EXECUTIVE SUMMARY

INTRODUCTION

The St. Clair River was listed in 1985 by the International Joint Commission (IJC) as one of 42 Areas of Concern (AOC) in the Great Lakes Basin. Areas of Concern were identified based on known water quality problems. A letter of intent was signed in December, 1985 by the Premier of Ontario and the Governor of Michigan, establishing a joint RAP process and providing for Ontario to take the lead role for the St. Clair River AOC. This agreement facilitated the development of a Binational Remedial Action Plan (RAP) Committee, or RAP Team, in 1987 comprised of federal, state and provincial representatives.

The RAP Team has been charged with development of a Remedial Action Plan for the St. Clair River, which is a staged process. This document represents the combination of efforts in development of Stage 1, in order to address the following requirements:

-detail existing environmental conditions in order that environmental problems in the St. Clair River may be defined and described;

-identify beneficial uses that are impaired, the degree of impairment and the geographical extent of impairment within the Area of Concern; and

-determine the causes of impairment, providing an assessment of all known sources of pollutants of concern and a description of other potential sources.

In addition to the technical document to address the above, an extensive public participation program has been developed in order to inform the public, improve the plan by gaining information and advice from the public, gain support for plan implementation, and provide a mechanism for accountability to the public.

A number of initiatives were undertaken to raise the profile of the RAP process among the general public through outreach activities, and a focused effort was placed upon the establishment of a Binational Public Advisory Council (BPAC) which could work with and advise the RAP Team on a regular basis during development of the RAP. The BPAC was created during early 1988. Its specific roles are to enable the RAP Team to be informed on public opinion and views regarding goals for the RAP and to advise the RAP Team on problem identification, planning methodology, public involvement, technical information, identification of available remedial options, selection of remedial actions and plan recommendations.

The BPAC consists of approximately 48 members from both Ontario and Michigan, representing a cross-section of communities on both sides of the river. Members of the BPAC have demonstrated extensive interest and knowledge in development of the RAP, and have provided active and informed input throughout the process. In October 1988, four members of the BPAC were elected as delegates to the RAP Team to facilitate communication between the RAP Team and BPAC.

Agency members of the RAP Team are able to provide technical expertise, either directly or through communications with experts within each of their organizations. While the Ontario Ministry of the Environment has been charged with the lead responsibility for development of the RAP, the Michigan Department of Natural Resources co-chairs the RAP Team, with additional members representing agencies including the Ontario Ministry of Natural Resources, Environment Canada, Fisheries and Oceans Canada, and the U.S. Environmental Protection Agency.

THE RAP PROCESS

The mechanisms for a cooperative binational venture such as a Remedial Action Plan for the St. Clair River, have been established through the development of the Great Lakes Water Quality Agreement (GLWQA). This agreement first signed by Canadian and U.S. governments in 1972, was revised in 1978 and subsequently amended in 1987. The amending protocol in 1987 included an annex which required Canadian and U.S. governments to develop and implement Remedial Action Plans for each of the Great Lakes Areas of Concern. As outlined in the 1987 GLWQA, an Area of Concern is defined as "a geographic area that fails to meet the General or Specific Objectives of the Agreement where such failure has caused, or is likely to cause impairment of beneficial use or the areas ability to support aquatic life". Fourteen use impairments are specified in the GLWQA including the following:

i. Restriction on Fish and Wildlife Consumption;
ii. Tainting of Fish and Wildlife Flavour;
iii. Degradation of Fish and Wildlife Populations;
iv. Fish Tumours or other Deformities;
v. Bird or Animal Deformities or Reproductive Problems;
vi. Degradation of Benthos;
vii. Restrictions on Dredging Activities;
viii. Eutrophication or Undesirable Algae;
ix. Restrictions on Drinking Water Consumption, or Taste and Odour Problems;
x. Beach Closings;
xi. Degradation of Aesthetics;
xii. Added Cost to Agriculture or Industry;
xiii. Degradation of Phytoplankton and Zooplankton Populations; and
xiv. Loss of Fish and Wildlife Habitat.

The existence of any one of the use impairments could be sufficient to list an area as an Area of Concern. Using this list as a basis, the IJC has solicited input in development and refinement of Listing/Delisting Criteria for Great Lakes' AOCs. In some cases, even with specific criteria outlined, it is difficult to definitively establish whether a beneficial use is impaired. As a consequence, the RAP Team has been required to exercise prudence and extensive consultation with both technical experts within and outside the RAP Team, as well as the BPAC. The St. Clair River Remedial Action Plan has used available environmental quality data to compare with the IJC Listing Criteria, in order to determine the impairment status of beneficial uses in the St. Clair River. In addition, exceedences of existing water quality criteria or effluent requirements, have been highlighted even though a direct relationship with an impairment of beneficial uses may not have been demonstrated. The public (both individuals and organizations) and various levels and types of government agencies were included throughout the Stage 1 RAP development process in an attempt to reach consensus on the problems in the St. Clair River.

Annex 2 of the 1987 protocol amending the GLWQA specifies that the RAP should be submitted to the IJC for review and comment at 3 stages. This document represents a completed Stage 1 outlining the definition and description of environmental problems, causes of these use impairments, a description of all known sources of pollutants involved, and an evaluation of other possible sources.

Stage 2 will define the specific goals for the Area of Concern and will describe the remedial and regulatory measures selected to achieve these goals. The Stage 2 RAP will include:

1. an evaluation of remedial measures in place;
2. an evaluation of alternative additional measures to restore beneficial uses;
3. a selection of additional remedial measures to restore beneficial uses and a schedule for their implementation;
4. an identification of the persons, agencies, or organizations responsible for implementation of the selected remedial measures;
5. a process for evaluating the implementation and effectiveness of remedial measures; and
6. a description of surveillance and monitoring process to track the effectiveness of

remedial measures, and the eventual confirmation of the restoration of the uses.

Stage 3 of the St. Clair River RAP will be submitted when beneficial uses are restored. This stage of the RAP will include documentation that the beneficial uses are restored as measured through implementation of the monitoring program.

REGULATORY PROGRAMS

Numerous programs, regulations, objectives, guidelines and agreements to maintain and enhance environmental quality are in place and/or under development in Ontario, Michigan and at the federal levels in both Canada and the United States. The Stage 1 RAP identifies the current regulatory tools available to each jurisdiction and the control mechanisms currently in place and under development. An evaluation of this information as it pertains to the St. Clair River AOC will be undertaken as part of the Stage 2 RAP.

DESCRIPTION OF STUDY AREA

The boundaries of the Area of Concern include the entire river from the Blue Water Bridge (connecting Sarnia and Port Huron) to the southern tip of Seaway Island, west to St. John's Marsh and east to include the north shore of Mitchell's Bay on Lake St. Clair.

The St. Clair River forms the upper-most portion of the corridor between Lakes Huron and Erie serving as a `connecting channel' from Lake Huron to Lake St. Clair. The river flows approximately 64 km (40 mi) in a southerly direction from the outflow of Lake Huron to Lake St. Clair. Prior to entering Lake St. Clair, the river divides into several channels creating an extensive delta known as the St. Clair delta (also referred to as the St. Clair Flats). The river velocity ranges from 1.67 m/s (5.48 ft/s) at the northern extremity to 0.31 m/s (1.02 ft/s) at Lake St. Clair. The river's width varies between approximately 250 and 1,200 m (820 and 3,940 ft) with river flows ranging from a winter low of 4,200 m3/s and a summer high of 5,500 m3/s (0.148 to 0.194 X 106 cfs). The average monthly discharge rate from 1900 to 1981 was 5,121 m3/s (0.181 X 106 cfs).

A number of tributaries including the Murphy Drain, Talfourd, Baby and Bowens Creeks in Ontario and the Black, Pine and Belle Rivers in Michigan drain into the St. Clair River. Tributary watersheds in Ontario represent an area of 20,976 ha (51,810 acres) of which Talfourd Creek comprises 20,800 ha (51,400 acres). The total watershed area of all the Michigan tributaries is 315,900 ha (780,600 acres).

Several islands have been created by the division of the river into numerous channels in the St. Clair delta area. Walpole Island consists of 6 separate islands, all of which are separated by a series of channels. Seaway Island lies between the South Channel and the St. Clair Cutoff, and Basset Island is between the St. Clair Cutoff and Basset Channel. Collectively, these islands along with Squirrel, Walpole, Pottowatamie and St. Anne Islands form the Walpole Island Indian Reserve on the Canadian side of the International Border. On the U.S. side, Dickinson Island is located between the North Channel and the Middle Channel, and Harsens Island lies between the Middle and South Channel.

The St. Clair River lies on the eastern rim of the Michigan Basin typified by consolidated sedimentary rocks of Paleozoic origin, overlain by glacial and post glacial lake deposits. The channel of the St. Clair River is cut through hard stony glacial clay till in its centre, and a fine silt clay till in the nearshore area. The hard till substrate of the river is resistant to erosion accounting for the river's straightness and high water clarity. The sediments of the St. Clair delta are derived from silts and sands eroded from the shores of Lake Huron. These soils are comprised mainly of fine sandy loams.

There are two primary terrestrial biological zones located adjacent to the main river. These include: (1) the upland hardwood forests, mostly located on the banks of the river and along its tributaries; and (2) a

diverse species assemblage in areas which are transitional to the river and its wetlands. Wetlands are particularly prominent in the area of the delta. The transitional zone can be divided into four main species assemblages including shrub ecotones, wet meadows, sedge marshes and island shorelines and beaches. A large portion of the original hardwood forests have been cleared for agricultural, industrial or urban development.

Submergent and emergent macrophytes are the main primary producers in the St. Clair system, as well as providing cover and food for fish, waterfowl and invertebrates. There are four main types of aquatic plant communities in the St. Clair River and delta including open water communities, river channel communities, cattail marshes and abandoned river channel communities.

Aquatic life within the river is also diverse, consisting of phytoplankton, zooplankton, benthic fauna, and numerous fish species. Phytoplankton composition is dominated by diatoms. The zooplankton community is dominated by fugitive drift species carried into the river from Lake Huron. At least 179 benthic faunal species are known to occur in the St. Clair River. The most common benthic invertebrates represent the Nematoda, Oligochaeta, Amphipoda, Diptera, Ephemeroptera, Trichoptera, Gastropoda and Pelecypoda orders. There are at least 91 species of fish including both residents and migrants.

Land Use

Land uses adjacent to the St. Clair River are in large part comprised of the following: agriculture, urban, rural, industrial, native lands, recreation, forests and wetlands, and waste disposal.

In Ontario, 78 percent of immediate St. Clair drainage area is dedicated to agricultural applications including cash cropping, beef and swine operations. In Michigan, 68 percent of the area draining into the St. Clair River is dedicated to agricultural purposes, with cash cropping, beef and dairy operations accounting for the majority of this activity.

Approximately 170,000 people live on or near the shores of the St. Clair River, with about 90,000 on the Canadian side and 80,000 on the U.S. side. While much of this population is centred in the cities of Sarnia, Ontario and Port Huron, Michigan, a significant portion live in rural areas.

Most of the areas' industry is concentrated within the industrial area between Sarnia and Corunna in Ontario, although industrial facilities occur downstream of Corunna as well as on the Michigan side of the AOC. The presence of the St. Clair River and the local geology are the primary reasons for the concentration of industry in this area. Industrial facilities along the river include petroleum refineries, organic and inorganic chemical manufacturers, paper companies, salt producers and thermal electric generation facilities.

Two Native Indian reserves situated along the Canadian shore of the St. Clair River include the Chippewa of Sarnia Band Reserve and the Walpole Island First Nations Indian Reserve. Band members in the Walpole Reserve operate a community farm, localized industry and also rely on hunting, fishing and trapping for food and income.

An extensive park network provides substantial recreational amenities along both shores of the St. Clair River. These include campgrounds, day use parks, marinas and a limited number of beaches.

A relatively small portion of the land bordering on the St. Clair River is forested. Eight coastal wetland areas are situated along the St. Clair River and an additional seven are situated within the delta. An estimated 3,380 hectares (8,350 acres) of emergent aquatic plants occur primarily in the lower portion of the St. Clair River.

There are also a total of 21 industrial and two municipal waste sites and landfills in Ontario located within close proximity to the river. The majority of the industrial waste disposal and landfill sites are located

near the head of the river where groundwater seepage rates tend to be highest. In Michigan, there are six sites of environmental contamination within 4.8 km (3 miles) of the St. Clair River which are listed on the Priority List for Evaluation and Interim Response under Act 307.
Numerous deep well injection sites are situated on both sides of the St. Clair River. Seventy-two injection wells, including 63 currently in operation, are located on the Michigan side of the St. Clair River. There are no injection wells where hazardous waste is injected into or above underground sources of drinking water. In Ontario, deep injection wells were used to dispose of industrial wastes, cavern brines and oil field brines between 1958 and 1972. Of the 35 deep injection wells originally operated, approximately 20 wells are currently utilized for the disposal of cavern brine and oil field brine.

Water Resource Use

Water resource uses on the St. Clair River are numerous and include: shipping, water supply, fish and wildlife habitat, commercial fishing, sport fishing, hunting and trapping, native consumptive resource utilization, swimming and recreational boating, naturalist uses and effluent receiver. The St. Clair River is part of the Great Lakes Seaway conveying commodities such as coal and lignite from lower Great Lakes ports or ocean ports and iron ore, limestone and grain from ports in the upper Great Lakes. A minimum depth of 8.2 m (27 feet) is required for shipping on the river necessitating periodic dredging of sediments, particularly in the lower channels. Dredged material removed for navigational purposes is disposed of in confined disposal facilities or in open waters, contingent upon contaminant levels which are monitored in representative samples.

Approximately 2.7 percent of the river's average flow is utilized for in-plant process operations and once-through, non-contact cooling water by industrial facilities along the length of the river. Most of the cooling water which is drawn from the river (80 percent) is utilized by thermal generating stations. The treated water supply for Sarnia and Port Huron is provided from intakes in lower Lake Huron, however, a number of downriver communities currently rely on St. Clair River water for drinking purposes.

The St. Clair River provides diverse and extensive fish and wildlife habitat. At least 91 species of fish have been recorded as resident or migrants in the river and its delta, with at least 46 species utilizing the area for spawning and nursery habitat. The coldwater fish community is largely composed of exotic species (rainbow and brown trout, chinook and coho salmon and rainbow smelt) which have filled the niche left absent by native species such as lake trout, lake whitefish and lake herring. Important members of the coolwater fish community are lake sturgeon, northern pike, muskellunge, walleye and yellow perch. The warmwater community includes longnose gar, bowfin, smallmouth bass, largemouth bass, white bass, channel catfish, suckers and several species of minnows and sunfishes.

The wetlands and associated open waters of the lower St. Clair River and Lake St. Clair is one of the most important wetland systems in the Great Lakes region for ducks, geese and swans. The Area of Concern provides habitat for at least 20 species of amphibians, 25 species of reptiles, 250 species of birds and 60 species of mammals.

During the early 1800s lake whitefish, lake herring, walleye and yellow perch formed the principle catch for the commercial fishery. A change in species composition has occurred over time, due in part to overfishing of more desirable species and habitat alterations. Catch records reflect the permanent closure of Michigan's commercial fishery in 1909 to all species except carp and in Ontario to the closure of the smallmouth bass commercial fishery, in response to increasing pressure from recreational fishermen. The commercial fishery in Lake St. Clair was closed for a 10 year period beginning in 1970, due to high mercury contamination. Presently, commercial fishing within the St. Clair River itself is considered negligible. In contrast, bait fishing is an important industry on the Ontario side of the St. Clair River, spurred by the popularity of sport fishing.

Sport fishing has been a popular long-standing activity on the St. Clair River and its delta distributaries. No Ontario based intensive creel surveys have been undertaken on the river however, some records are available for Lake St. Clair. During 1977-1985, ice anglers fished an average of 33,140 angler days and

harvested an average of 128,838 walleye, yellow perch and bluegills annually. Over the same period, summer anglers expended an average of 93,225 angler days and harvested an average of 193,382 walleye, yellow perch, smallmouth bass and muskellunge annually. In Michigan, the average annual fishing effort during 1983-1985 was 690,750 angler days in the St. Clair system (including the river, delta and Lake St. Clair). The average combined catch by boat, shore and ice anglers was 1,392,000 fish. This represented a value of approximately $7.6 million (U.S.) generated by the recreational fishery on an annual basis. In Ontario, the value of the sport fishery in 1989 was estimated to be $3.2 million (Cdn).

Hunting and trapping are significant uses of the St. Clair River Area of Concern. In Ontario and Michigan, waterfowl hunting and small game harvesting account for the bulk of these activities. The St. Clair River and the wetlands of the delta provide many of the waterfowl hunting opportunities available in Lambton and Kent Counties of Ontario.

Fishing, hunting and trapping are important activities to native people living on the St. Clair River, as they provide food, revenue and a continuance of traditional values. Considerable revenue is generated through harvesting of pelts, lease of reserve lands, guiding services and fishing and hunting licences. For example, prior to 1980 more than 100,000 muskrats were harvested annually. In 1987 the average price was $6.00 (Cdn) per pelt, however, the recent downturn in the fur industry reduced the 1989 harvest to only 10,000 pelts valued at $20,000 (Cdn).

The St. Clair River system, due to its ready accessability to many people in southwestern Ontario and southeastern Michigan, is a significantly utilized recreational waterbody. Swimming, boating, as well as naturalist activities are some examples of recreational uses of the St. Clair River.

There are 56 point sources discharging into the St. Clair River and its tributaries from Michigan and Ontario. These include thermal electric generating stations; industrial facilities representing the organic chemicals, inorganic chemicals, petroleum refining, pulp and paper, and food processing sectors; and municipal wastewater treatment plants. Total point source flows from all facilities are approximately 11,800 X 103 m3/day (3,068 X 106 U.S. gal/day).

A large number of the petrochemical facilities located in the industrial area in and south of Sarnia ('Chemical Valley') were constructed during the early 1940s in support of the war effort. The Sarnia area was selected during this period and historically because of its proximity to the St. Clair River, as well as the presence of local underground sodium chloride (salt) deposits, both prerequisites for manufacturing chlorinated organic chemicals.

Refineries in the area manufacture such products including:

- gasoline, diesel, jet fuel;
- petrochemical feed stocks;
- lubricating oils and waxes;
- aromatic solvents;
- petrochemicals; and
- fuel coal products.

Chemical manufacturing facilities produce a wide array of products including the following:

- polyethylene resins;
- solvents;
- polyvinyl chloride resins;
- polypropylene;
- styrene monomer;
- rubber latex and synthetic rubber; and
- fertilizers and many other products.

In addition to the Ontario and Michigan industrial and municipal point sources are numerous Combined Sewer Overflow (CSO) discharges which combine urban runoff with partially treated sewage during high precipitation events. CSOs are located in Sarnia, Port Huron and a few smaller communities. Nonpoint sources of contaminants to the St. Clair River AOC include atmospheric deposition onto the watershed, urban and rural runoff, the resuspension of contaminated sediments, groundwater, and spills from ships, industries and other facilities.

ENVIRONMENTAL CONDITIONS

Habitat Loss & Wildlife Populations

Losses of the aquatic plant community have occurred due to industrial, agricultural, recreational and urban developments. Many of the wetlands of the St. Clair system have been lost, primarily because of drainage of large tracts of land for agriculture. Considerable wetland acreage was also lost due to dredging or filling related to navigation, marina and housing developments. In addition, many wetlands have been seriously impaired by dykes that hydrologically separate them from the main channel.

Between 1873 and 1973 wetland losses of 72 percent (5,252 ha/12,972 acres) occurred on the Michigan side of Lake St. Clair. The Ontario wetlands, from the Thames River mouth in Lake St. Clair north to Chenal Ecarte, dwindled from 3,574 ha (8,830 acres) in 1965 to 2,510 ha (6,200 acres) in 1984. These include losses within the AOC along channels of the Walpole Island Indian Reserve. Drainage for agriculture accounted for 92 percent of the losses and the remainder was due to marina and cottage development.

In addition to habitat losses documented for the delta, there have been extensive alterations to the shoreline and inland areas upstream of the delta. These losses are due to industrial, agricultural and urban development throughout the watershed of the AOC. Extensive bulkheading and infilling has occurred along much of the river resulting in the loss of spawning, rearing and feeding sites for many fish species.

Estimated peak numbers of waterfowl were approximately 150,000 in the Ontario portion of the delta during the autumn. Use of this area during the autumn has shown an overall increase of 37 percent between 1968-1982, however, there has been a 14 percent decline in the use of this area by diving ducks during the fall. Spring use of this area has shown little change between 1968 and 1982 in terms of the estimated peak number of waterfowl (60,000 birds), however, use of the area by dabbling ducks, such as American widgeon, green-winged teal, blue-winged teal and wood ducks, decreased by 79 percent between 1968 and 1982.

Water Quality

Results of water surveys in the St. Clair River reveal that the most contaminated portion of the river, as identified by concentrations which are elevated above those at the head of the river or laterally across the river, by conductivity, and by water quality guideline exceedences, is governed by the flow pattern of the river. The majority of the contaminants in the St. Clair River waters originate in the industrial area south of Sarnia. A contaminant plume tends to hug the Canadian shoreline from the Cole Drain and gradually enlarges downstream where it extends up to 300 m (984 ft) from the Canadian shore at Port Lambton. The flow pattern of the river funnels the plume into the Chenal Ecart and South Channel of the delta.

Exceedences of Objectives, Guidelines and Standards

Contaminants which have exceeded, Canadian Guidelines, Great Lakes Water Quality Agreement (GLWQA) Objectives and/or Provincial Water Quality Objectives (PWQO) include, fecal coliform bacteria, cadmium, copper, iron, zinc, hexachlorobutadiene, hexachlorobenzene and octachlorostyrene.

The discharge of inadequately treated sewage from Michigan CSOs during runoff events have also causes impairments downstream of the outfalls. Michigan Water Quality Standards (WQS) were exceeded for fecal coliform bacteria, chloride, cadmium, copper, lead, mercury, zinc, dieldrin, total PCBs, hexachlorobenzene, tetrachloroethylene and carbon tetrachloride. In addition, the periodic discharge of inadequately treated sewage from Michigan CSOs imports downstream areas.

Copper exceeded the PWQO and GLWQA Objective by up to 4 times (average) and the Michigan WQS, Rule 57 Value by up to 2 times at the Lambton (Sarnia area) and Walpole Island water intakes in 1988. The source of the copper to the Lambton WTP, which draws its water from Lake Huron, is unknown but is clearly upstream of the AOC. Iron exceeded the PWQ and GLWQA Objectives, however, the pattern of contamination does not indicate likely sources within the AOC.

The Provincial Water Quality Guideline for phosphorus was occasionally exceeded prior to 1986, however, the ambient concentrations in 1986 and 1988 were generally well below the guideline. Ammonia exceeded the PWQO within the industrial area in 1977, however, recent data collected at the water treatment plant intakes suggest that this parameter is below objectives for the protection of aquatic life. Chloride concentrations are elevated in the contaminant plume on the Ontario side with 1986 concentrations increasing by more than an order of magnitude from upstream of the Sarnia industrial complex to immediately offshore of the industrial area. There is no PWQO for chloride, however, increasing concentrations both downstream and during the period from 1985 to 1988 are of concern. Also, the maximum chloride concentration adjacent to the Ontario industrial waterfront exceeded the Michigan Surface WQS during 1986.

Hexachlorobenzene in the area immediately downstream of the Cole Drain exceeded the PWQO and the Michigan Surface WQS, Rule 57 Value (January 1991). Hexachlorobenzene concentrations in water exceeding these guidelines, measured from 1984 through 1986, originated downstream of the Cole Drain and remained as exceedences up to the head of Stag Island near Corunna. Octachlorostyrene concentrations were found to exceed the Ontario Ministry of the Environment interim advisory from downstream of the Cole Drain, Dow and Suncor outfalls, and down-river within 100 m (328 ft) of the Canadian shoreline at Port Lambton and in the delta channels, Chenal Ecart and South Channel during 1985 and 1986. Hexachlorobutadiene concentrations exceeded the Canadian Water Quality Guideline for the protection of aquatic life downstream of the Cole Drain and Dow 1st Street Sewer complex. Total PCB concentrations in whole water during 1985 exceeded the Michigan Surface WQS, Rule 57 Value (January 1991) (0.00002 mg/L) at 11 stations located throughout the river. These included stations located at both the head and mouth of the river and no pattern relating to sources within the AOC could be identified.

Parameters Elevated Above Background Concentrations

Other parameters found in the plume along the Ontario shore at concentrations which were elevated above those upstream of the plume (head of river or Lake Huron) in 1986, but either did not exceed guidelines or for which no guidelines are available, include hexachloroethane, pentachlorobenzene, 1,1,1-trichloroethane and chloroform. Minor organics exhibiting elevated levels during 1986 in the Sarnia area are methylene chloride, bromodichloromethane and dibromomethane. Although not exceeding guidelines, these parameters have been listed by OMOE on the Effluent Monitoring Priority List (EMPPL) which identifies those contaminants of greatest concern due to combined exposure and effects concerns.

Concentrations of tetrachloroethylene and carbon tetrachloride were found in the St. Clair delta channels, particularly in South Channel, and at the mouths of South Channel, Bassett Channel and Chenal Ecart in concentrations which were elevated relative to those in central Lake St. Clair during 1984. Higher concentrations of both parameters in the South Channel relative to the North Channel or in Lake St. Clair suggest a contaminant plume which originates along the Ontario side of the St. Clair River.

Hexachlorobutadiene, hexachlorobenzene and octachlorostyrene in Talfourd and Bowens Creeks and the Pine River (Michigan) occurred at concentrations elevated above those typically found at the head of the St. Clair River, suggesting that these tributaries may also serve a sources of contaminants.

Historical Trends
Levels of mercury in the St. Clair river waters have been reduced by up to two orders of magnitude between 1973 and 1988:

- in 1973, mercury concentrations in water were 4.6 and 2.4 mg/L at the head and mouth of the river respectively;

- in 1984, whole water samples had mercury concentrations at or below detection (0.01 mg/L) for most of the river with locally elevated maximum concentrations averaging 0.1 mg/L offshore of the Sarnia industrial area and Chenal Ecart respectively;

- in 1986, whole water samples were also generally at or below detection (0.01 mg/L) throughout the river with maximum concentrations reduced to 0.03 mg/L; and

- in 1988, whole water samples with annual means of 0.03, 0.02 and 0.01 mg/L at the intakes for the Lambton, Walpole Island and Wallaceburg Water Treatment Plants.

Although much reduced, these 1988 mean concentrations of total mercury were higher than the Michigan Rule 57(2) value (January 1991) for methylmercury (0.0013 mg/L).

The average and maximum concentrations of hexachlorobenzene downstream of Dow's 1st St. Sewer complex were lower in 1985 and 1986 than 1984. However, due to a lack of historical data for industrial chlorinated organics, it is not possible to identify long-term trends in hexachlorobenzene for the St. Clair River.

Bottom Sediment Quality

Results of bottom sediment surveys in the St. Clair River reveal the most heavily contaminated portion of the river, as identified by the most frequent exceedences of dredged material disposal guidelines, by relatively high concentrations and by sediment toxicity, is the area within 100 m (328 ft) of the Ontario shore from the Cole Drain to downstream of Suncor.

Sediment Guideline Exceedences

Contaminants in bottom sediments sampled between 1977 and 1986 located along the Ontario shore of the St. Clair River and in some tributary mouths which exceed the Ontario Ministry of the Environment's guidelines for the open water disposal of dredged material are total Kjeldahl nitrogen, total phosphorus, arsenic, mercury, cadmium, copper, chromium, iron, lead, nickel, zinc, oil and grease, and PCBs. Concentrations of oil and grease, arsenic, copper, iron, manganese and mercury are classified as heavily polluted by the U.S. EPA interim guidelines for the disposal of Great Lakes harbour sediments whereas chromium and nickel are moderately polluted based on samples obtained from 1983 to 1986. Hexachlorobenzene and total PAHs exceeded the lowest effect level of Ontario's proposed biologically-based sediment quality guidelines. Most exceedences occurred along the Sarnia industrial waterfront, as far downstream as the Lambton Generating Station, and at the mouths of Talfourd Creek, Baby Creek and the Murphy Drain.

Sediments on the Michigan side of the river are generally much less polluted than those on the Ontario side. Mean concentrations of copper and iron from 23 stations sampled in 1985 along the Michigan shore exceed the Ontario open water disposal of dredged material guidelines. The mean copper concentration is also classified as moderately polluted by the EPA interim guidelines for the disposal of Great Lakes harbour sediments. Two sites immediately downstream of the CN tunnel had

concentrations of lead which exceed the Ontario disposal guideline and are classified as heavily polluted by the U.S. EPA interim guideline. Maximum iron concentrations in sediment along the Michigan side of the river are also classified as heavily polluted. Sediments in the lower river, downstream of the mouth of the Pine River, exceeded OMOE guidelines for arsenic, chromium, iron and nickel and were classified as heavily polluted by the U.S. EPA guidelines for arsenic, iron and manganese during 1983. Oil and grease concentrations in sediment of the North Channel, adjacent to Port Huron and adjacent to Marine City were classified as moderately polluted by the EPA interim guidelines.

Elevated Concentrations of Parameters in Sediments

Other parameters measured up to 1986 found in sediments at high concentrations, relative to sediments upstream of the Sarnia industrial area, but either not exceeding guidelines or for which no guidelines are available include zinc, oil and grease, phenanthrene, hexachlorobutadiene, octachlorostyrene, tri-, tetra- and pentachlorobenzene, hexachloroethane, tetrachloroethylene, carbon tetrachloride, tetrachloroethanes, pentachloroethane, chlorobutenes, heptachlorostyrene, octachloronapthalene, alkanes, diphenylether, biphenyl, 4-ethylbiphenyl and diethyl biphenyl, dibenzofurans and dibenzo-p-dioxins. In most cases there are no sediment quality guidelines for these parameters, however, they have been listed by OMOE on the Effluent Monitoring Priority List (EMPPL) which identifies those contaminants of greatest concern due to combined exposure and effects concerns.

Organic contaminants found in sediments on the Michigan side of the river included hexachlorobutadiene, hexachlorobenzene and octachlorostyrene. Concentrations of these parameters in sediments immediately downstream of the mouth of the Black River were elevated above those from the St. Clair River upstream of the mouth of the Black River. These three parameters also occurred at concentrations in sediment during 1984 which were elevated relative to upstream stations in the vicinity of the Marysville WWTP.

Historical Trends in Sediment Contamination

Sediment cores from the St. Clair River downstream of the Dow 1st Street outfall show a pattern of declining concentrations of PAHs, mercury and oil and grease up to 1985. Mercury concentrations in surficial sediments offshore of Dow, for example, have declined from a high of 90 g/g since the early 1970s to 52 g/g in 1986. Similarly, maximum lead concentrations in sediment downstream of the Ethyl Corporation outfall have declined from 640 g/g in 1983 to 330 g/g in 1985. Oil and grease concentrations downstream of Esso Petroleum have declined from maximum values of 28,000 g/g in 1977 to between 750 and 5,300 g/g in 1985 and 86 to 3,500 g/g during 1986. PCB concentration ranges in the river reach between Esso Petroleum and Suncor declined from 3 to 10 g/g in 1977 to 0.035 to 2.6 g/g in 1985 and below detection to 2.1 g/g in 1986. Although differences in analytical and sampling methodology may affect the results, there appears to be a trend of declining concentrations of mercury, lead, PCBs and oil and grease in bottom sediments of the St. Clair River.

In contrast, higher concentrations of hexachlorobenzene and octachlorostyrene in surficial layers of cores suggest continued high loadings, at least up to 1985.

Biota Quality

Benthic Macroinvertebrates

Studies of benthic invertebrate community structure from 1968 to 1985 indicate a strong pattern of improving environmental quality on the Canadian side of the St.? Clair River. The U.S. side of the river had healthy benthic communities throughout this monitoring period. The implementation of industrial and municipal abatement programs since the early 1970s has resulted in the reclamation of 9 km (5.6 mi) of the Ontario portion of the river between 1977 and 1985. Further anticipated improvements in benthic structure will be tested by a repeat of the 1985 investigation which was carried out during 1990, however, the results are not yet available.

Data on heavy metals in benthic fauna suggest that lead and cadmium contamination of two species of mussel in the St. Clair River and downstream, are primarily the result of discharges from Canadian sources.

Inputs along the industrial complex south of Sarnia are considered to result in accumulations in the tissue of introduced mussels sampled in the period of 1982 to 1987 of octachlorostyrene; hexachlorobenzene; hexachlorobutadiene; pentachlorobenzene; PCBs; PAHs; chloroform; benzene; ethylbenzene; xylenes; 2,4,5-trichlorotoluene; 1,2,4-trichlorobenzene; 1,2,3,5-trichlorobenzene; 1,2,3,5-tetrachlorobenzene; and 1,2,4,5-tetrachlorobenzene. Inputs to the river between Talfourd Creek and Polysar in Corunna contributed 1,3,5-trichlorobenzene, pentachlorobenzene and 1,2,3,5-tetrachlorobenzene. Accumulations of lead in mussel tissue were found immediately offshore and downstream of the Ethyl Corporation discharge.

Mussel studies in the St. Clair delta undertaken in 1982 and 1987, however, suggest that body burdens of octachlorostyrene, pentachlorobenzene and hexachlorobenzene have decreased in this area.

Fish

Mercury, lead, octachlorostyrene, hexachlorobenzene and PCBs have been found in the flesh of sport and/or juvenile fish with concentration patterns indicating sources in the industrial complex south of Sarnia. Concentrations of mercury and PCBs measured in 1985 are sufficient in the larger size classes of walleye, white sucker, carp, yellow perch, freshwater drum and/or gizzard shad at certain locations to exceed consumption guidelines. The consumption guideline for lead had not been exceeded as of 1985.

The octachlorostyrene criterion for the protection of piscivorous wildlife established for Niagara River biota was exceeded by all annual means for catfish and carp in Lake St.? Clair collected up to 1986 as well as in juvenile fish collected downstream of the industrial complex at Suncor and Lambton Generating Station up to 1987. The hexachlorobenzene criterion for the protection of piscivorous wildlife was not exceeded at any location for channel catfish, carp or juvenile fish.

Although not conclusive, analyses of spottail shiners between 1978 and 1987 indicate that concentrations of DDT, hexachlorobenzene, octachlorostyrene and PCBs have declined. Statistically significant reductions in fish tissue were found for PCBs and octachlorostyrene in fish collected during 1987 at the Lambton Generating Station compared to those collected in 1985 and 1986 at the same location. Total PCBs, however, have increased from 1987 to 1988 at this collection site.

Wildlife

Recent (1985?1988) data on organic chemical contaminant burdens in wildlife are available for certain mammalian and avifauna from the vicinity of the AOC, particularly the lower river and delta. However, there are no data on the impacts of these chemical burdens on wildlife health nor population dynamics nor on health effects of those people who consume these wildlife.

PCBs, octachlorostyrene, hexachlorobenzene, pentachlorobenzene and several chlorinated pesticides were found to accumulate in resident muskrats and turtles, as well as non-migratory ducks living within the AOC. Non-migratory redheads and mallards were found to have the highest concentrations of octachlorostyrene, particularly in liver tissue, as compared to other species of duck within the AOC. Herring gull eggs from colonies in the lower St.? Clair River had 1.6 to 3.5 times the concentrations of hexachlorobenzene than eggs from colonies in the Detroit and Niagara Rivers and Lakes Superior, Erie and Ontario. Migratory goldeneye ducks also accumulated PCBs, DDE, octachlorostyrene, dieldrin, hexachlorobenzene and heptachlor epoxide over a three month period (December to February) while resident in the lower St. Clair River. Domestic, chemically clean ducks introduced to the St.? Clair River delta were found to bioaccumulate octachlorostyrene, hexachlorobenzene and PCBs by up to five times within an approximately one month period (July-August).

ENVIRONMENTAL CONCERNS/USE IMPAIRMENTS

Impairments to beneficial uses in the St. Clair River AOC were determined from the data presented on physical, chemical and biological environmental conditions. As a result, the GLWQA beneficial use categories were identified as impaired, not impaired or requiring further assessment. In the latter case, further assessment is required prior to concluding whether or not the use is impaired. For some beneficial uses this requires the development of concentration based guidelines for chemicals or species for which none are available. Such guidelines are not necessarily endemic to the St. Clair River AOC, but will require assessment of conditions within the entire Great Lakes ecosystem.

Table 1.1 summarizes the findings with regard to each use impairment as well as the parameters and locations for which ambient water quality criteria were exceeded. The status of each impairment is also identified. Use impairments in the St. Clair River AOC are: restrictions on fish consumption, bird and animal deformities, degradation of benthos, restrictions on dredging activities, restrictions on drinking water consumption, drinking water taste and odour problems, beach closings, degradation of aesthetics, added cost to agriculture and industry, and loss of fish and wildlife habitat. Beneficial uses determined not to be impaired include dynamics of fish populations, eutrophication or undesirable algae, and degradation of phytoplankton and zooplankton populations.

SOURCES OF CONTAMINANTS

Point sources contribute by far the largest loadings for the majority of contaminants entering the St. Clair River. However, the nonpoint source loadings should not be disregarded with respect to remedial strategies. Of particular concern are nonpoint source loadings of copper, iron, lead, mercury, nickel, cadmium, cobalt, PAHs, and PCBs. Nonpoint source loadings constitute more than ten percent of the total loadings for each of these parameters. In addition, nonpoint phosphorus and zinc contributions are close to ten percent of the total loadings. The actual contributions from nonpoint sources may be underestimated because data are not available from all nonpoint sources.

It should be noted there are shortcomings in the available data. For example, not all parameters have been analyzed from all sources, data have been collected during various time periods, different sampling techniques and detection limits were used and different methods for calculating loads (eg. point sources) were used. The absence of data does not preclude the potential presence of a contaminant in discharges.

Loadings of contaminants due to spills from Ontario and Michigan sources have also been identified. Because many spills represent large, short-term inputs, they can not be compared directly to ongoing loads discharged from point sources. This is because the pollutants in spills are often mixed with other chemicals and acute biological effects due to spills may be noted due to the large loadings contributed at one time rather than chronic or sublethal effects related to smaller loadings contributed over a long period of time.

In comparing the current loadings database (1986 to 1989 data) to the 1986 total loadings reported by UGLCCS (1988), loadings of suspended solids, cadmium, cobalt, zinc and octachlorostyrene appear to have increased. These higher loadings are in part due to the inclusion of more sources in the current report, particularly for suspended solids and total phosphorus. Increases in the metals reflect generally higher loadings from the Sarnia WPCP during 1987 than in 1986. Octachlorostyrene loadings are reflective of higher loadings reported for the Cole Drain.

Improvements, i.e., reduced loadings since 1986, include BOD5 (particularly significant as there are more sources for which data are reported), phenols and volatiles. Reduced phenol loadings have occurred at most Ontario industries in both the petroleum refining and organic chemicals sectors. Reduced volatile loadings at Dow have contributed to the greatest reductions since 1986. The total volatile loading values reported for Ethyl and Polysar are based on the 1986 survey and it is not known whether loadings have been reduced.

A significant portion of the volatile component for Polysar is benzene, whereas the major volatiles from Dow are 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, carbon tetrachloride and tetrachloroethylene. Reductions in chlorinated organics from Dow, including hexachlorobenzene (>50%), octachlorostyrene (40%), tetrachloroethylene (62%) and hexachlorobutadiene (50%), have been reported for the period 1986/87 to 1990 based on a preliminary assessment of MISA self-monitoring data.

Causes of Impairments

In attempting to define remedial strategies for restoring beneficial uses, it is necessary to relate the impairments to chemicals and the sources of chemicals. Presently it is not possible to establish direct cause-effect relationships for every impaired use. However, it is possible to directly relate impairments resulting from biota and sediment criteria exceedences to a chemical and, hence, sources. Although not identified as a use impairment by the IJC, exceedences of water quality guidelines for the protection of aquatic life is a concern and can be related to specific chemicals and sources.

Table 1.2 lists those parameters which exceed guidelines (biota, sediment or water) and summarizes corresponding sources and loadings based on data presented in Chapter 8. Although spills are not included in this table, the number of spills and the large total loads contributed from some spills must be considered with regard to developing remedial options to restore impaired beneficial uses, particularly those related to restrictions on dredging activities, drinking water consumption, drinking water taste and odour problems and degradation of aesthetics.

Parameters designated as exceeding sediment criteria (Table 1.2) may cause restrictions on dredging activities in some locations. Costs associated with sediment analysis and confined disposal may also contribute to additional costs.

Concentrations of mercury and PCBs in certain species and sizes of sport fish have resulted in restrictions to fish consumption.

Benthic faunal communities were found in 1985 to be degraded or severely degraded in association with sediments which had the highest mean concentrations of copper, mercury, nickel, zinc, oil and grease, fibre, total organic carbon and total phosphorus. Sediments in portions of the river having degraded benthos were also found to have occasional exceedences of Ontario's biologically-based sediment guidelines for PAHs (lowest effect level) and hexachlorobenzene (lowest and severe effect levels).

Beach closings occur along the Ontario shore of the St. Clair River due to coliform bacteria densities which exceeded both Ontario and Michigan standards. In addition, all areas downstream of Michigan CSOs are identified as impaired areas due to the periodic discharge of inadequately treated sewage. Loadings of bacteria from sources in the St. Clair River AOC have not been well documented, however, known sources of bacteria to the AOC include CSOs, stormwater, effluent from water pollution control plants, and other sources including agricultural runoff, private septic systems, and some industrial outfalls.

Floating scums, oil slicks, spills and odours have been periodically reported and contribute to the degradation of aesthetics. In addition to spills, ongoing discharges of oil and grease occurs from point sources as well as wet weather periodic discharges from Sarnia CSOs and stormwater (Table 1.2).

Ontario industrial and municipal point sources contribute the largest loadings of most contaminants to the St. Clair River AOC, in comparison with estimates from other sources located within the AOC. Upstream sources are estimated to contribute loadings of mercury, phosphorus, chloride and suspended solids comparable to total sources within the AOC. Other sources located within the study area which, based on the current database, contribute relatively large loadings of certain parameters include Ontario tributaries and Sarnia stormwater.

ENVIRONMENTAL CONDITIONS

PHYSICAL IMPACTS TO THE ST. CLAIR AOC

Habitat Loss

Wetland communities common to the St. Clair River and delta were discussed in Chapter 5 (Section 5.7.7) along with their location and extent (Section 5.7.7.2). The importance and value of these resources, particularly as they relate to wildlife habitat, fisheries habitat, commercial and sport fishing, hunting and trapping, Native consumptive uses, and naturalist values, were clearly identified and documented in Chapter 5. The loss of these wetland resources, as well as other fish and wildlife habitat is considered a major concern in the AOC.

Edsall et al. (1988a) and McCullough (1985) described some of the losses of the aquatic plant community that have occurred over time due to industrial, agricultural and urban developmental pressures. Many of the wetlands of the St. Clair system have been lost, primarily because of drainage of large tracts of land for agriculture although Martz (MDNR, pers. com.) suggests that considerable wetland acreage was also lost due to dredging or filling related to marina and housing developments. In addition, many wetlands have been seriously impaired by dykes that block them from the lake. This has occurred for a variety of purposes ranging from a desire to manage a site exclusively for waterfowl, to preventing trespassing. Invariably this results in a number of impairments such as loss of hydrological functions of the wetland and the loss of fish habitat. The following information on wetland loss has been modified from Edsall et al. (1988a).

1. In 1873, the Michigan side of lake St. Clair and the St. Clair Flats supported 7,274 ha (17,975 acres) of wetland vegetation (Table 6.1); by 1973, the habitat was reduced to 2,020 ha (5,000 acres), a 72 percent loss. Significant losses occurred not only in the St. Clair Delta and St. John's Marsh, but on the entire margin of the lake as well (Figure 6.1). Some coastal areas, particularly north of the Clinton River, appear to have been drained for agriculture in the 1860s, so the 1873 data (Figure 6.1) do not include the entire wetland acreage that existed prior to European settlement.

2. The Ontario wetlands from the Thames River north to Chenal Ecart dwindled from 3,574 ha (8,830 acres) in 1965 to 2,510 ha (6,200 acres) in 1984 (McCullough, 1985). Figure 6.2 and Table 6.1 present specific areas of wetland losses in the coastal Ontario wetlands between 1965 and 1984. As indicated, losses have occurred within the Walpole Island Indian Reserve and along the eastern shores of Lake St. Clair (Table 6.1). Drainage for agriculture accounted for 92 percent of the losses, and marina and cottage development consumed the remaining 8 percent. During the record high lake level in the early 1970s, about 1,000 ha (2,470 acres) of emergent shoreline marsh from Mitchell Bay southward to the Thames River were also temporarily lost (McCullough 1985). This loss was tempered in part by the flooding of transition vegetation on the upland (east) margin of the wetlands. The St. Clair Flats and Anchor Bay in Michigan are also subject to flooding, but most of the recent wetland losses there are due to diking and filling for urban development.

3. In Ontario, the coastal zone north of the Thames River was once an open marsh, but over the decades many dikes have been constructed, and the enclosed marshes have been colonized with cattails. Although the shoreline in these areas remains as wetland, the diking has separated it from the inland portions of the wetland and altered the hydrology. These diked Ontario wetlands (like those on Harsens Island in Michigan) are effectively managed for waterfowl hunting and the result is a loss of other diverse wetland functions, particularly those related to fish production. The adverse impact of isolating and fragmenting wetlands by means of roadbeds, canals, earthen dikes and other developments appears not be to fully recognized. For example, many conservationalists in Michigan are advocating the preservation of St. John's Marsh, but few call for an increase in its hydrologic connectivity to Lake St. Clair. Moreover,

unless a wetland is physically destroyed, not merely fragmented or disconnected from a lake, most people would not refer to an isolated wetland as being impaired or degraded.

4. Wetland losses exceed those shown in Table 6.1 and Figures 6.1 and 6.2, if the definition of wetlands is expanded to include areas colonized by submersed vegetation. While data are not available specifically for the St. Clair system, Jaworski and Raphael (1976) have shown that more than 9,000 ha (22,250 acres) of wetlands were actually lost to shoreline development in Lake St. Clair (Table 6.2) between 1873 and 1968, if submergent macrophytes are added to the total wetland habitat. Losses are most evident in the Clinton River, the St. Clair delta, and along the eastern shore of the lake.

In addition to habitat losses documented for the delta, there have been extensive alterations to the shoreline and inland areas upstream of the delta. These losses are due to industrial, agricultural and urban development throughout the watershed of the AOC. The overall extent of the loss of wetland and shoreline habitat within the watershed has not been well documented. Extensive bulkheading and infilling has occurred along much of the river resulting in the loss of spawning, rearing and feeding sites for many fish species. The preservation of the remaining unaltered wetland and shallow water nearshore areas is extremely important for the maintenance of a healthy, diverse fish community.

Wildlife Populations

Changes in waterfowl use between 1968 and 1982 in the wetlands along the east shore of Lake St. Clair and on the Walpole Island Reserve was studied by Dennis and North (1984). The shoreline marshes of Lake St. Clair and Lake Erie are considered the most extensive and highest quality habitat for migratory waterfowl in Ontario, south of James Bay. Of the 13,700 ha (33,839 acres) of wetland examined, 9,800 ha (24,206 acres), or 76 percent, were within the Walpole Island Reserve. Much of this land is leased by hunt clubs.

Dennis and North (1984) estimated peak numbers of waterfowl to be 150,000 birds in these marshes in the fall. Use of this area during the autumn has shown an overall increase of 37 percent between 1968-1982. This is a result of nearly twice as many mallards, three times as many geese and fourteen times as many swans. However, some ducks have declined in numbers. For example, there has been a 14 percent decline in the use of this area by diving ducks during the fall.

Spring use of this area has shown little change between 1968 and 1982 in terms of the peak number of waterfowl which is estimated at 60,000 individuals (Dennis and North 1984). However, use of the area by dabbling ducks, such as American widgeon, green-winged teal, blue-winged teal and wood ducks, has decreased (McCullough 1985). Between 1968 and 1982, spring use by these species decreased by 79 percent, while fall use has declined by 41 percent. Use of the marshes by diving ducks during the spring has more than doubled. There has also been some increase in the number of geese and swans visiting the area in the spring.

Overall increases in wetland use are attributed to expanded populations of mallards, tundra swans and Canada geese, an increase use of baited sanctuaries (i.e., a cost effective way of increasing hunting success), and the establishment of a National Wildlife Area on the Ontario shore of Lake St. Clair. The reduction in use by certain species in the fall or spring is attributed to pressures such as the drainage and subsequent loss of wetland areas, increased boat traffic, increased hunting on portions of the wetlands owned by the Walpole Indian Band and population declines of species such as black ducks and ruddy ducks. Continent wide wetland loss is a factor to migrating bird survival, but this has not been assessed for the St. Clair wetland species.

There are no data available on trends in the use of the AOC for other wildlife species.

Dennis and North (1984) and McCullough (1985) predict that further development of the wetlands in the form of agricultural drainage, navigation and hunting will result in large reductions in use of the wetlands

by most species of waterfowl. The delta is home to many native species including many which are rare and endangered (Chapter 5, Section 5.8.3). It also serves as an important dietary supplement for residents of the Walpole Island Indian Reservation (Great Lakes Institute 1987). The remaining wetlands of the delta are thus an extremely valuable resource which should be protected from physical and chemical impacts.

SOURCES

INTRODUCTION

The sources of chemicals which impact on water quality, sediment and biota in the St. Clair River Area of Concern include point sources and nonpoint sources. Point sources refer to the discharge of effluent streams through man-made pipes and sewers. These include both municipal sewage treatment facilities and industrial process or waste streams. Industries or municipalities that discharge to tributaries are considered as indirect point sources. Nonpoint sources are diffuse inputs which reach the river from multiple points of origin including natural and man-made delivery mechanisms. These may include atmospheric deposition, intermittent urban runoff, rural land runoff, navigation, groundwater migration (including contributions from waste disposal sites) and release from bottom sediments.

Several contaminants of concern for the St. Clair River RAP were identified in Chapter 6 on the basis of exceedences of guidelines established for the concentration of chemicals in sediment, biota and/or water. These chemicals are listed below and the media for which they exceeded guidelines are also indicated (b-biota; w-water; s-sediment):

Metals
cadmium (w,s)
copper (w,s)
chromium (s)
iron (w,s)
lead (w,s)
manganese (s)
mercury (b,w,s)
nickel (s)zinc (w,s)

Conventional Pollutants
oil and grease (s)
total Kjeldahl nitrogen (s)
total phosphorus (w,s)
arsenic (s)
bacteria (w)
chloride (w)

Organic Contaminants
octachlorostyrene (b,w)
hexachlorobenzene (w,s)
hexachlorobutadiene (w)
tetrachloroethylene (w)
carbon tetrachloride (w)
dieldrin (w)
PCBs (b,w,s)
PAHs (s)

At least some loadings data are available for most of these parameters. Chromium and hexachlorobutadiene loadings data were not available at the time of writing. Fecal coliform bacteria data are not directly comparable to that for the other parameters as bacteria are measured as densities of organisms (i.e., number of organisms per unit volume), not as loadings (i.e., weight per unit time). Bacteria data are generally not included in this chapter. Primary sources are known to be urban and rural runoff, combined sewer overflows and municipal Wastewater Treatment Plants.

As part of the MISA program, the Ontario Ministry of the Environment identified a list of contaminants of greatest concern based on combined exposure and effects concerns. This list, and the rationale of its

development, are contained in the report entitled; "Effluent Monitoring Priority Pollutants List" (EMPPL, OMOE 1987a).

The EMPPL utilizes a chemical hazard assessment methodology based on a chemical's environmental persistence, potential to bioaccumulate, acute and sublethal toxicity to biological organisms including humans, and potential to exist in effluents discharged to surface waters. The list is comprised of those chemicals that have been detected or are potentially present in Ontario municipal and industrial effluents and pose a hazard to the receiving environment. Hazard assessment data obtained from the primary literature and used in the development of the EMPPL, was compiled into the Chemical Evaluation Search and Retrieval System (CESARS) data base jointly prepared by the Ontario Ministry of the Environment and the Michigan Department of Natural Resources.

Based on this list, several additional parameters known to occur in the St. Clair River have been identified as being of interest with regard to source identification. These are:

Benzene
Pentachlorobenzene
Toluene
Chlorophenols
Xylene
1,1- and 1,2-Dichloroethane
Carbon Tetrachloride
Trichloroethylene
Hexachloroethane
1,1,1- and 1,1,2-Trichloroethane
2,4,5-Trichlorotoluene

Pentachlorobenzene and chlorophenols belong to the general class of chlorinated organics (higher molecular weight chlorinated aromatic organics) whereas the remainder are volatile organics (lower molecular weight volatile organics). Tetrachloroethylene, which is included in the list of parameters exceeding guidelines, is also classed as a volatile organic. Of those parameters in the EMPPL list, loadings data are most complete for chlorophenols (as total phenols).

Ammonia-nitrogen, cyanide and suspended solids are also considered important even though they do not exceed guidelines nor are they listed as part of the EMPPL. This is due to the fact that they are ubiquitous in the Environment, and in some incidences may be responsible for effects other than those for which chemicals were evaluated to be considered for inclusion on the EMPPL. Ammonia-nitrogen has exceeded guidelines for water quality in the past, however, there are little or no recent data for this parameter. Suspended solids adsorb chemicals and are thus important with regard to the delivery and transport of various chemicals to and through the AOC. Loadings of these three parameters are monitored in the effluent of numerous point sources.

Chapter 8 is divided into two major sections, point and nonpoint sources. The point source section is further subdivided into municipal and industrial point sources which are described on an individual basis for Ontario and Michigan. The nonpoint source section has seven sections of which two are dominant. These are waste disposal sites and landfills, and spills. For both Ontario and Michigan, waste disposal sites and landfills are described individually. The other parts of the nonpoint source section are described separately for Ontario and Michigan if data were available. The most recent loadings data for parameters measured from point and nonpoint sources, except for spills, is tabulated in the summary section (Section 8.4) in order to determine total and relative average daily loadings of contaminants to the St. Clair River. This summary table is reproduced below as Table 8.1 to assist the reader in comparing among sources and parameters. It should be noted that this table is not a complete loading summary as all sources identified have not been analyzed for all parameters.

It should be noted that the method of computing loads is not the same for all tables reported in this chapter. In some cases, geometric means, medians and mean concentrations are used with a variety of flows in order to estimate loadings. These calculations will produce similar results if the data are not highly skewed, however, this may not be the case with some organic contaminants that tend to be log-normally distributed. The impact of some contaminants may depend on the infrequent but very large loads (e.g., the highest 10 percent of the load frequency distribution curve) can contribute as much as all the other loads combined.

POINT SOURCES

The locations of major Ontario and Michigan point source dischargers to the St. Clair River are shown in Figure 8.1

In Michigan, there are five municipal Wastewater Treatment Plants (WWTPs) including the Marine City, Marysville, Port Huron, St. Clair County-Algonac and St. Clair WWTPs. Six industrial facilities which discharge to the Michigan side of the St. Clair River are discussed in this section. These include three electric generating stations, two paper companies and a salt processing facility.

In Ontario, point sources include 27 industrial facilities encompassing the organic chemicals, inorganic chemicals, petroleum refining and electric generating sectors. There are also four Water Pollution Control Plants (WPCPs) and two sewage lagoons which discharge to the Ontario side of the St. Clair River or its tributaries. The WPCPs include facilities at Point Edward, Sarnia, Corunna and Courtright. Sewage lagoons, which discharge intermittently, occur at Sombra and Port Lambton (Figure 8.1).

Michigan Regulatory Summary

Michigan point sources include 11 major facilities, five municipal and six industrial, discharging to the St. Clair River. All dischargers to the surface waters of the State of Michigan are required to have a National Pollutant Discharge Elimination System (NPDES) permit to ensure that Michigan's Water Quality Standards (WQS) are met in the receiving waters. These standards are established to protect designated uses including agriculture, navigation, industrial and public water supply, warmwater fish, other indigenous aquatic life and wildlife, and partial body contact recreation, as a minimum. Rule 57 of the WQS protects aquatic life, terrestrial life and human health from toxic substances.

A permit application characterizing the effluent must be submitted to the Surface Water Quality Division. This triggers a review of the facility, processes used and materials which may be in the effluent. The NPDES permit requirements may include:

1) limits for specific parameters that are presently in the discharge which have a reasonable potential of being acutely toxic at the end of the outfall pipe, or exceeding Michigan's WQS (including chronic toxicity) outside the designated mixing zones;
2) whole effluent toxicity limits;
3) monitoring of limited parameters to evaluate compliance;
4) monitoring (biological and/or chemical) for a specific period of time to further characterize the effluent; and
5) special conditions such as minimization plans for highly bioaccumulative materials or biouptake studies.

In addition to water quality based effluent limits, treatment technology concerns for each industrial category must be met. A more complete description of this process is provided in Chapter 4.

All of the NPDES permits issued to facilities discussed in this chapter contain effluent limits, monitoring requirements and other special conditions. A copy of the NPDES permit for each facility is provided in Appendix 8.1. Effluent limits and monitoring requirements are provided in the appropriate point source

discussion. A summary of the special conditions required in each of the eleven NPDES permits is provided in Table 8.2. Each permit states that effluent discharges shall not physically or chemically alter in-stream characteristics. Should degradation occur, immediate steps to remedy the noncompliance shall be taken by the permittee and the permittee must notify the MDNR. Any changes in facility operations or sewerage system users that result in increased levels of any chemical must be reported to MDNR. Also, these NPDES permits do not authorize discharges of any type to the groundwater.

Results of monthly self-monitoring, waste characterization studies and Compliance Sampling Inspections are used to assess each facility's compliance with its permit and to set additional permit limits and monitoring requirements. Routine biomonitoring studies are conducted by MDNR and the results are used to develop any permit requirements for biomonitoring programs. Under Rule 82 of the WQS, facilities are not allowed to discharge effluent that would cause acute toxicity in the mixing zone, while Rule 57 prevents facilities from discharging effluent that would be chronically toxic to organisms in the receiving water. Facilities discharging effluent that is acutely or chronically toxic, or is close to being toxic, are required (by NPDES permit) to develop biomonitoring programs. If the biomonitoring program documents exceedences of Rules 57 or 82, the facility is required to develop and implement a Toxicity Identification/Reduction Evaluation (TI/RE) plan.

Municipal Point Sources

Five day biochemical oxygen demand (BOD5), suspended solids (SS) and total phosphorus (TP) have traditionally been used as indicators of municipal wastewater treatment plant performance and effluent quality. These parameters, among others, are used by the Ontario Ministry of the Environment (OMOE) and the Michigan Department of Natural Resources (MDNR) to assess compliance.

"The strength of wastewater is measured by the BOD5 test. This is the amount of oxygen required by microorganisms to reduce the organic content in sewage to carbon dioxide, measured over a 5 day period. High BOD concentrations in the effluent are an indication of high organic content remaining in the effluent and, therefore, ineffective treatment. Discharge of such effluent may cause oxygen depletion in receiving waters and other environmental impairment.

Removal of suspended solids in sewage effluent is important because excessive amounts of solids discharged to a water course can cause aesthetic problems and kill fish by clogging their respiratory passages (gills). Also, many trace contaminants such as metals and toxic organics are often adsorbed on the solids.

Total phosphorus has been identified as a major factor in the eutrophication of receiving waters. Excessive amounts of phosphorus cause rapid growth of algae and weeds. When algae and weeds die they decompose and use up dissolved oxygen. Lack of dissolved oxygen can kill aquatic organisms" (OMOE 1988a).

<u>MICHIGAN MUNICIPAL POINT SOURCES</u>

There are five major municipal Wastewater Treatment Plants (WWTPs) discharging to the St. Clair River from Michigan. These include the Port Huron, Marysville, St. Clair, Marine City and St. Clair County-Algonac WWTPs. These facilities are required by their NPDES permits to comply with several special conditions (Table 8.2). Applicable implementation dates are provided in each NPDES permit (Appendix 8.1).

The first special condition relates to pretreatment of industrial waste. Three of the five facilities (Port Huron, Marysville and Marine City) are required to implement an industrial waste pretreatment program. This condition details the municipal facility's responsibility to assure that all non-domestic effluent sources entering the sewage system be documented and controlled to comply with established limits, either federal or local. The permittee must maintain records and information for three years on all

monitoring and enforcement activities, and must annually review and modify the pretreatment program for present and future adjustments. The permittee shall include this information in the Annual Pretreatment Summary Report submitted to the Surface Water Quality Division, MDNR. St. Clair County-Algonac and St. Clair WWTPs are not required to develop industrial pretreatment programs. However, the permittees are required to report any discharges or proposed discharges that would result in a pretreatment requirement. The permits may be modified, if necessary.

A second special condition contains the requirement for the facility to implement a Program for Effective Residuals Management. This outlines effective methods for management and/or disposal of WWTP residuals (i.e. solids, sludge, ash, grit and other materials removed as part of the wastewater treatment process). The program is designed to accomplish safe disposal of potential pollutants including a materials management plan, yearly residual production, storage and disposal locations, residuals analysis and monitoring program, and hydrogeologic studies for areas of groundwater concern.

Specific requirements for implementation of the Combined Sewer Overflow Program are contained in the NPDES permits for Marine City, Marysville, Port Huron and St. Clair (Appendix 8.1). The CSO Program is discussed in general terms in Chapter 4.

Table 8.5 provides the estimated daily loadings to the St. Clair River and its tributaries for 1988 and 1989 from the five major Michigan WWTPs. The loadings were calculated using the monthly discharge monitoring reports (DMRs) provided by the facilities. The DMRs are based on self-monitoring requirements put forth in the individual NPDES permits (Appendix 8.1). Average daily loads were calculated in most cases. However, median loads were calculated when data for one or more months were reported in the DMR as below the analytical level of detection, not detected, or zero. Loadings provided in Table 8.5 are gross effluent loadings. Although net loadings would provide the best indication of contaminant loadings from each facility, intake data, required in order to calculate net loads, were not available.

Generally, loadings were calculated based on average effluent flows and concentrations. In some cases, however, loadings are reported directly by the facility. Where effluent concentrations were below the analytical detection limit, loadings were calculated using the level of detection as the reported concentration and the load is reported as less than (<) the value shown. The flows and concentrations used to calculate the point source loads are presented in Appendix 8.2. This appendix also provides the loading values in both metric (kg/d) and imperial (lbs/d) units.

The Port Huron WWTP is an activated sludge secondary treatment plant with chemical phosphorus removal. Plant operations include bar screens, aerated grit chambers, primary clarifiers, activated sludge aeration tanks, secondary clarifiers and chlorination. Sludges are land applied during the appropriate seasons and incinerated during the wintertime. Ash from the incineration process is hauled to a licensed landfill. The plant serves 50,000 people and has a design and average flow of 20 and 12 MGD (75.7 and 45.4 X 103m3/d), respectively. The facility is regulated under NPDES Permit No. MI 0023833 issued September 17, 1987 and modified on June 25, 1990.

The Port Huron permit establishes effluent limits for several parameters including copper and zinc (Table 8.6). Both of these metals were found in the effluent during a wastewater survey conducted at the facility in 1985. The permit also requires the facility to monitor its effluent semimonthly for PCBs and to implement the approved long term compliance plan for reducing PCBs in effluent to below 1.2 x 10-5 g/l. This requirement is incorporated into the permit to minimize the introduction of PCBs into the sewer system. As of July 1, 1990, the facility is not allowed to discharge PCBs in excess of the detection limit (0.5 g/l). The facility has maintained compliance with this limit.

Requirements for the regulation and correction of discharges from its combined sewer overflow system are also included in the permit. The program is consistent with that outlined in Chapter 4 and requires submittal of a Final CSO Control Program by December 31, 1992.

Total suspended solids, total phosphorus, zinc, and PCBs are the parameters of concern discharged from this facility. The average annual loadings for total suspended solids and total phosphorus for 1988 and 1989 are shown in Table 8.5. The last Compliance Sampling Survey, conducted November 9-10, 1987, showed the facility was in compliance with its NPDES Permit and the discharge did not contain any organic or inorganic contaminants at levels of concern. The next Compliance Sampling Survey is scheduled for 1992.

Routine review of facility self-monitoring reports and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of the NPDES Permit with two exceptions. One, the facility has not signed a multijurisdictional agreement with one outlying township in its collection system required under the Industrial Pretreatment Program. Secondly, the facility is in noncompliance with its effluent limit for total residual chlorine pending action by the Water Resources Commission to modify its effluent limit.

The Marysville WWTP is a trickling filter secondary plant with chemical phosphorus removal. Plant operations include screening, grit removal, primary settling, two trickling filters, secondary settling, and chlorination. Sludges are treated using aerobic digestion and disposed of by land application. The plant serves 8,000 people and has a design flow and average flow of 2.6 and 1.9 MGD (9.8 and 7.2 X 103m3/d), respectively. The facility is regulated under NPDES permit No. MI0020656 issued May 24, 1990 (Appendix 8.1). Final effluent limits and monitoring requirements are listed in Table 8.7.

Mercury, zinc, PCBs, total suspended solids and total phosphorus are the parameters of concern discharged from this facility. Limits for metals and PCBs were incorporated into the Permit because they were detected in the effluent during the 1986 Compliance Sampling Survey. Monitoring is required to determine if these contaminants are being discharged in significant concentrations. The average annual loadings for these parameters for 1988 and 1989 are shown in Table 8.5. The last Compliance Sampling Survey, conducted July 29-30, 1986, showed the facility was in compliance with its NPDES permit and the discharge did not contain any organic or inorganic contaminants at levels of concern. The next Compliance Sampling Survey is scheduled for 1991.

As indicated in Table 8.2, the Marysville Permit also requires regulation and correction of discharges from its combined sewer overflow system. The program is consistent with that outlined in Chapter 4 and requires submittal of a Final CSO Control Program by October 1, 1992.

Routine review of facility self-monitoring reports and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of the NPDES Permit.

The St. Clair WWTP is a trickling filter secondary treatment plant with chemical phosphorus removal. Plant operations include grit removal, air flocculation, primary sedimentation, two trickling filters, and chlorination. Sludges are anaerobically digested then land applied according to approved procedures. The plant serves a population of 6,000 and has design and average flows of 1.4 and 1.3 MGD (5.3 and 4.9 X 103m3/d), respectively. The facility is regulated under NPDES Permit No. MI 0020591 issued June 15, 1989 and modified May 24, 1990 (Appendix 8.1).

Final effluent limits and monitoring requirements established in the permit are summarized in Table 8.8. The St. Clair permit establishes effluent limits for several parameters including silver, lead, and zinc. The permit requires monitoring of these parameters on a quarterly basis. Special permit requirements are shown in Table 8.2.

Table 8.5. The average monthly ammonia-nitrogen concentration ranged between 1.39 and 3.65 mg/l from January to December 1990. The zinc concentrations measured ranged between <10 to 60 g/l, and lead between 60 and <130 g/L.

The last Compliance Sampling Survey, conducted July 25-26, 1989 showed the facility to be in substantial compliance with its NPDES Permit and the discharge did not contain any organic or inorganic contaminants at levels of concern. Routine review of facility self-monitoring reports and periodic inspections by District personnel indicates that the facility is in substantial compliance with the terms and conditions of the NPDES permit.

The Marine City WWTP is a trickling filter secondary treatment plant with chemical phosphorus removal. Plant operations include grit removal, primary sedimentation, two trickling filters, secondary clarifiers, and chlorination. Sludges are anaerobically digested then land applied according to approved procedures. The plant serves a population of 6,523 and has design and average flows of 1.6 and 1.8 MGD (6.1 and 6.8 X 103 m3/d), respectively. The facility is regulated under NPDES Permit No. MI 0020893 issued September 22, 1989 (Appendix 8.1). Final effluent limitations and monitoring requirements are summarized in Table 8.9. Additional special programs and permit requirements are shown in Table 8.2.

The City is in the process of constructing a new WWTP including replacement of the trickling filter treatment system with a new oxidation ditch treatment system. The City has applied for and received a $10.4 million loan from the State and Federal governments. Construction of the new plant is scheduled to begin in the Fall of 1991.

Requirements for the regulation and correction of discharges from its combined sewer overflow system are included in the permit. The City, through the requirements of a Final Order, will separate the combined sewers within their system by 1994.

Total suspended solids, total phosphorus, and toluene are the parameters of concern discharged from this facility. The average loadings for total suspended solids and total phosphorus for 1988 and 1989 are shown in Table 8.5. The last Compliance Sampling Survey, conducted July 25-26, 1989, showed the facility to be in substantial compliance with its NPDES Permit and the discharge did not contain any inorganic contaminants at levels of concern. However, low-level concentrations of toluene were discovered in the wastewater during the survey. District compliance staff are reviewing this information for possible administrative compliance actions.

Routine review of facility self-monitoring reports and periodic inspections by District personnel indicates that the facility is in substantial compliance with the terms and conditions of the NPDES permit.

The UGLCCS (1988) reported an elevated concentration of total cyanide (270 g/L) in the Marine City WWTP effluent. The city determined that this was the result of cyanide-containing wastewater from an industrial source. The industry was not properly pretreating its wastewater prior to discharge. Through the city's IPP program, the industry was brought into compliance with the ordinance limits and the concentrations in the WWTP final effluent have returned to normal (Point Source Workgroup UGLCCS 1988).

The St. Clair Co.- Algonac WWTP is a rotating biological contactors (RBC) secondary treatment plant with chemical phosphorus removal. Plant operations include rough screening, comminutor, primary sedimentation, rotating biological contactors, secondary clarifiers and chlorination. Sludges are anaerobically digested then land applied according to approved procedures. The plant serves a population of 14,000 and has design and average flows of 2.7 and 1.6 MGD (10.2 and 6.1 X 103m3/d), respectively. The facility is regulated under NPDES Permit No. MI 0020389 issued June 15, 1989 (Appendix 8.1). Table 8.10 summarizes final effluent limitations and monitoring requirements as specified in the St. Clair Co.- Algonac permit. Additional special programs and permit requirements are shown in Table 8.2.

Total suspended solids, total phosphorus, mercury and PCBs are the parameters of concern discharged from this facility. The average loadings for total suspended solids and total phosphorus for 1988 and 1989 are shown in Table 8.5. The concentrations of PCBs and mercury for all samples collected in 1990

were less than the detection limit. These parameters were added to the last NPDES Permit because they were detected in the effluent during the 1986 Compliance Sampling Survey.

The last Compliance Sampling Survey, conducted July 25-26, 1989 showed the facility to be in substantial compliance with its NPDES Permit and the discharge did not contain any organic or inorganic contaminants at levels of concern.

Routine review of facility self-monitoring reports and periodic inspections by District personnel indicates that the facility is in substantial compliance with the terms and conditions of the NPDES permit.

INDUSTRIAL POINT SOURCES

Industrial effluents include final effluent from industrial wastewater treatment facilities, runoff from industrial sites, cooling water or process streams. They may be discharged to the river either directly or indirectly. Direct discharges are those which enter the river via a pipe, sewer or channel which services the plant site. Indirect discharges are those which enter a drain/ditch prior to entering the river. Loadings from direct and indirect industrial sources are considered for this section.

Ontario Industrial Point Sources

There are a total of 27 facilities representing four industrial sectors. The facilities and the number and nature of their discharges (direct-D, indirect-I) are listed below.

PETROLEUM REFINING:
Esso Petroleum Canada (3-D)
Novacor Chemicals Ltd., Corunna (formerly Petrosar Limited) (1-D)
Shell Canada Products Ltd., Sarnia Manufacturing Centre (2-I via Allingham Drain and 5-I via Talfourd Creek)
Suncor Inc., Sunoco Division (1-D)

ORGANIC CHEMICALS:
AKZO Chemicals (2-I via Cole Drain)
BASF Canada Inc. (2-I " " ")
Chinook Chemicals (1-D)
Dow Chemical Canada Inc. (7-D and 3-I)
AMOCO (1-I via Cole Drain)
DuPont Canada Inc. (1-D)
Esso Chemical Canada (1-D)
Ethyl Canada Inc., Corunna (1-D)
Novacor Chemicals Ltd., Mooretown (1-D and 1-I via Baby Creek)
Novacor Chemicals Ltd., Sarnia (formerly Polysar Ltd.)
Polysar Rubber Corporation, Sarnia
INORGANIC CHEMICALS:
Cabot Canada Inc. (1-I via Cole Drain)
I.C.I. Nitrogen Products (1-D)
Fiberglas Canada Inc. (1-I via Cole Drain)
Partek Insulations Ltd. (3-I via Scott Road Drain)
Welland Chemicals Ltd. (5-I)
Linde-Mooretown (1-I)
Linde-Sarnia (1-I via Cole Drain)
Air Products (1-I via Cole Drain)
Cardox (1-D)
Liquid Carbonic (1-I)
Standard Aggregate

THERMAL GENERATING:
Ontario Hydro Lambton Thermal Generating Station (TGS) (3-D and 2-I)

One of the direct discharges identified above for Polysar/Novacor (Sarnia) is the outlet of the Cole Drain. This is because the outlet is on Polysar property. Loadings from that outlet incorporate all the upstream direct and indirect discharges, including direct discharge and seepage from several other industrial plant sites, landfills and surface runoff to the Cole Drain, the Scott Road Drain and the Perimeter Ditch for the Scott Road Landfills. The Cole Drain was formerly referred to as the "Township Ditch".

In the following sections, an overview of these industrial point sources describing the companies products, processes and wastewater treatment is included. Available 1984 through 1989 net discharge data (self-monitoring data as reported in the OMOE Industrial Dischargers Reports) are presented for regularly monitored parameters (industry-specific).

Net loadings are used as the basis of comparison for most years and most industries. In some cases, however, only gross loadings are reported. Gross and net loadings can not be compared to each other. Net loadings are determined by subtracting loadings in the intake water from those of the outfall in order to determine only the loads from the facility. Gross discharge data (i.e., total of intake and outfall) are the only data available for 1989 for the petroleum sector and for all years at I.C.I., Ethyl, Novacor Chemicals and Fiberglas Canada. The 1989 petroleum sector data for regularly monitored parameters are not used with the exception of the twelve month MISA Monitoring study described at the end of the Petroleum Sector discussion.

Industry-specific effluent guidelines are also indicated, many of which have been determined by Certificates of Approval (CofA). The first page of the CofA for industrial facilities of the St. Clair River are provided in Appendix 8.2 for illustrative purposes. Each CofA is maintained as a discreet document and a complete listing is not currently available.

Loadings, as expressed in kg/d based on annual averages, are utilized in the following discussion for comparative purposes. Data from the Ontario Industrial Direct Discharges Reports are annual averages (monthly averages are provided in each report) whereas data from specific surveys are based on sampling periods ranging from 3 to 6 days (UGLCCS 1988) to 12 months (MISA Monitoring Study for the Petroleum Sector).

Toxicity testing is conducted by OMOE based on a static lethality test using rainbow trout (OMOE 1989b). The test measures the concentration of effluent that will kill 50 percent of the test fish in four days (LC50, 96hr). The Federal toxicity tests are based on 24 hour and/or 96 hour static lethality tests using rainbow trout. More than 50 percent mortality is considered a violation of the guidelines (Environmental Protection 1989). Specific results for individual facilities are only available for the petroleum sector.

Michigan Industrial Point Sources

There are six major industrial dischargers to the St. Clair River in Michigan. The following sections describe the facilities, treatment processes, requirements of the NPDES permits, and the quality of the effluent discharged by each. Their locations are shown in Figure 8.1.

The major Michigan industries discharging to the St. Clair River are:

James River KVP, Port Huron
E.B.Eddy Paper (formerly Port Huron Paper), Port Huron
Detroit Edison Company, Marysville Station
Akzo Salt Incorporated (formerly Diamond Crystal Salt Company)
Detroit Edison Company, St. Clair Station
Detroit Edison Company, Belle River Station

The NPDES permits contain several special conditions which are indicated in Table 8.2.

Table 8.32 provides the estimated daily loadings to the St. Clair River and its tributaries for 1988 and 1989 from the six major Michigan industrial point source dischargers. The loadings were calculated using the monthly discharge monitoring reports (DMR) provided by the dischargers. The DMRs are based on self-monitoring requirements put forth in the individual NPDES permits (Appendix 8.1). Average daily loads were calculated in most cases. However, median loads were calculated when data for one or more months were reported in the DMR as below the analytical level of detection, not detected, or zero. Loadings provided in Table 8.32 are gross effluent loads. Although net loads would provide the most accurate indication of contaminant loadings generated by each facility, intake data, required in order to calculate net loads, were not available.

As in the case of Michigan municipal point sources (Section 8.2.3.2), the loadings were calculated based on average effluent flows and concentrations. In some cases, however, loadings are directly reported by the facility.

Akzo Salt, Inc. (formerly Diamond Crystal Salt Company) produces sodium chloride products for domestic and industrial use. Process and cooling water is obtained from the St. Clair River. Process water is sand-filtered and chlorinated prior to use. Process wastewaters are from sand filter backwash, daily graveller and condenser cooling, continuous boiler blowdown and vacuum blowdown. All are discharged to a sedimentation tank for treatment. Sedimentation tank effluent is either recycled back underground for solution mining purposes or discharged to the outfall flume. The outfall flume discharges non-contact cooling water, treated process wastewater and stormwater to the St. Clair River via outfall 002 in compliance with the terms and conditions of NPDES Permit No. MI 0001031 issued August 23, 1990 (Appendix 8.1).

Final effluent limitations and monitoring requirements for this facility are listed in Table 8.33. Additional special permit requirements are shown in Table 8.2.

The NPDES permit of the AKZO Salt facility contains a special condition that requires the permittee to submit a biomonitoring plan for acute toxicity testing on the effluent from outfall 002. The plan was submitted on October 30, 1990. The plan is presently under review by Division staff.

Total suspended solids and chlorides are the only parameters of concern discharged from this facility. Loads to the St. Clair River from Akzo Salt for 1988 and 1989 are provided in Table 8.32.

The last Compliance Sampling Inspection (CSI), conducted on August 14-15, 1990 showed the facility was in compliance with its NPDES permit and the discharge did not contain any organic or inorganic contaminants at levels of concern.

Routine review of facility self-monitoring data and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of the NPDES permit.

The Detroit Edison Company (DECO), Belle River Station is a coal fired, electric generating facility with a maximum output of 1352 megawatts. It has a maximum design flow of 1,000,000 MGD and an average daily flow of 411 MGD (1,556 X 103m3/d).

The DECO-Belle River facility is located approximately 2 km (1.2 mi) inland, west of the St. Clair River. The plant takes its cooling and process water from the St. Clair River. Non-contact cooling water, boiler blowdown, and oily water treatment is handled by the Belle River plant treatment systems. The treated wastewater is discharged to the St. Clair River via outfall 001 through a submerged multiport diffuser. Bottom Ash transport water and low volume waste is discharged to the Belle River via Webster Drain via outfall 002.

The facility is regulated under NPDES Permit No. MI 0038172, issued September 21, 1989 (Appendix 8.1). A summary of the DECO-Belle River plant NPDES permit effluent limitations are listed in Table 8.34. Additional special permit requirements are shown in Table 8.2.

The NPDES permit of the DECO-Belle River facility contains a special condition that requires the permittee to conduct a Short-Term Waste Characterization Study for methylene chloride, lead, cadmium, selenium, and silver. These parameters were found in sampling results submitted by the company with their permit application. Monitoring required under this condition is designed to determine whether these constituents are discharged in significant quantities. Results of STWCS were submitted by the company April 14 , 1990.

The permittee is also required by the permit to undertake a study to reduce the discharge of settleable solids to the maximum extent practicable from outfall 002. The study shall include the investigation of alternative treatment technologies. Results of the study were submitted to the District office on January 4, 1991. The results are presently under review by District staff. A study of the intake structure to quantify entrainment and impingement of fish is also a requirement of the NPDES permit. The results of the study are to be submitted to the Chief of the Surface Water Quality Division, MDNR by July 1, 1991.

An Aquatic Toxicity Assessment was conducted on the effluent from both DECO-Belle River outfalls in January 1986. Test animals (Daphnia magna) remained alive and vigorous throughout the tests, and showed no signs of toxic effects.

Loads to the St. Clair River and the Belle River from The DECO-Belle River plant for 1988 and 1989 are provided in Table 8.32.

The last Compliance Sampling Inspection (CSI), conducted on July 29-30, 1986, showed the facility was in compliance with its NPDES permit and the discharge did not contain any organic or inorganic contaminants at levels of concern. The next sampling survey for this facility is scheduled for September 3-4, 1991.

Routine review of facility self-monitoring data and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of the NPDES permit.

The Detroit Edison Company (DECO), Marysville Power Station is a coal fired, electric generating facility that generates power during peak load periods. The facility generates about 3500 megawatt hours per day and supplies an average of 2.4 million pounds (1,088.6 tonnes) of steam per day.

Water for the DECO - Marysville facility is obtained from the St. Clair River. The total discharge to the St. Clair River is via the outlet canal, outfall 001, which receives all the wastewater from several wastewater sources. The chemical waste system treats boiler blowdown and metal cleaning wastes. Solids are settled out and the waste is treated with lime slurry until a predetermined pH is reached. The treated wastewater is discharged via the outlet canal. The ash waste system treats wastewater for the removal of bottom ash. The system includes four ash basins, polymer addition, and treatment in a gravity settler. Oily waste is pumped to an oily waste equalization basin, then to an oil-water separator and a pressure sand filter. The waste is then discharged to the outlet canal.

On May 1, 1988 the facility went on "Economy Reserve" and is not generating electricity at the present time. The only discharges at the present time include stormwater runoff and discharge from a small temporary boiler used to heat the plant buildings. Because of the possibilities of increased power needs in the future and the continued discharge of stormwater the facility is still regulated under NPDES Permit No. MI 0001694, issued on February 26, 1985 (Appendix 8.1). Final effluent limitations and monitoring requirements for this facility are listed in Table 8.35. Additional special permit requirements are shown in Table 8.2.

The NPDES permit of the DECO-Marysville facility contains a special condition that requires the permittee to conduct a Short-Term Waste Characterization Study for several volatile, acid and base/neutral compounds discharged from outfall 001. Zinc was detected in the effluent during a Sampling Survey. Monitoring required under this condition is designed to determine whether these constituents are discharged in significant quantities.
Loads to the St. Clair River from The DECO-Marysville plant for 1988 and 1989 are provided in Table 8.32.

The last Compliance Sampling Inspection (CSI), conducted on March 9-10, 1987, showed the facility was in compliance with its NPDES permit and the discharge did not contain any organic or inorganic contaminants at levels of concern.

Routine review of facility self-monitoring data and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of the NPDES permit.

The Detroit Edison Company (DECO), St. Clair Power Station is a oil/coal fired, electric generating facility with a maximum output of 1550 megawatts. The plant's seven generating units produce about one quarter of the power for the Detroit metropolitan area.

The majority of the water used at the plant is once through non-contact condenser cooling water, obtained from the St. Clair River. The cooling water is chlorinated for slime control and discharged to the St.Clair River via outfall 001. Other continuous and intermittent flows are discharged through outfall 001, from five main treatment systems. Possible oil contaminated wastewaters are routed to waste equalization basins, then pumped to gravity type parallel plate oil-water separators and finally to pressure sand filters for polishing prior to discharge. Treatment of boiler blowdown and metal cleaning wastes includes solids removal, pH adjustment and removal of metal precipitates. This wastewater is then discharged to outfall 001. Fly ash is sluiced to settling lagoons, solids settled by gravity and the overflows go to outfall 001. Bottom Ash is sluiced to two separate lagoons. Alum is added to the influent of the first lagoon to aid settling. Overflows from the second basin can be pumped to outfall 001 but normally goes through 002 to the St. Clair River. Coal pile runoff is collected and pumped to settling basins. Turbidity is monitored, and when acceptable, the overflow is pumped to outfall 001. Air scrubber water, miscellaneous cooling water and demineralizer regeneration wastewater flow to settling basins and are discharged to the Belle River or the St. Clair River. Water treatment wastewater, stormwater runoff, coal pile runoff, and chemical and non-chemical metal cleaning waste from the DECO-Belle River plant are also discharged through the St. Clair Plant outfalls.

The facility is regulated under NPDES Permit No. MI 0001686, issued on August 23, 1990 (Appendix 8.1). A summary of the DECO-St.Clair plant NPDES permit effluent limitations are listed in Table 8.36. Additional special permit requirements are shown in Table 8.2. The NPDES permit of the DECO-St.Clair facility contains a special condition that requires the permittee to conduct a Short-Term Waste Characterization Study (STWCS) for copper, lead, cadmium, amenable cyanide, selenium, silver and chromium for various outfalls. Lead was detected in the effluent during a 1986 Sampling Survey. Monitoring required under this condition is designed to determine whether these constituents are discharged in significant quantities. Results from the STWCS were submitted the District office on February 4, 1991. The submittal is presently under review by Division staff.

Loads to the St. Clair River and the Belle River from The DECO-St. Clair plant for 1988 and 1989 are provided in Table 8.32.

The last Compliance Sampling Inspection (CSI), conducted on July 29-30, 1986, showed the facility was in compliance with its NPDES permit and the discharge did not contain any organic or inorganic contaminants at levels of concern. The next sampling survey for this facility is scheduled for September 3-4, 1991.

Routine review of facility self-monitoring data and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of the NPDES permit.

E.B. Eddy Paper, Inc. manufactures specialty papers from wood pulp and secondary fibers. The plant is rated at 400 tonnes/day (440 tons/day) of paper production. Cooling water and process water are obtained from the St.Clair River.
Process wastewater is treated by air flotation clarifiers and discharged, in combination with a portion of the non-contact cooling water, through outfall 009 to the St.Clair River. Additional non-contact cooling water and backwash from the intake sand filters is discharged through outfall 008 to the Black River. Both of these discharges are regulated under NPDES Permit MI0002160, issued July 21, 1988 and modified July 19, 1990 (Appendix 8.1). Monitoring requirements and final effluent limitations are shown in Table 8.37 and additional special conditions in the Permit are indicated in Table 8.2.

The effluent from E.B. Eddy Paper, Inc. was found to be acutely toxic during a July 1987 aquatic toxicity study. As a result of this study, the NPDES Permit required the company to conduct Acute Toxicity Testing of outfall 009 effluent. This testing was completed in 1989/1990 and the reports indicated that the effluent was toxic. In accordance with Rule 82 of the WQS, the facility has developed and submitted a Toxicity Identification/Reduction Evaluation (TI/RE) Plan. The Plan is currently under review by staff of the Surface Water Quality Division.

Parameters of concern discharged from this facility include total suspended solids, total phosphorus, cadmium, and total phenols. The last three parameters were detected at 25 g/l, 14 g/l and in the June 26-27, 1990 Compliance Sampling Survey. The May 22-23, 1989 Compliance Sampling Survey did not indicate that the discharge contained any organic/inorganic parameters at levels of concern. The cadmium, total phenols, and other low level detected purgeable halocarbons and aromatic hydrocarbons will be reviewed by staff of the Surface Water Quality Division.

Loads to the St.Clair River from the E.B. Eddy Paper facility for 1988 and 1989 are provided in Table 8.32.

E.B. Eddy Paper, Inc. was issued a Notice of Non-compliance and a Notice of Violation in 1989 for discharges of "unnatural turbidity" from outfall 009 to the St.Clair River. The facility modified their treatment facilities to eliminate the discharge of white sulphur bacteria in 1990.

Routine review of facility self-monitoring reports and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of their NPDES Permit. The facility has had periodic non-compliances with pH limitations during 1990 and the District compliance staff has initiated administrative compliance action against the facility to cause correction of these problems.

James River KVP-Port Huron produces light weight and Kraft specialty papers from recycled and virgin fibers. The facility has an average production rate of 160 to 170 tonnes (176.3 to 187.3 tons) of paper per day. Cooling water and a portion of the process water is obtained from the St.Clair River.

Process wastewaters are treated by three Save-Alls. The effluent from these three units, along with felt shower water, press water, and miscellaneous process flows, is discharged to two parallel air flotation clarifiers. Recovered fibers are either recycled or landfilled. The treated process wastewater, combined with cooling water, storm water drainage, and microstrainer backwash, is discharged to the St.Clair River at an average volume of 2.8 MGD (10.6 X 103m3/d) under regulation of NPDES Permit MI0003450, issued May 24, 1990 (Appendix 8.1). The established effluent limitations and monitoring conditions are shown in Table 8.38. Additional special permit requirements are shown in Table 8.2.

Due to the results of Toxicity Testing conducted in 1987 and 1989, James River KVP was required to conduct Acute Toxicity Testing as part of their NPDES Permit. The Toxicity Testing was completed in February of 1990 and the effluent is within the requirements of Rule 82 of the WQS.

A Short Term Wastewater Characterization Study (STWCS) was required in the NPDES Permit to provide additional information on possible total residual chlorine in the effluent. The data for the total chlorine residual STWCS was submitted October 10, 1990 and is currently under review.

Total suspended solids and total copper are the two parameters of concern discharged from this facility. Copper was detected in effluent sampling performed by the facility during their permit reapplication process, thus it was incorporated into the NPDES Permit. Loads to the St.Clair River from James River KVP for 1988 and 1989 are provided in Table 8.32.
Compliance Sampling Surveys were conducted at James River KVP on May 22-23, 1989 and June 26-27, 1990. The results of these surveys showed that the facility was in compliance with its NPDES permit and the discharge did not contain any organic or inorganic contaminants at a level of concern.

Routine review of facility self-monitoring reports and periodic inspections by District personnel indicate that the facility is in substantial compliance with the terms and conditions of its NPDES Permit. During October 1990 and December 1990 the facility failed to meet its 44 g/l daily maximum for total copper with one out of four samples in each month exceeding the limitation at 50 /l. District compliance staff is reviewing this data for possible administrative compliance action.

REGULATORY PROGRAMS

MICHIGAN & UNITED STATES

Numerous programs, regulations, objectives, guidelines and agreements to maintain and enhance environmental quality are in place and/or under development in Ontario, Michigan, and at the federal levels in both Canada and the United States. Many of the programs and regulations relevant to the control and enhancement of environmental quality in the St. Clair River AOC are outlined in this chapter. Legislation applicable to this discussion is listed in Appendix 4.1. The discussion is intended to outline the major aspects of the most important regulatory programs that affect environmental quality in the AOC. The chapter is organized by jurisdiction to point out the regulatory tools that each has to work with at this point in time. It is not the intent to compare or contrast programs, but rather to present information that will form the basis of many decisions affecting the AOC.

The determination of whether a beneficial use is impaired will be based on the IJC listing/delisting criteria (discussed in Chapter 2) and also to a large degree on compliance with existing policies, regulations, standards, etc. Of particular importance in this regard are the ambient water quality criteria that are established for the protection of water quality and/or water uses (by humans and other life). Although these criteria and their applications are discussed in detail under the appropriate jurisdictional section, Table 4.1 is provided as a quick reference. This table summarizes the Michigan Water Quality Standards, Ontario Provincial Water Quality Objectives and the Great Lakes Water Quality Agreement Specific Objectives for toxic substances. All will be used to assist in the determination of whether a use is impaired and whether exceedences of water quality standards occur. U.S. EPA criteria are not included because they are not directly applicable to the AOC.

The Stage 2 RAP will contain recommendations that are consistent with the legislation, policies, standards and programs described in this Chapter. Stage 2 may also recommend new programs or changes to existing regulatory programs if existing programs have been shown to be ineffective in protecting beneficial uses.

Water Quality Standards

Existing and future uses of Michigan surface waters are protected under the Michigan Water Resources Commission Act, 1929 PA 245, as amended. The Act, under Sections 2 and 5, provides for the Part 4 Rules of the Water Resources Commission (WRC) which are Michigan's Water Quality Standards (WQS). These Standards (1) establish water quality requirements applicable to the Great Lakes, their connecting waterways, and all other surface waters of the state, (2) protect public health and welfare, (3) enhance and maintain the quality of water, (4) protect the state's natural resources, (5) meet the requirements of the federal Clean Water Act, (6) are consistent with the U.S.-Canada Great Lakes Water Quality Agreement, and (7) are legally enforceable.

The WQS, filed with the Secretary of State on November 14, 1986, were approved by the U.S. EPA pursuant to Section 303 of the Clean Water Act. Therefore, Michigan WQS supersede the U.S. EPA criteria for Michigan surface waters. This discussion focuses on the Michigan WQS. Copies of the Water Resources Commission Act and the Water Quality Standards are available upon request from the Michigan Department of Natural Resources (MDNR), Surface Water Quality Division.

Michigan WQS are currently undergoing a triennial review, as required by the Clean Water Act. No substantive changes to the standards are proposed at this time. Therefore, the following discussion will also be applicable once the new standards are approved. As part of the triennial review, a comparison was made of Michigan's WQS and the Great Lakes Water Quality Agreement (GLWQA) objectives. The WQS were found, overall, to be consistent with the goals and specific objectives of the GLWQA. The report of the comparison is provided in Appendix 4.4.

The Water Quality Standards designate specific uses as a minimum basis for which all Michigan surface waters must be protected. These uses include agricultural, industrial, and public water supply; use by warmwater fish, other indigenous aquatic life, and wildlife; navigation; and partial body contact recreation (e.g. fishing and boating). Additional protection is afforded to waters that are protected for use by coldwater fish; this includes the Great Lakes, their connecting waters (except for the Keweenaw Waterway), and all waters designated by the Michigan Department of Natural Resources (MDNR) as trout streams or trout lakes. All waters of the state are designated for, and shall be protected for, total body contact recreation (e.g. swimming) from May 1 to October 31. The WQS also specify that all waters be protected for the most restrictive of all applicable designated uses. The standards also define parameters and criteria levels necessary to protect a waterbody for its designated uses. Specific WQS are stated which set forth minimum and maximum levels for certain water quality parameters (Table 4.11).

Toxic substances are controlled under a narrative rule (Rule 323.1057) specifying that they shall not be present in Michigan waters at concentrations that are, or may become, injurious to the public health, safety or welfare; plant and animal life; or the designated uses of those waters. Rule 57 is applicable to the 256 chemicals and classes of chemicals listed on the 1984 Michigan Critical Materials Register; the priority pollutants and hazardous chemicals in the Code of Federal Regulations; and any other toxic substances determined by the WRC to be of concern at a specific site.

Specific, allowable levels of toxic substances may be established by the MDNR under Rule 57. Specific guidelines for the development of allowable levels of toxic substances in surface water have been developed and are available upon request from the MDNR, Surface Water Quality Division. Following these guidelines, concentrations of toxic substances in surface water necessary to protect aquatic life, wildlife and human health (life cycle safe and cancer risk) are calculated. The most restrictive concentration is used as the allowable level in surface water. Allowable levels of toxic substances in surface water are given in Table 4.12. Allowable levels for certain toxic substances may be water body specific. For example, the toxicity of some heavy metals is dependent on the hardness of the water. Therefore, allowable levels for those metals are also dependent on water hardness.

Portions of waterbodies can be designated as mixing zones which are defined as areas where point source discharges are mixed with the receiving water. However, there are several requirements that apply to the water quality within the mixing zone. As a minimum restriction, waters may not be acutely toxic to fish or fish food organisms anywhere within the mixing zone. Exposures in mixing zones may not cause deleterious effects to populations of aquatic life or wildlife, and the mixing zone shall not prevent the passage of fish or fish food organisms in a manner which would result in adverse impacts on their immediate or future populations.

The Water Quality Standards are minimally acceptable water quality conditions. Ambient water quality should be equal to or better than the Water Quality Standards at least 95 percent of the time. Antidegradation requirements exist for waters that have better water quality than the established Water Quality Standards, or that is needed to protect existing uses. The Antidegradation Rule of the WQS states that waters may not be lowered in quality unless it is determined by the WRC that degradation of the these waters will not impair designated uses or be unreasonable and against public interest in view of the existing conditions.

The rules also declare that Michigan waters which do not meet the Water Quality Standards shall be improved to meet those Standards. Where the water quality of a certain waterbody does not meet the Water Quality Standards as a result of natural causes or conditions, further reduction of water quality is prohibited.

Point Source Discharge Permits

Effluent requirements for wastewater discharged to Michigan surface waters are established in National Pollutant Discharge Elimination System (NPDES) permits. The NPDES permitting system was

established for the entire nation in 1972 by the federal Water Pollution Control Act ("Clean Water Act"; PL 92-500). NPDES permits are required for all point source discharges of pollutants under the Clean Water Act and the Michigan Water Resources Commission Act.
Operation of the NPDES permitting program was delegated to Michigan by the U.S. EPA in October 1973. Effluent limits are required to be at least as stringent as the National effluent guidelines. The Michigan WRC is responsible for issuance or denial of NPDES permits. Effluent requirements and other conditions of a permit are recommended to the WRC by MDNR staff, with assistance from other state departments including the Michigan Department of Public Health. The general responsibility for enforcement of NPDES permit requirements lies with the Department of Natural Resources. The Michigan Department of the Attorney General works with the MDNR as needed to enforce NPDES permit requirements.

The NPDES permits are complex legal documents. Each permit contains the following general parts: specific authorization to discharge wastewater; effluent limitations and monitoring requirements; special conditions applicable to the particular discharge; special conditions applicable for certain general types of programs, such as industrial pretreatment program requirements, management requirements for sludges and other residuals, combined sewer overflow requirements, etc; and the general requirements applicable to all permits, such as what to do in emergency situations, operator certification, permit modification procedures, etc.

The permit is the primary legal document which states under what conditions a discharge is authorized. There are, however, two other areas that are critical to the success of the NPDES program. Prior to permit issuance, water quality studies, surveillance, and monitoring on both the point source discharges and the receiving water body are conducted as needed to determine what limitations should be placed in the permit. This includes both chemical and biological (toxicity tests, biological surveys) characterization. The facility desiring a permit to discharge is required to submit a permit application detailing the treatment process and discharge characteristics (e.g. flow, chemical characteristics). After permit issuance, enforcement followup is needed to ensure compliance with the permit.

One goal of the Clean Water Act is to move toward zero discharge of pollutants by use of treatment technology-based standards, and requiring that minimum receiving Water Quality Standards be achieved. Treatment technology-based discharge standards and effluent limitations based on the Water Quality Standards are determined for a given discharger. Since both must be met, the permits contain the more stringent of the two limits.

Treatment technology based standards are promulgated by the U.S. EPA based on the category of the industrial or municipal facility. National standards have been developed for 26 industrial categories, and involve over 125 toxic pollutants commonly discharged by these industries. Treatment technology-based standards are promulgated for direct discharges to lakes and streams, and for indirect discharges to surface water via sanitary sewer systems. Discharges to storm sewers which do not receive subsequent treatment are considered direct discharges. As treatment technologies improve, these federal standards are expected to become more restrictive in order to progress toward the goal of zero discharge.

Treatment technology-based effluent limitations (TTBELs) are often collectively referred to as the "Effluent Limit Guidelines". When Effluent Limit Guidelines do not exist for a certain discharge, either because none of the industrial categories cover the specific type of operation, or because Effluent Limit Guidelines have not been promulgated for the category yet, treatment technology-based limits must be determined. In this case, the "best professional judgement" of the permit writer is used to determine what the treatment technology-based effluent limits should be for the specific facility. The primary factors that are considered in establishing best professional judgement limits are the type of waste and pollutants, and available technology for a specific discharge. Other factors which may also be considered include costs and benefits of installing a certain treatment technology, and the age of the facility and equipment.

Water quality based effluent limits are determined following the WQS and associated guidelines to ensure that Water Quality Standards are achieved in the receiving waters. The WQS apply at flows greater than the design (drought) flow of the receiving streams. The design flow is the most restrictive of the 12 monthly 95 percent exceedence flows, a statistically-derived, low-flow value that occurs very infrequently. The applicable flows at which Water Quality Standards apply may be different than the 95 percent exceedence flow if the WRC determines that a more restrictive design flow is necessary, or that seasonal design flows may be granted. All Water Quality Standards for conventional pollutants apply after mixing with the design flow. For toxic substances, not more than one-fourth of the receiving water design flow is used for mixing. This is applied to both chemical specific values and biological toxicity endpoints determined through standardized toxicity tests.

Each surface water discharge permit application is reviewed to ensure that appropriate water quality-based control requirements are incorporated in the NPDES permit. Potential contributors are considered in a wasteload allocation process used by MDNR to establish these water quality-based control requirements. Site specific determinations are made based upon existing data and design conditions for the discharge and the receiving water. Water quality-based effluent limits are proposed when there is the reasonable potential that a point source discharge will cause or contribute to an excursion above any WQS. Water quality based effluent limits are determined by mathematical models used to simulate the substances in the receiving waters. For most toxic pollutants, a simple materials balance is used for calculations. When there are multiple dischargers to a single receiving waterbody, the assimilative capacity must be allocated among them.

Another consideration when issuing permits is "Antibacksliding". This concept has been contained in federal regulations for several years, and was incorporated into the federal Clean Water Act by the 1987 amendments. It is a complex concept which, roughly translated, means that limitations in a previous permit will not be made less stringent when the permit is reissued. Exceptions to the "antibacksliding" rule include when the permittee was unable to achieve the previous permit limits, and when production is increased.

NPDES permits have a maximum life of 5 years. When permits expire, they are reviewed and reissued. A complete cycle of reissuance occurs every 5 years, with approximately 20 percent of the permits being reissued each year. Under Michigan law, an expired permit remains in effect until a new permit is issued or denied.

Critical Materials and Wastewater Report

A Critical Materials and Wastewater Report must be filed annually with the MDNR by all businesses that discharge wastewater to lagoons, deep wells, the surface of the ground, surface waters, septic tanks, or municipal sewer systems according to the Michigan Water Resources Commission Act. The types of wastewater that must be reported are process water, non-contact cooling water, condenser water, commercial laundry and commercial car wash water. Sanitary wastewater which is discharged to any system other than a municipal sewer or septic tank must also be reported.

The Critical Materials and Wastewater Report sets forth the nature of the business, a list of materials used in or incidental to its manufacturing process, including by-products and waste products, and the estimated volume of wastewater discharged. The materials which must be reported appear on the Critical Materials Register (CMR) as compiled by the MDNR with the advice of a technical advisory committee. The most recent CMR, published October 1, 1988, contains 284 chemicals. The information provided in the report may be used for purposes of pollution control including the determination of parameters to be limited by the NPDES permit.

Nonpoint Sources

The regulation and control of nonpoint sources of pollution in Michigan is the responsibility of a number of state, federal and local agencies, under a variety of programs and legislative directives. Until recently, however, the state lacked a comprehensive, coordinated plan to address nonpoint sources of pollution.

In November 1988, Michigan submitted a four year management plan to the U.S. EPA to address pollution problems caused by nonpoint sources. This management plan, and an assessment of the extent of surface and groundwater contamination due to nonpoint sources (also submitted in November 1988), are required under Section 319 of the Clean Water Act of 1987.

Michigan's Nonpoint Source Management Plan and Assessment Report have been approved by EPA. The Management Plan meets the requirements of the Clean Water Act and qualifies Michigan for federal funding to reduce nonpoint source pollution. Michigan received 1.3 million dollars through Section 319 of the Clean Water Act in Fiscal Year 1990. These funds are being used to implement programs in the Nonpoint Source Management Plan.

Solving nonpoint source pollution problems in Michigan will require the implementation of abatement programs through the cooperative efforts of federal, state and local agencies. Nonpoint source program implementation can occur on either a statewide or watershed basis. One of Michigan's priorities is to emphasize implementation of nonpoint source programs on a watershed basis. Approximately 30 watershed projects are either in the planning or implementation phases throughout the state. A number of statewide programs including development of best management practices, hydrologic analysis, construction site erosion control, technical assistance and information/education programs are underway.

Navigational Dredging and Sediment Disposal

Dredging projects in Michigan are evaluated by MDNR and the Michigan Department of Transportation following the International Joint Commission (IJC) Guidelines presented in "Guidelines and Register for Evaluation of Great Lakes Dredging Projects," Report of the Dredging Subcommittee, January 1982 and the U.S. EPA "Interim Guidelines for the Disposal of Great Lakes Harbor Sediment" of 1977. All dredging projects proposed in Michigan are subject to review and certification under Sections 401(a) and 404(t) of the Federal Clean Water Act, PL 92-500. Through the certification process Michigan addresses water quality impacts which may occur during the proposed dredging and disposal, impacts to fish and wildlife, recreational use concerns and scheduling of the proposed operation.

Water quality concerns may also be addressed under Rule 92 of Michigan's Water Quality Standards. This rule provides that the Water Resources Commission may determine that a dredging activity results in unacceptable impacts on designated uses, and that the Water Quality Standards are applicable during and subsequent to the dredging activity. In these cases, the "401 water quality certification", issued under Section 401 of the Clean Water Act, would reflect any restrictions on the dredging and/or disposal operation. Acting under the authority of Rule 92, the Commission determined that the use of overflow dredging in areas with contaminated sediments (not suitable for open water disposal due to contamination) results in unacceptable impacts on designated uses. Each dredging project where the use of a hopper dredge is proposed is evaluated to determine whether the use of hopper overflow should be prohibited due to sediment contamination. Evaluation of the St. Clair River maintenance project conducted by the Corps of Engineers found that overflow dredging should not be restricted. However, it was recommended that the decision be re-evaluated when new data become available.

Dredging permits and 401 Water Quality Certifications may also be required under the Inland Lakes and Streams Act, 1972 PA 346, and the Great Lakes Submerged Lands Act, 1955 PA 247, as amended. All 346/247 permit applications are reviewed with respect to existing sediment contaminant data, and all sites are visited by MDNR personnel regardless of the degree of contamination. Projects proposed in areas with known sediment contamination are reviewed by the MDNR Surface Water Quality Division. Sediment sampling and analysis and/or project modification may be required prior to permit issuance.

The disposal method for dredged sediment is determined following an evaluation of the sediment type, contaminant type and concentration, potential beneficial uses of the material to be dredged, and availability of disposal sites. The U.S. EPA Interim Guidelines for the Disposal of Great Lakes Harbor Sediment, 1977 (Table 4.13) are used as a preliminary indicator as whether the sediments are suitable for open water disposal, or require confinement. Dredged sediments may be suitable for various types of upland disposal depending on the presence of leachable substances and the hazard to the environment. The Solid Waste Management Act, 1978 PA 64, as amended, and the Michigan Environmental Response Act, 1982 PA 307, as amended, and the administrative rules adopted pursuant to these Acts govern upland disposal options.

The Michigan Hazardous Waste Regulations, under the Hazardous Waste Management Act, 1979 PA 64, as amended, and 40 CFR 261 (1986) may be applied to sediments when disposal in a landfill is proposed. Under these regulations, the person(s) doing the dredging may be requested to conduct an extraction procedure toxicity (EP toxicity) and/or the toxicity character leaching procedure (TCLP) to determine if the material is "hazardous". If the material is classified as "hazardous" under the Resource Conservation and Recovery Act (PL 94-586), disposal in a licensed hazardous waste landfill is required.

Wetlands and Shorelines

Wetlands protection and management in Michigan is governed by ten state and two federal statutes that include a variety of specific protection and permitting programs. The state statutes are listed and briefly described in Table 4.14. The two federal statutes, the Clean Water Act of 1972 and the Rivers and Harbors Act of 1899, deal mainly with navigation issues. The Clean Water Act regulates the discharge of dredged or other fill material into navigable waters and their adjacent wetlands. The U.S. EPA is currently developing a Great Lakes Basin wetlands strategy to guide the State and Federal jurisdictions on the protection and management of wetlands.

The most recent and comprehensive of the state laws is the Wetland Protection Act, 1979 PA 203. This act provides for the preservation, management, protection and use of wetlands; requires permits to alter wetlands; and provides penalties for illegal wetland alteration. Act 203 established a state policy to protect the public against the loss of wetlands and make explicit determinations on the benefits wetlands provide. It also established a permit program to regulate some activities in wetlands that are above the ordinary high water marks of lakes and streams. Additionally, Act 203 explicitly authorized more stringent and broader regulation of wetlands by local governments, and set up a cooperative process for the sharing of information and expertise between the MDNR and local governments.

Activities in wetlands contiguous to waterbodies are regulated without regard to the size of the wetland because of the close relationship these areas have to surface waters. Non-contiguous wetlands, however, are regulated by permit only if they are greater than five acres in size. In counties of less than 100,000 people, activities in non-contiguous wetlands are not regulated until a wetland inventory is completed.

The MDNR can also regulate some activities in wetlands anywhere in the state, regardless of size, if they are determined to be essential to the preservation of natural resources and the landowner has been so notified by the Department.

The Shorelands Protection and Management Act provides for the designation of protected environmental areas along Michigan's Great Lakes shoreline that are important for the preservation and maintenance of fish and wildlife. Environmental areas covered by the Act are usually wetlands or marshes, although some are upland areas or islands. The Act applies to designated property that lies up to 1,000 feet landward of the ordinary high water mark of the Great Lakes or a connecting waterway, and those lands bordering other waters affected by levels of the Great Lakes. The Act does not apply to wetland areas already protected in national parks. Currently, 295 miles of Great Lakes or connecting waters shoreline have been designated as protected environmental areas. This is 9.0 percent of Michigan's 3,288 coastal shoreline miles. Fifty-two miles of protected environmental areas border Lake

Superior, 85 are on Lake Michigan, 140 border Lake Huron, 6 are along the Detroit River, and 12 are located on Lake Erie.

Wetland water quality is determined by characteristics and conditions different from those used to evaluate the quality of lakes and streams. In general, natural wetlands are characterized as having very shallow water with abundant vegetation, high organic bottom deposits, and the periodic absence of oxygen throughout the water and bottom sediments (Kadlec and Kadlec 1979). In essence, wetlands are characterized by conditions that are considered undesirable in lakes and streams. Consequently, the quality of wetlands is generally described in terms of their use.

Wetlands are included in Michigan's WQS under the general category "other surface waterbodies within the confines of the state". The antidegradation rule contained in the standards provides some protection to wetlands. However, few of the criteria currently included in the standards are directly applicable to wetlands because of their unique environmental conditions relative to traditional measurements for good water quality.

Hazardous Waste

The generation, treatment, transport, storage and disposal of hazardous wastes are controlled by programs developed under the Hazardous Waste Management Act, 1979 PA 64. Waste disposal sites are also regulated under the federal Resource Conservation and Recovery Act (RCRA), 1976 PL 94-580. Clean ups and other responses to contaminated sites may occur under two programs, the U.S. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 1980 PL 96-510, commonly referred to as "Superfund", and the Michigan Environmental Response Act (MERA), 1982 PA 307. Both programs utilize risk assessments to evaluate the severity of contamination at specific sites based on known or potential impacts to (mainly) human health and the environment. Sites are then ranked according to their relative severity, thereby establishing priorities for remedial actions. The major difference between the programs is that Superfund sites are assessed based on conditions when the site was at its worst, and site assessments conducted under PA 307 are based on conditions at the time of assessment. Both of these programs may provide funding, on a priority basis, for remedial investigations, feasibility studies and clean up actions prior to identification of, and/or agreement on the course of action with a responsible party.

Pesticides

The use of pesticides is addressed through the Michigan Pesticide Control Act, 1976 PA 171. This act specifies requirements for registration of pesticide products, certification and licensing of pesticide applicators, and investigations of suspected pesticide problems. Public Act 171 adopts major portions of the Federal Insecticide, Fungicide and Rodenticide Act at the state level. This allows the state primacy in the areas of pesticide registration, labelling and distribution; licensure of pesticide dealers; certification of pesticide applicators; and, enforcement. In all other areas, the federal pesticide requirements apply. Pesticide programs are under the jurisdiction of the Michigan Department of Agriculture, which also manages programs for emergency response in cases where contaminants may enter food chains.

Air Quality

The Federal Clean Air Act, as amended in 1970 and 1977, directs the U.S. EPA to establish National Ambient Air Quality Standards. Since 1971, the U.S. EPA has established standards for seven pollutants: suspended particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone (photochemical oxidants), hydrocarbons and lead. Air pollution control is addressed through a permitting process similar to the NPDES process, under the authority of the federal Clean Air Act and the Michigan Air Pollution Act, 1965 PA 348.

The Clean Air Act Amendments were signed into law on November 15, 1990. The Act requires emission standards which reflect maximum achievable control technology to be developed for new and existing major sources of 190 air toxic compounds.

The Act also includes provisions specifically for the protection of the Great Lakes from toxic air pollutants. Michigan served as the lead state on efforts to address Great Lakes protection in the amendments. The Clean Air Act now requires EPA to promulgate emission standards for sources which account for 90 percent of the emissions of seven designated pollutants (Polycyclic organic matter, alkylated lead compounds, hexachlorobenzene, mercury, polychlorinated biphenyls, 2,3,7,8-tetrachlorodibenzofurans and 2,3,7,8-tetrachlorodibenzo-p-dioxin). The Act directs EPA to consider bioaccumulation and food chain effects of air toxins when performing the assessment of residual risks remaining after technology controls are applied. Additionally, the Act provides for a multi-year study of the extent and effect of atmospheric deposition into the Great Lakes and other waters. A Great Lakes monitoring network must be established by December 31, 1991 which must include a dry and wet deposition monitoring facility on the shores of each of the Great Lakes.

A 14 member Air Toxics Policy Committee was established in December of 1987 by the Michigan Air Pollution Control Commission and the MDNR to develop a long-range strategy for developing rules to regulate, control, and abate the emission of toxic air pollutants from both new and existing sources. The Committee decided to develop rules for new and modified sources first. Atmospheric deposition of toxic pollutants to the Great Lakes was a consideration in the rules development. The Committee presented the proposed regulations for new sources to the Commission in September 1989. Public hearings have been held and a summary of public comments and responses have been compiled. Discussions with industry and environmental representatives on further revisions to the draft rules are expected to lead to final agreement on the rules package by the fall of 1991 which will be submitted for the final stages of the legislative process.

Regional initiatives are also currently taking place to facilitate the reduction of toxic air pollutant emissions which can enter the Great Lakes Basin through atmospheric deposition.

The first initiative is the implementation of the Great Lakes States' Air Permitting Agreement. Signed by the Great Lakes Environmental Administrators in November 1988, the agreement commits the air regulatory programs to require the best available control technology for toxics on sources of compounds to the maximum degree allowed under existing authority. Special focus is placed on air emission sources of Great Lakes critical pollutants including mercury, alkylated lead compounds, total polychlorinated biphenyls, hexachlorobenzene, benzo-a-pyrene, 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin and 2, 3, 7, 8-tetrachlorodibenzofuran.

The second major regional initiative is the development of a regional air toxics emission inventory. In order to assure that adequate controls of toxic air pollutants will be required, the sources of toxic air pollutants must be identified. Emission inventories are the mechanism used to ascertain the type of pollutants and quantities emitted by an air pollutant source.

A grant was received from the regional Great Lakes Protection Fund to begin the process of developing a regional air toxics emission inventory. This fund was established by the eight Great Lakes states to fund research and demonstration projects that focus on the enhancement of Great Lakes ecosystem health. This comprehensive computerized database will identify 25 compounds of potential concern to the Great Lakes Basin emitted from area, point and mobile sources in eight states. If adequate funding is received, the initial computerized database will be completed in approximately 2 years, with capability to be updated on a regular basis.

Several air toxics monitoring initiatives are also taking place throughout the state of Michigan. The Michigan Urban Air Toxics Monitoring Program was established in January 1990. Sampling is being conducted to obtain information on 29 organic compounds and 13 trace metals surrounding three urban areas. The current sampling locations are in Kalamazoo, Midland and Detroit.

The MDNR Air Quality Division (AQD) initiated a "background" air monitoring project in November 1990. The program is funded, in part, by a grant awarded to the AQD from the Great Lakes Protection Fund. Air monitors are located at three rural areas in Michigan: Sault Ste. Marie, Traverse Bay and Saginaw Bay. Sampling is conducted monthly and will last one year for compounds considered by the International Joint Commission to be "critical pollutants" in the Great Lakes ecosystem. The compounds include: total polychlorinated biphenyls and 90 component congeners, polynuclear aromatic hydrocarbons, hexachlorobenzene, dieldrin and 13 trace metals of concern. The goal of this project is to confirm the presence and magnitude of these pollutants to develop baseline data for further research projects.

A second research proposal, would incorporate the data obtained from the "background study". AQD has requested funding from the Great Lakes Protection Fund to help support this project, the grants will be awarded summer 1991. MDNR AQD and the University of Michigan research staff would jointly conduct a study to investigate the transport, deposition and source areas of toxic contaminants measured across Michigan.

Fish Consumption Advisories

The Michigan Department of Public Health (MDPH) has issued fish consumption advisories since the early 1970s in an effort to provide guidance to the public on ways to reduce their exposure to contaminants from fish. The advisories are intended primarily for the frequent fish consumer because body burdens and risk of health problems from contaminants increase over time with repeated exposure. Because the impacts on reproduction and child development are largely unknown, pregnant women, nursing mothers, women who anticipate having children and children age 15 and under are especially advised not to consume contaminated fish.

The MDPH has adopted contaminant concentrations for edible portions of fish which, when exceeded, trigger consideration of a fish consumption advisory (Table 4.15). These "trigger levels" are based on U.S. Food and Drug Administration (FDA) regulatory guidelines, and the application of risk assessments.

Three different types of advisories may be issued depending on the percentage of specimens from a sample that exceed the trigger level(s). Advice on fish consumption for organic compounds is based on the following criteria:

a) No advisory for limiting consumption will be issued when contaminants are undetected or when 10 percent or less of the tests for a particular fish species and location exceed any of the advisory trigger levels as shown in Table 4.15.

Advice on fish consumption for mercury is based on a regression analysis of fish length versus mercury concentration. Consumption advisories due to mercury contamination would be issued for particular size categories as follows:

a) No advisory for limiting consumption will be issued when concentrations of mercury for a particular fish species and location are less than 0.5 ppm.
b) An advisory for reduced consumption to no more than one meal per week will be issued when any of the advisory trigger levels are exceeded by more than 10 percent but less than 50 percent of the specimens tested for a particular species and location, and the mean concentrations do not exceed the trigger levels for the contaminants found. Nursing mothers, pregnant women, women who anticipate bearing children and children age 15 and under would be advised not to eat these fish. Michigan is likely to change this advisory to "Nursing mothers ..., and children under age 15 ..." in the 1991 advisory to promote consistency among the Great Lakes jurisdictions.
c) A "No Consumption" advisory will be issued when any advisory trigger level is exceeded by 50 percent or more of the specimens tested of a particular species and location.

When sufficient information to fully characterize the degree of contamination or human health risk does not exist, a precautionary position will be advocated until the situation can be fully evaluated.

The Health Advisory on fish consumption is published annually as part of the Michigan Fishing Guide. The advisory for the St. Clair River AOC is discussed in Chapter 6. The fishing guide is provided to each individual who purchases a fishing license, and is available free of charge from MDNR, MDPH and local health departments. Notices of consumption advisories are provided to the press and editors of sports journals.

Drinking Water Standards

The responsibility for drinking water regulations at the federal level is with the U.S. EPA. The federal Safe Drinking Water Act (SDWA) as amended in 1986 (PL 99-339, 100 State. 642) requires U.S. EPA to publish "maximum contaminant level goals" (MCLGs) for contaminants which in the judgement of the Administrator may have any adverse human health effects and which are known or anticipated to occur in public water systems. In addition to publishing MCLGs, which are non-enforceable health goals, the U.S. EPA must promulgate National Primary Drinking Water Regulations (NPDWR). The NPDWR may include either (a) a maximum contaminant level (MCL) or (b) a treatment technique. A treatment technique may be set only if it is not economically or technologically feasible to ascertain the level of a contaminant. An MCL must be set as close to the MCLG as feasible.

The 1986 amendments to the SDWA require the U.S. EPA to promulgate NPDWRs for 83 contaminants in three phases, by June 19, 1989. EPA has not met this schedule. In December of 1975, EPA published National Interim Primary Drinking Water Regulations for ten inorganic chemicals, six pesticides, and two microbiological indicator contaminants (total coliforms and turbidity). Some of these Interim Regulations, such as fluoride and coliform, have been finalized as NPDWRs. Other parameters such as Giardia and viruses, are being addressed by U.S. EPA through the establishment of required treatment techniques. The U.S. EPA is continuing to develop and promulgate NPDWRs for the remaining 83 contaminants.

National Primary Drinking Water Regulations under the SDWA are also to include monitoring requirements which assure a drinking water supply will dependably comply with the MCLs. The SDWA also contains public notification requirements should a public water supply (1) fail to comply with the MCL or treatment technique; (2) fail to comply with any monitoring requirements; (3) obtain a variance or exemption; or (4) fail to comply with any requirements of any schedule prescribed pursuant to a variance or exemption.

The federal SDWA delegates authority for the implementation of the Act to the states where the state has legislation which equals or exceeds the requirements of the Act. Any modifications to or deviations from the requirements must be approved by U.S. EPA.

The MDPH has had a drinking water program since 1913. The Michigan Safe Drinking Water Act, 1976 PA 399, was passed in 1976 with rules becoming effective in 1978. The Michigan SDWA authorizes the MDPH to provide for the supervision and control of public water supplies. The State regulations adopt the federal MCLs for organic and inorganic chemicals, microbiological contaminants, and turbidity contained in the federal act, except for radioactivity. There is no MCL for corrosivity, however monitoring requirements exist, and the water must be noncorrosive. The Michigan standards have been approved by the U.S. EPA as equivalent to or more stringent than the federal MCLs. A complete list of the MCLs and monitoring requirements for community water systems in Michigan is given in Appendix 4.5.

Drinking water standards apply after treatment either at the point of entry into the distribution system (plant tap), or at the point of use (the customer's tap) depending on the contaminant. The required sampling location for each contaminant is identified in Appendix 4.5. Drinking water standards do not apply to the raw water as taken from the waterbody (i.e. before treatment).

Michigan Waste Prevention Strategy

In February 1991, MDNR completed the development of a comprehensive strategy to reduce, at the source, waste generated by individuals, businesses and state government. The concept of waste prevention is relatively simple: If a waste is not created in the first place, it can never cause damage later. By avoiding the generation of waste at the source, waste prevention strategies are inherently the most protective of human health and the environment.

While it is true that progress has been made over the past several decades through expanded use of pollution controls and waste management practices, many persistent environmental problem remain. Environmental problems have become more difficult to predict and avoid when relying on pollution control alone. In short, such practices can no longer be relied on as the primary strategy to protect the environment, human health and, ultimately economic sustainability.

Michigan's Waste Prevention Strategy provides a vision in which future discharges to the air, water and land would be allowed only after a determination is made that there is no prudent and feasible alternative to its creation and discharge; and even then, only after sufficient treatment has been applied to meet the best available treatment technology requirements and other applicable standards. To realize this vision will mean a fundamental shift in permitting programs, which requires changes in statutes and rules.

A number of actions and recommendations to speed the implementation of waste prevention by individuals, businesses and state government are set forth in the strategy document. Recommendations include: enhanced education and promotion efforts for waste prevention; training programs; on-site technical assistance provisions to businesses; convening groups to discuss the feasibility of waste prevention initiatives in compliance and enforcement orders, environmental permits, cross-media inspections, banning certain toxic chemicals, etc.; and developing and implementing waste prevention plans for all state departments.

ENVIRONMENTAL CONCERNS/USE IMPAIRMENTS

INTRODUCTION

The objective of this chapter is to summarize the use impairments and water, sediment and biota quality problems described in Chapter 6 (Environmental Conditions). Annex 2 of the Great Lakes Water Quality Agreement of 1978, as amended in 1987, defines 'Impairment of Beneficial Use(s)' as "...a change in the chemical, physical or biological integrity of the Great Lakes System sufficient to cause any of the following:

(i) Restrictions on fish and wildlife consumption;
(ii) Tainting of fish and wildlife flavour;
(iii) Degradation of fish and wildlife populations;
(iv) Fish tumours or other deformities;
(v) Bird or animal deformities or reproduction problems;
(vi) Degradation of benthos;
(vii) Restrictions on dredging activities;
(viii) Eutrophication or undesirable algae;
(ix) Restrictions on drinking water consumption, or taste and odour problems;
(x) Beach closings;
(xi) Degradation of aesthetics;
(xii) Added costs to agriculture or industry;
(xiii) Degradation of phytoplankton and zooplankton populations; and
(xiv) Loss of fish and wildlife habitat."

Several of these use impairment categories are divided into subcategories for discussion purposes in this chapter to more clearly define the scope of the problems in the St. Clair River AOC. For example, `restrictions on fish and wildlife consumption' is divided into `restrictions on fish consumption' and `restrictions on wildlife consumption'.

A determination as to whether a specific use impairment exists in the St. Clair River AOC was made using the International Joint Commission Listing/Delisting Guidelines for Great Lakes Areas of Concern in conjunction with applicable standards, guidelines and objectives where available. In the absence of standards, guidelines or objectives, impairment status is based on best professional judgement from the evidence available. The status of beneficial uses as well as exceedences of ambient standards, guidelines and objectives are summarized in Table 7.1.

ACRONYMS AND ABBREVIATIONS

ADI Acceptable Daily Intake: The dose that is anticipated to be without risk to humans when taken daily. It is not assumed that this dose guarantees absolute safety. The determination of the ADI is often based on the application of laboratory animal toxicity data concerning chronic (long-term) doses to the environmental doses to which humans are exposed.

AOC(s) Areas of Concern: Geographic locations recognized by the International Joint Commission where water, sediment or fish quality are degraded, and the objectives of the Great Lakes Water Quality Agreement of local environmental standards are not being achieved.

BaP Benzo-a-Pyrene

BAT Best Available Technology/Treatment

BATEA Best Available Technology/Treatment Economically Achievable

BCF Bioconcentration Factor; the ratio of the concentration of a particular substance in an organism to concentration in water.

BCT Best Conventional Technology/Treatment.

BEJ Best Engineering Judgement.

BHC Benzene Hexachloride or Hexachlorocyclohexane. There are three isomers; alpha, beta, and gamma. Gamma-BHC is the insecticide lindane.

BOD Biochemical Oxygen Demand: The amount of dissolved oxygen consumed during the decomposition of organic nutrients in water during a controlled period and temperature.

BMP Best Management Practices

BPAC Binational Public Advisory Committee

BPJ Best Professional Judgement

BPT Best Practical Treatment

CANUSLAK (related to joint spill agreement)

CEPA Canadian Environmental Protection Act

CERCLA Comprehensive Environmental Response, Compensation and Liability Act

CFR Code of Federal Regulations

COA Canada-Ontario Agreement Respecting Water Quality in the Great Lakes.

COD Chemical Oxygen Demand: The amount of oxygen required to oxidize completely by chemical reagents the oxidizable compounds in an environmental sample.

CofA Certificate of Approval

CMR Critical Materials Register

CSO Combined Sewer Overflow; combined storm and sanitary sewer systems.

CWA Clean Water Act

DCB Dichlorobenzene

DDD A natural breakdown product of DDT.

DDE Dichlorodiphenyldichloroethylene. A natural breakdown product DDT.

DDT Dichlorodiphenyltrichloroethane: A widely used, very persistent chlorinated pesticide (now banned from production and use in many countries).

DFO Department of Fisheries and Oceans (Canada)

DMR Discharge Monitoring Report

DOA Department of Agriculture (Canada)

DOE/EC Department of Environment/Environment Canada

DWQO Drinking Water Quality Objective

EAA Environmental Assessment Act (Ontario)

EARP Federal (Canada) Environmental Assessment Review Process

EC-50 Effective concentration of a substance producing a defined response in 50% of a test population. The higher the EC-50, the less effective the substance is because it requires more material to elicit the desired response.

EMPPL Environmental Ontario Effluent Monitoring Priority Pollutants List

EMS Enforcement Management System

EP Extraction Procedure

EP/OR Environmental Protection, Ontario Region, Environment Canada

EPA United States Environmental Protection Agency
Environmental Protection Act (Ontario)

FDA Food and Drug Administration

FPAC Farm Pollution Advisory Committee

GLISP Great Lakes International Surveillance Plan. It provides monitoring and surveillance guidance to U.S. and Canadian agencies responsible for implementing the provisions of the GLWQA that include general surveillance and research needs as well as monitoring for results of remedial actions.

GLWQA Great Lakes Water Quality Agreement

HCB Hexachlorobenzene

HCBD Hexachlorobutadiene

HCE Hexachloroethane

HWC Health and Welfare Canada

IJC International Joint Commission: A binational organization established in 1909 by the Boundary Waters Treaty. Through the IJC, Canada and the United States cooperatively resolve problems along their common border, including water and air pollution, lake levels, power generation and other issues of mutual concern.

IMAC Interim Maximum Acceptable Concentration

IPP Industrial Pretreatment Program

LaMP Lakewide Management Plan

LC50 Lethal concentration (by volume) of a toxicant or effluent which is lethal to 50% of the test organism over a specified time period. The higher the LC50, the less toxic it is because it takes more toxicant to elicit the same response.

LD50 Lethal dose which is lethal to 50% of the test organism over a specified time period. The higher the LD50, the less toxic it is because it takes more toxicant to elicit the same response.

LIMA Lambton Industrial Meterological Alert

MAC Maximum Acceptable Concentration

MCL Maximum Contaminant Level

MCLG Maximum Contaminant Level Goal

MDNR Michigan Department of Natural Resources

MDPH Michigan Department of Public Health

MERA Michigan Environmental Response Act

MISA Municipal-Industrial Strategy for Abatement: The principal goal of this program is the virtual elimination of toxics discharged from point sources to surface waters in Ontario.

MGD Million Gallons Per Day

MSP Michigan State Police

NCP National Oil and Hazardous Substances Pollution Contingency Plan

NOAA National Oceanic and Atmospheric Administration

NPDES National Pollutant Discharge Elimination System; a permit system limiting municipal and industrial discharges, administered by U.S.EPA and the states.

NPDWR National Primary Drinking Water Regulation

NPS Nonpoint Source

NSPS New Source Performance Standards

NTU Nephelometric Turbidity Unit

OCS Octachlorostyrene

OMNR Ontario Ministry of Natural Resources

OMOE Ontario Ministry of the Environment/Environment Ontario

OWRA Ontario Water Resource Act

PAH Polynuclear Aromatic Hydrocarbons, also known as Polycyclic Aromatic Hydrocarbons or Polyaromatic Hydrocarbons. Aromatic Hydrocarbons composed of at least 2 fused benzene rings, many of which are potential or suspected carcinogens.

PBB Polybrominated biphenyl; used primarily as a fire retardant.

PCB Polychlorinated biphenyls; a class of persistent organic chemicals with a potential to bioaccumulate and suspected carcinogens; a family of chemically inert compounds, having the properties of low flammability and volatility and high electric insulation quality. Past applications include use as hydraulic fluids, heat exchange and dielectric fluids; plastisizers for plastics.

PCP Pollution Control Planning Program

PCPA Pest Control Products Act

PEAS Pollution Emergency Alert System

pH The negative power to the base 10 of the hydrogen ion concentration. A measure of acidity or alkalinity of water on a scale from 0 to 14; 7 is neutral; low numbers indicate acidic conditions, high numbers, alkaline.

PL Public Law

POTW Publicly Owned Treatment Works

PTS Persistent Toxic Substance: Any toxic substance with a half-life in water of greater than eight weeks.

PWQO Provincial Water Quality Objectives

QCB Pentachlorobenzene

RAP Remedial Action Plan

RCRA Resource Conservation and Recovery Act

SAC Ontario MOE Spills Action Centre

SDWA Safe Drinking Water Act

SEMCOG Southeast Michigan Council of Governments

SLC Screening Level Concentration

SPCC Spill Prevention and Control Countermeasure

SPDES State Pollutant Discharge Elimination System; a state administered permit limiting municipal and industrial dischargers.

STP Sewage Treatment Plant

SWEEP Soil and Water Environmental Enhancement Program

TCB Trichlorobenzene

TCDD Tetrachlorodiebenzo-p-dioxins

TDGA Transportation of Dangerous Goods Act

TCDF Tetrachlorodibenzofurans

TDS Total Dissolved Solids

TKN Total Kjeldahl Nitrogen

TOC Total Organic Carbon

TOTAL DDT Sum of DDT isomers and metabolites

TP Total Phosphorus

TTBEL Treatment Technology-Based Effluent Limitation

UDMP Ontario Urban Drainage Management Program

UGLCCS Upper Great Lakes Connecting Channels Study

U.S.EPA United States Environmental Protection Agency

WHO World Health Organization

WPCP Water Pollution Control Plant

WQBEL Water Quality Based Effluent Limits

WQS Water Quality Standards

WRC Water Resources Commission

WTP Water Treatment Plant (for drinking water)

WWTP Waste Water Treatment Plant