disconnection (Toronto)

A downspout disconnection pilot project for residents along Heward Avenue was completed with 49% of all properties having their downspouts disconnected from the private drain and discharged to the surface. This pilot project will have a positive impact on the pollution loadings from the sewer system on Lake Ontario. A second larger downspout disconnection pilot project is underway for 1049 residential properties in the Queen Street East area.

Combined Sewers

Sewer Separation (Scarborough, City of York, East York)

The Cities of Scarborough, Toronto and York, and the Borough of East York have ongoing sewer separation programs. As of 1990, the percentage of separated sewers for the municipalities were: City of Toronto, 70%; Scarborough, 70%; Borough of East York, 65%; and, the City of York, 45%.

Eastern Beaches Detention Tank — Phase II (Toronto)

The initial phase of the Eastern Beaches Detention Tank project involved the installation of a tank to collect discharges from several storm sewers and one combined sewer overflow on the western portion of the eastern beaches. The detention tank is providing a degree of protection to the Woodbine and Beaches Park beaches by maintaining low bacterial densities. The construction of a second, larger detention tank is proposed to further protect the Eastern Beaches in maintaining low bacterial densities.

Sewer System Master Plan and Combined Sewer Overflow (CSO) Tunnel (Toronto)

A sewer system master plan is being developed for the City of Toronto to improve the water quality of the City's waterfront and the Don and Humber Rivers. The plan includes the virtual elimination of combined sewer overflows (CSOs) and consideration of control and treatment of stormwater runoff. The City's preferred solution for the control of CSOs and stormwater in the Eastern Beaches, is to construct a deep tunnel with a pumping station and forcemain, to the Main Sewage Treatment Plant.

Sanitary Sewer System

Keel Street Trunk Relief Sewer (Metro Toronto)

The planning for a new trunk relief sewer system for the Humber and Black Creek sewersheds using a class environmental assessment (schedule c) has been completed. The additional capacity will provide for future development and on-line detention for combined sewer overflows.

Household Hazardous Waste Program (Metro Toronto)

Metro Works established a collection system in 1986 to encourage households to safely dispose of household hazardous wastes; such as, batteries, paints and pharmaceuticals. Residents can either drop off their wastes at permanent depots or if they are within Metropolitan Toronto or they can have their wastes picked up by a "toxics taxi." In 1989 the two programs collected 213 tonnes of household hazardous waste.

Habitat

Waterfront Habitat Rehabilitation Projects (Metro Toronto and Region Conservation Authority)

Natural fish and wildlife habitats are being created at five sites along the Metro Toronto Waterfront. A wetland creation and estuary rehabilitation project is in progress at Mimico Creek, a northern pike spawning habitat project is in progress at the Toronto Islands (trout pond), a fish reef is being created at Ashbridge's Bay Park and Bluffers Park (boat basin), and a wetland is being created at Bluffers Park (west embayment). Revegetation and enhancement of existing vegetation will be a component of all of the habitat projects.

Various Projects (Non-Government Organizations)

Many non-governmental organizations exist which are involved in rehabilitating and remediating streams and habitats. The Action to Restore a Clean Humber organization is involved in remedial works that are targeted at restoring and maintaining a clean Humber River and enhancing the ecological value of the watershed. Since 1990, projects have included stream clean-ups

(3 dump trucks and 200 shopping charts in 1990), shrub and tree plantings (2,500 trees and shrubs and 300 wildflowers as of fall 1991), and erosion control projects including the installation of rip-rap.

Education and Awareness

Water Conservation Program (Toronto)

Free water meters are being installed in private homes as part of a water conservation program. Water meters encourage water conservation by charging homeowners only for the volume of water that they use. In 1990, 1,298 water meters were installed. Homeowners also received water conservation kits and additional information on water and energy conservation.

Robinson Creek Restoration Project (Metro Toronto and Region Conservation Authority)

A community based valley and stream corridor rehabilitation and education program is in progress for Robinson Creek at the headwaters of the Rouge River. In 1992 residents and students were involved in planting of 350 native trees and 120 native shrubs alongside the creek. Projects to maintain the health of these newly planted areas (watering and mulching) is ongoing. Benefits of this rehabilitation project include improved flood control, water quality and habitat.

Storm Drain Marking (Fisheries and Oceans Canada)

Storm Drain Marking is a program for volunteer groups to raise awareness about the direct linkage between storm sewers and receiving waters and to discourage residents from dumping hazardous wastes into catchbasins. Volunteers paint fish silhouettes beside storm drains and distribute brochures on the proper disposal of household hazardous wastes. Permission to paint the silhouettes must first be obtained from local municipalities.

Responsibilities and Timelines for Lead Implementators

LEGEND: ● = INITIATE ACTIVITY ○ = ACTIVITY ONGOING
ABBREVIATIONS EXPLAINED AT END OF TABLE

ACTION	LEAD(S)	PARTNER(S)	TIMELINE (YEARS)		
			1-5	5-10	10-20
STORMWATER					
1. Improve Industrial/Commercial/Institutional (ICI) Best Management Practices (BMPs)	RM	EC, LM, MOEE	●	○	○
2. Improve Spills Response and Prevention	MOEE	EC, LM, MOT, RM,	●	○	○
3. Improve Controls on Agricultural Practices	MAF	AC, FA, MTRCA, MNR, MOEE	●	○	○
4. Reduce Sediment from Construction Activities	LM, RM	MTRCA, MNR, MOEE	●	○	
5. Trace and Disconnect Industrial/Commercial/ Institutional (ICI) Cross Connections	LM, RM	MOEE	●		
6. Trace and Disconnect Residential Cross Connections	LM, RM	MMA, MOEE	●	○	○
7. Construct Pilot Stormwater Ponds and Develop Design Criteria	MOEE	EC, LM, MNR, MTRCA, RM	●	○	
8. Create Wetlands for Treating Stormwater	MTRCA	EC, LM, MNR, MOEE, RM	●	○	○
9. Improve Erosion Controls to Reduce Sediment	MTRCA	LM, MNR, MOEE, RM	●	○	○
10. Improve Catchbasin Design and Cleaning Practices	LM, RM		●	○	○
11. Ensure Proper Handling Contaminants at Snow Disposal Sites	RM	LM	●		

ACTION	LEAD(S)	PARTNER(S)	TIMELINE (YEARS)		
			1-5	5-10	10-20
COMBINED SEWERS					
12. Reduce and Virtually Eliminate Combined Sewer Overflows (CSOs) to Receiving Waters	LM, RM	EC, MOEE	○	○	○
13. Construct the Eastern Beaches Detention Tank (Phase 2)	LM (Toronto),	EC, MOEE, RM (Metro)	●		
14. Construct the Keele Trunk Relief Sewer	RM (Metro)	EC, MOEE	●		
SANITARY SYSTEM					
15. Use Municipal Sewer Use By-Laws to Reduce Contaminant Loadings	LM, RM		●	○	○
16. Improve Household Hazardous Wastes (HHW) Programs	RM	MOEE	○	○	○
17. Improve Main Sewage Treatment Plant (STP)	RM (Metro)	EC, MOEE	○	○	
18. Improve Humber Sewage Treatment Plant (STP)	RM (Metro)	EC, MOEE	○	○	
19. Improve Highland Creek Sewage Treatment Plant (STP)	RM (Metro)	EC, MOEE	○	○	
20. Improve North Toronto Sewage Treatment Plant (STP)	RM (Metro)	EC, MOEE	○	○	
HABITAT					
21. Continue Fish and Wildlife Habitat Improvement Programs	MNR	EC, DFO, MTRCA, NGO	○	○	○
EDUCATION/NGOs					
22. Establish and Fund a Continuing Communications Plan	MOEE	EC, LM, MTRCA, RM	○	○	○
23. Establish a Resource Centre on Water Quality Issues	MOEE	EC	●		

Responsibilities and Timelines for Lead Implementators

ACTION	LEAD(S)	PARTNER(S)	TIMELINE (YEARS)		
			1-5	5-10	10-20
24. Ensure Metro Area Public Participation in Other RAPs	MOEE	EC	○	○	○
25. Promote Awareness/Participation in Lake Ontario Toxics Management Plan (LOTMP)	EC	MOEE	○	○	○
26. Promote Education on Water Conservation and Other Water Issues	MOEE	EC, LM, ME, MNR, MTRCA, RM	○	○	○
27. Promote Education on the Use of Fertilizers and Pesticides	MOEE, MAF	AC, EC, LM, MTRCA, RM	●		
28. Provide Support to Non-Government Organizations (NGOs)	EC, MTRCA	LM, MOEE, RM	○	○	○
29. Promote Public Involvement in Sediment Reduction Projects	MTRCA	LM, MNR, RM	●	○	○
LAWS/POLICIES					
30. Finalize and Implement Provincial Lakefill Policy	MOEE	MNR, MTRCA, WRT	●	○	○
31. Update Policy on Disposal of Dredged Material	MOEE		●		
32. Continue Programs for Quality Control of Fill Material	MTRCA	EC, MOEE, RM	●		
33. Develop Strategy for Dealing with Contaminated Sediments	MOEE	EC, MTRCA	●		
34. Finalize and Implement Municipal-Industrial Strategy for Abatement (MISA) Regulations	MOEE	LM, RM	●	○	
35. Develop a Stormwater Program (Policy, Guideline, Manual)	MOEE	EC, LM, MNR, MTRCA, RM	●		
36. Develop an Implementation Strategy for Stormwater Quality Program	MNR, MOEE, MTRCA		●		

ACTION	LEAD(S)	PARTNER(S)	TIMELINE (YEARS)		
			1-5	5-10	10-20
37. Develop Stricter Regulations on Pesticides Use	MOEE	AC, EC, MAF	●		
38. Implement Full Cost Pricing for Water	RM	LM	●		
39. Promote Legislation to Ensure Safety of Drinking Water Planning	MOEE	LM, RM	●		
PLANNING					
40. Promote the RAP Goals through Support of Regional Planning Initiatives	MTRCA	EC, LM, MNR, MOEE, RM	○	○	○
41. Include Watershed Perspectives in Planning Processes	MOEE, MMA	LM, MNR, RM	○	○	○
RESEARCH/MONITORING					
42. Continue Environmental Monitoring Programs and Integrate Results	MTRCA	EC, MNR, MOEE, RM	○	○	○
43. Complete Studies of Toxic Contaminant Sources and Biomonitoring	MOEE	EC, LM, RM	○		
44. Complete Fate and Transport Modelling Study	MOEE	EC, LM, RM	○		
45. Initiate Waterfront Sediment Study	MOEE	EC, MTRCA		●	
46. Continue Long-Term Fish Community Monitoring	MNR	MOEE, MTRCA	○		
47. Complete Main Sewage Treatment Plant (STP) Municipal-Industrial Strategy for Abatement (MISA) Pilot Site Study	MOEE	EC, RM (Metro)	○		
48. Continue Development of Contaminant Residue in Biota (CRAB) Guidelines and Provincial Water Quality Objectives (PWQOs)	MOEE		○	○	○
49. Assess Problems Arising from Deep Well Disposal, Landfills and Hazardous Waste Sites	MOEE	LM, MTRCA, RM	●		

Responsibilities and Timelines for Lead Implementators

Action	Lead(s)	Partner(s)	Timeline (Years)		
			1-5	5-10	10-20
50. Investigate Methods of Reducing Use of Sodium Chloride	MOEE	LM, MOT, RM	●		
51. Establish Design Standards for Roads/Parking Areas for Runoff Quality Control	MOEE	MOT	●		
52. Encourage Research on Protection and Rehabilitation of Aquatic Habitats	MNR	EC, MTRCA	○	○	○
53. Investigate Methods to Reduce/Eliminate Viral Contamination of Wastewater	MOEE	HWC, LM, MOH, RM	●		

AC = Agriculture Canada

DFO = Department of Fisheries and Oceans (Canada)

EC = Environment Canada

FA = Farm Associations

HWC = Health and Welfare Canada

LM = Local Municipalities

ME = Ministry of Education

MNR = Ministry of Natural Resources (Ontario)

MMA = Ministry of Municipal Affairs (Ontario)

MOEE = Ministry of Environment and Energy (Ontario)

MAF = Ministry of Agriculture and Food (Ontario)

MOH = Ministry of Health (Ontario)

MOT = Ministry of Transportation

MTRCA = Metro Toronto and Region Conservation Authority

NGO = Non-Government Organizations

RM = Regional Municipalities

WRT = Waterfront Regeneration Trust

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