

1965-12-01

# Interim Report on the Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River

International Joint Commission

Follow this and additional works at: <http://scholar.uwindsor.ca/ijcarchive>

---

## Recommended Citation

International Joint Commission (1965). Interim Report on the Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River. *International Joint Commission (IJC) Digital Archive*. <http://scholar.uwindsor.ca/ijcarchive/8>

This IR is brought to you for free and open access by Scholarship at UWindsor. It has been accepted for inclusion in International Joint Commission (IJC) Digital Archive by an authorized administrator of Scholarship at UWindsor. For more information, please contact [scholarship@uwindsor.ca](mailto:scholarship@uwindsor.ca).

INTERIM REPORT  
OF THE  
INTERNATIONAL JOINT COMMISSION  
UNITED STATES AND CANADA

ON THE

POLLUTION OF  
LAKE ERIE , LAKE ONTARIO  
AND THE  
INTERNATIONAL SECTION  
OF THE  
ST. LAWRENCE RIVER

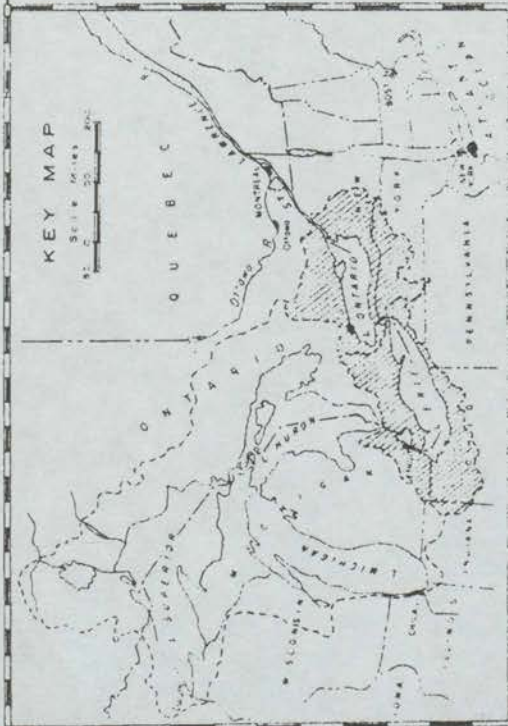
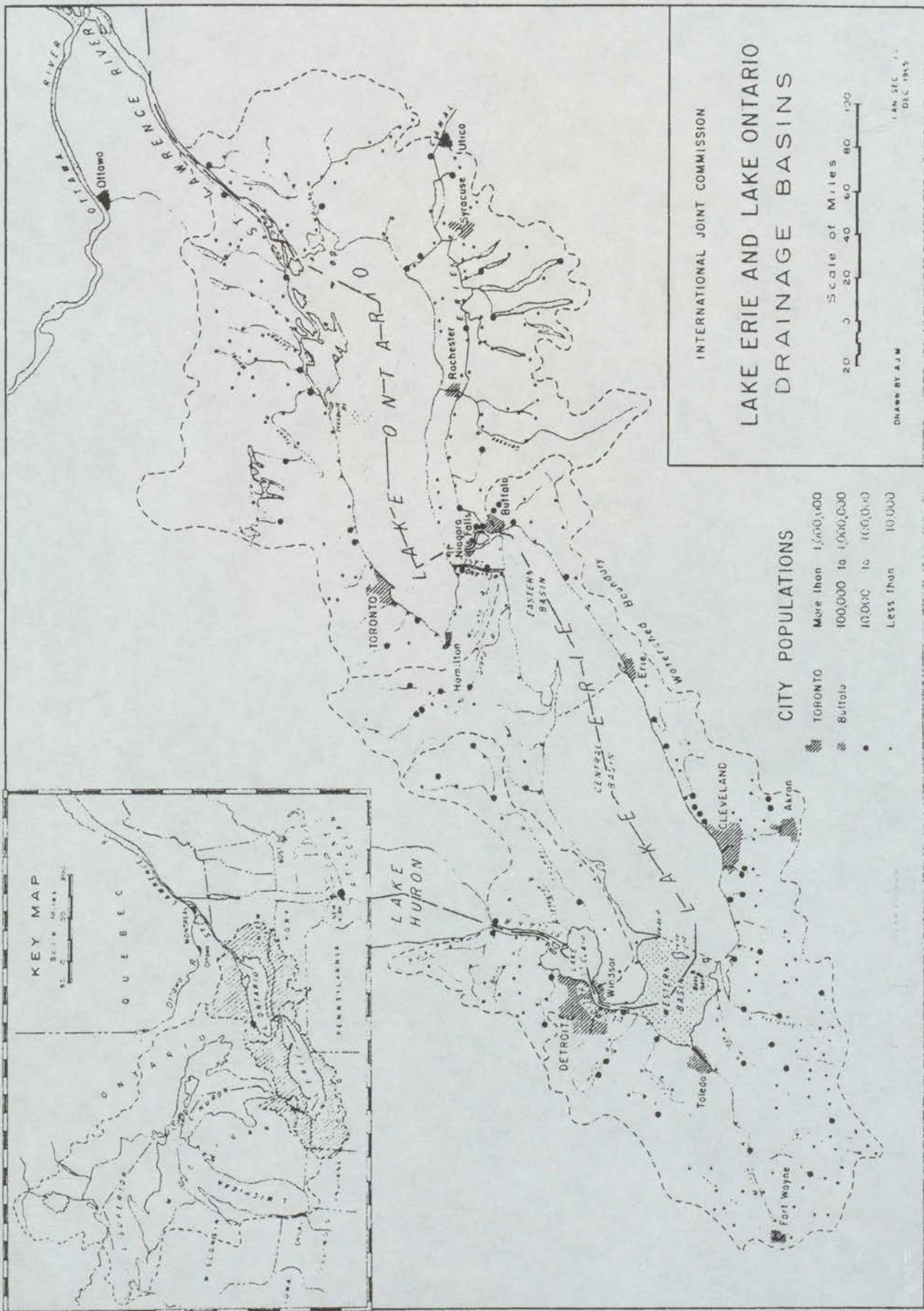
DECEMBER 1965

1965

## TABLE OF CONTENTS

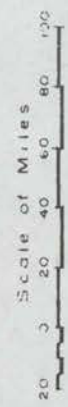
	Page
MAP OF LAKE ERIE AND LAKE ONTARIO BASINS.....	Frontispiece
THE PROBLEM.....	1
CONDITIONS IN LAKE ERIE AND LAKE ONTARIO.....	3
EUTROPHICATION OF THE LAKES.....	6
SOURCES OF POLLUTION.....	8
USES OF THE WATERS.....	10
TRANSBOUNDARY EFFECTS.....	12
PROGRAMME OF THE INVESTIGATION.....	13
RECOMMENDATIONS.....	15
THE REFERENCE.....	17





INTERNATIONAL JOINT COMMISSION

# LAKE ERIE AND LAKE ONTARIO DRAINAGE BASINS



IAN SEC. /  
DEC. 1965

DRAWN BY A.J.M.

## CITY POPULATIONS

- More than 1,000,000
- 100,000 to 1,000,000
- 10,000 to 100,000
- Less than 10,000

- TORONTO
- Buffalo
- Detroit
- Toledo
- Cleveland
- Akron
- Erie
- Buffalo
- Niagara Falls
- Rochester
- Syracuse
- Utica
- Fort Wayne
- Windsor
- Detroit
- Toledo
- Cleveland
- Akron
- Erie
- Buffalo
- Niagara Falls
- Rochester
- Syracuse
- Utica

Interim Report of  
INTERNATIONAL JOINT COMMISSION  
On The  
POLLUTION OF LAKE ERIE, LAKE ONTARIO  
and the  
INTERNATIONAL SECTION OF THE ST LAWRENCE RIVER

THE PROBLEM

On October 7 of last year the Secretary of State for External Affairs for the Government of Canada and the Secretary of State for the Government of the United States requested the International Joint Commission to investigate and report upon the extent, causes, locations and effects of pollution in the waters of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River and to recommend the most practicable remedial measures which might be considered necessary. The terms of reference are attached hereto.

The Commission is conducting its technical investigations through boards composed of federal, provincial and state officials. Because of the magnitude and complexity of the problems involved, it will inevitably be some time before these investigations can be completed. However, the Commission has now been apprised by its boards of certain relevant and important information deriving from various



studies which have already been made, notably those of the United States Public Health Service. This information, although far from complete, reveals that the situation, particularly in Lake Erie, is serious and is deteriorating. For this reason, the Commission has concluded that the facts should be brought immediately to the attention of the two governments.

The major element in the situation, which has become apparent only in recent years, is the excessive enrichment of these waters by nutrients. This phenomenon, which is known technically as eutrophication, causes the prolific and rapid growth of aquatic vegetation such as algae. These algae not only interfere seriously with essential uses of the waters but their decay progressively exhausts the dissolved oxygen in the lower depths of the Lakes.

It has been established that a high proportion of the nutrients discharged into the Lakes is contained in the effluents from municipal and from some industrial facilities. Although there is as yet no conclusive evidence that the removal of phosphates, one of the essential nutrients involved, from the wastes discharged would in itself reverse the effects of eutrophication, the Commission, on the advice of its technical advisers, is satisfied that such action would materially retard further deterioration in the quality of these waters and should be taken.

CONDITIONS IN LAKE ERIE AND LAKE ONTARIO

Information supplied to the Commission by the Advisory Boards stressed the pronounced changes which have taken place in recent years in the waters of Lake Erie and to a lesser extent Lake Ontario. The changes are associated with the addition of waste products from the watershed. The bacteriological, chemical and biological changes induced by these wastes have a deleterious effect on the water quality. Recent data indicate an accelerated rate of deterioration in Lake Erie. There is indication that a similar process, though less advanced, is taking place in Lake Ontario.

(a) Algal growths: Algae are a low form of aquatic plants with no root system. They occur either as single cells or in colonies of cells. The numerical concentration of algae in an area of Lake Erie adjacent to Cleveland increased from 200-400 cells per millilitre between the years 1920 and 1930, to 1500-2300 in 1962. About 350 miles of the shoreline of Lake Erie and 300 miles of the shoreline of Lake Ontario in the United States are suitable habitats for Cladophora, a nuisance forming algae. Prolific growths of Cladophora were reported in these areas in 1965. In September of 1964 some 800 square miles of algal bloom was noted on the surface of Lake Erie. Some 43 miles of shoreline between Toronto and Presquille Point was affected by Cladophora accumulations in 1964 and in July, 1965, algal blooms were found in the southeast section of Lake Ontario.



Algal growths curtail commercial fishing and recreational activities, impart obnoxious odors, impair filtering operations of industrial and municipal water treatment plants, lower water front property values, interfere with the manufacture of certain industrial products, and generally threaten destruction of the lake as a valuable water resource.

The algal growths reflect the cumulative load of pollution and decomposition of organic waste products. Phosphate in the wastes is considered the essential enrichment constituent associated with the extensive growth of algae.

(b) Dissolved Oxygen: A drop in dissolved oxygen indicates the presence of organic pollution. Records show that in 1929 Lake Erie possessed a high degree of oxygen saturation even in the lower depths. Low dissolved oxygen figures were first observed in 1957 in the bottom layers of the central basin of Lake Erie. Surveys in 1959 and 1960 of the bottom zones of Lake Erie, where pronounced thermal stratification persists, indicated that an area of 1600 square miles of the central basin exhibited low oxygen concentrations of one part per million or less. In August 1964 an area of the same magnitude was found with dissolved oxygen concentration even lower. A total of 2600 square miles, or 25% of the entire lake area, had an oxygen level of less than 2 parts per million in the bottom layers.



These are adverse conditions for fish life and important fish food organisms. Furthermore, the oxygen exhaustion causes a release of plant nutrients from the bottom sediments into the water, thereby stimulating even more plant growth.

The oxygen deficiency in the deeper parts of the lake is primarily due to the decay of algae and organic matter within the lake. Thermal stratification inhibits the vertical movement of water, thereby preventing the replenishment of dissolved oxygen.

Existing records do not show any critical dissolved oxygen depletion in the main body of Lake Ontario.

(c) Bottom Fauna: The animal organisms that live on the Lake bottom constitute bottom fauna. Interference with their growth and reproduction has a detrimental effect on fish life.

Adverse conditions have developed in the western basin of Lake Erie. This area is within the influence of the flows from the Detroit, Huron, Raisin, Maumee, Portage and Sandusky rivers. Important fish food organisms such as mayfly and caddis fly, have virtually disappeared from the deeper waters off Bass Islands. They have been supplanted by sludge worms and blood worms which are inferior fish food, tolerant of a low oxygen content, and indicative of polluted conditions.

The commercial harvest of fish in Lake Erie previously consisted of Cisco, Whitefish, Sauger, Walleye and Blue Pike.

Now the catch consists of less desirable species such as Perch and Smelt.

(d) Chemical: The concentration of chemicals has increased in Lake Erie and Lake Ontario. The increases are parallel with but not so marked as the biological changes. Data obtained by the U.S. Bureau of Commercial Fisheries show definite increases since 1920 in the concentration of calcium, magnesium, sodium plus potassium, and chlorides.

Unfortunately there is little historical data on such important plant nutrients as phosphates and nitrates. However, existing data indicate a marked increase.

#### EUTROPHICATION OF THE LAKES

Eutrophication is the enrichment of waters by nutrients. It generally causes heavy growths of all aquatic vegetation. This can be compared to the stimulated growth of crops by the application of fertilizers.

The cycle following eutrophication is initiated by nutrients being introduced in wastes or run off waters. This stimulates the growth of algae. It is more pronounced in areas nearest to the source of enrichment. The algae die and sink to the bottom of the lake. The microbiota feed upon this organic matter and in the process deplete the dissolved oxygen. The greater the amount of algal growth, the sooner the dissolved



oxygen in the deeper waters is exhausted. Since the bottom waters are isolated by thermal stratification from the surface layers, the oxygen cannot be replenished.

Depletion of oxygen in the deeper waters is then followed, as indicated previously, by a release from the bottom deposits of nutrients which are in turn available to pass through the same cycle of plant growth and decay. The bottom deposit thus serves as a reservoir for nutrients. Under certain conditions this high productivity may be self-supporting and independent of any added amounts.

The onset of eutrophication is seldom noticed. Extreme eutrophy causes a sudden phenomenon requiring only a few years to become manifest. Consequently the change in appearance of a lake tends to take the public by surprise. Such is the case in Lake Erie. Observations show that once a lake has become eutrophic it remains so for a very long time, even if the source of new nutrients is cut off.

There is evidence that the Great Lakes are responding to the addition of artificial enrichment, the result of man's activities. The rate of response is related to the size and depth of the lake. Lake Erie, the shallowest of the Great Lakes, is the most advanced. Lake Ontario, a much deeper lake, does not show at present the same critical conditions.

Phosphorus appears to be the key nutrient in the enrichment of the waters. It is present in the form of phosphates in sewage and some industrial wastes. Although there is no

conclusive evidence that the removal of phosphates from the waste effluents will necessarily reverse the effects of eutrophication, sufficient information has been obtained from this continent and from Europe to justify proceeding on a programme of removing phosphates from the waste waters being discharged into the lakes and their tributaries.

Additional research is needed to secure the information lacking on the dynamics of eutrophication.

#### SOURCES OF POLLUTION

The most significant pollutants come from municipal sewage, industrial wastes, and land drainage.

(a) Municipalities: The United States portion of Lake Erie includes the states of Michigan, Ohio, Pennsylvania and New York. About 53% of the municipal wastes from a population of 10 millions receives secondary treatment, 41% primary treatment, and 6% no treatment.

The Canadian portion of Lake Erie is in the province of Ontario. About 79% of the municipal wastes from a population of 1.2 millions receives secondary treatment, 12% primary treatment, and 9% no treatment.

On the United States side of Lake Ontario municipal wastes from a population of 1.8 million are discharged into the lake. About 25% of these wastes receive secondary treatment, <sup>75%</sup>~~75%~~ primary treatment and 3% no treatment.



On the Canadian side of Lake Ontario the municipal wastes from a population of 2.5 millions are discharged into the lake. About 82% of the wastes receives secondary treatment, 17% primary treatment, and 1% no treatment.

The St. Lawrence River receives municipal wastes from a population of 156,000 in the two countries. Approximately 3% of the wastes receives secondary treatment, 82% primary treatment, and 15% no treatment.

(b) Industry: The Commission is informed that there are 271 sources of industrial wastes in the United States portion of Lake Erie. The states concerned have classified 63 of these as having inadequate waste treatment facilities. The adequacy of 26 has not been determined.

Similarly, 18 of the 29 sources of industrial wastes on the Canadian side of Lake Erie are reported to have adequate treatment; the balance have inadequate facilities.

Data on industrial wastes discharged into Lake Ontario and the St. Lawrence River are unavailable at present. This information is now being collected.

(c) Land drainage: Lake Erie, Lake Ontario and the St. Lawrence River receive for ultimate disposal all waters from their drainage basins in addition to the inflow from the Detroit River. Waters from overland runoff and deep percolation contain some agricultural wastes which affect the quality of receiving waters.

USES OF THE WATERS

The availability of water of high quality is now and will continue to be one of the most important factors in the development of the region. The concentrated industrial development and the accompanying density of population have created a high demand for usable water. Industry requires clean, safe water for all its operations along with the protection of its employees both at work and at home.

(a) Municipal: The waters of Lake Erie supply more than 3.2 million people in the United States with a consumption of 620 million gallons\* per day (mgd) and 150,000 people in Canada using 30 mgd.

The waters of Lake Ontario supply 590,000 people in the United States with a consumption of 140 mgd and about 2.5 million people in Canada using 370 mgd.

Detailed information is not available at present on municipal water consumption from the St. Lawrence River.

(b) Industry: United States industries withdraw an estimated 4,700 mgd of water from Lake Erie of which 95% is used for cooling. Canadian industries use 35 mgd from Lake Erie and the Welland Ship Canal.

\*For ease of comparison the quantities are expressed in U.S. gallons. One U.S. gallon equals 0.833 Imperial gallons.



Canadian industry uses 479,000 mgd from Lake Ontario and 50 mgd from the International Section of the St. Lawrence River. Again, only a small portion of this is used as process water.

Information is not available at present on the United States industrial withdrawals from Lake Ontario and the St. Lawrence River.

(c) Recreation: As might be expected, these waters are widely used for recreational purposes such as swimming, sport fishing, pleasure boating and hunting.

(d) Fishing: The total annual catch of fish in Lake Erie has fluctuated widely in the last 20 years varying from a low of 32 million pounds in 1947 to a high of 76 million pounds in 1956. The catch in 1964 was 39 million pounds. In Lake Ontario the annual catch has remained constant at about 2 million pounds.

(e) Navigation: Commercial shipping is significant on Lake Ontario and Lake Erie. The movement of domestic and international cargo is extensive. Some 230 million tons of cargo move annually over Great Lakes routes. It is estimated that about half of this amount traverses Lake Erie and Lake Ontario.

(f) Waste disposal: The disposal of wastes is and will continue to be an important function of these waters and their tributaries.

TRANSBOUNDARY EFFECTS

The Commission was requested to ascertain whether the waters under reference are being polluted on either side of the boundary to an extent which is causing or likely to cause injury to health and property on the other side.

Wastes discharged into these waters may be transported across the boundary by surface or sub-surface currents with resulting injury to health and property in the other country. Furthermore, the nutrient bearing wastes may accelerate the effects of eutrophication, resulting in a general deterioration of the waters of the lake. The decay of algae has depleted the oxygen content in some 2600 square miles in the lower depths of central Lake Erie. This area straddles the international boundary. It appears that there is circulation from one side of the boundary to the other, interfering with quality and usefulness of the waters in both countries.

Therefore, the Commission is proceeding on the assumption that the pollution of these waters in one country affects the quality and usefulness of the waters on the other side of the boundary. The study of lake currents necessary to confirm or deny this assumption and the analysis of the effects in the other country will proceed simultaneously. The results will be included in a later report.



PROGRAMME OF INVESTIGATION

This massive and complex investigation requires a cooperative and integrated programme coordinating the activities of various agencies. It encompasses the acquisition of factual data on pollutants, their sources and effects. Basic research will also be necessary. In order to ensure that all available resources of personnel and facilities, national and local on both sides of the boundary, are deployed with maximum effectiveness in the conduct of the investigation, the Commission necessarily relies upon the close cooperation, and coordination of the activities, of the federal services and the state and provincial pollution control agencies concerned.

The three phases of the Commission's programme are outlined below.

(a) Short term Concentrated Studies: Short term concentrated studies have been initiated to secure factual information on the extent, origin and location of pollution in these waters. Much work has been done during the past two years by the United States Public Health Service on Lake Erie. A parallel study is in progress on Lake Ontario. A similar programme on the Canadian side of Lake Erie and Lake Ontario is now underway. The Commission's programme will supplement and expand current field studies in the United States.

The programme involves chemical and physical analyses of all waters under reference and their tributaries, domestic and industrial waste assessment, and bioassays. As far as possible parameters for water quality will be determined in the initial studies. They will be subject to review in the continuing studies.

The Commission expects to report on this phase of the investigation by 1969.

(b) Continuing Studies: Continuing studies will be undertaken concurrently with the short term concentrated investigation. The comprehensive information required can be secured only through repetitive and long term studies. The programme will include intensive investigations on lake circulation, mixing and diffusion; the chemistry, physics and biology of the lakes; the changing effects and the relative significance of pollutants in the waters; parameters for water quality; continuous assessment of the effectiveness of remedial measures; and assessment of potential dangers from and the control of the entry of fertilizers, pesticides and herbicides.

(c) Research: A long term programme of research is necessary in order to answer fully the questions referred by the two Governments to the Commission. Research projects on the Great Lakes generally have been localized, of short duration, and lacking coordination. Consequently, there is a deficiency in the scientific knowledge and understanding



of the physical, chemical and biological behaviour of the Great Lakes, particularly in respect to pollutants and their dispersal.

The Commission recognizes that research is necessary in the following fields: the development of more effective means of treatment of all municipal and industrial wastes; the toxic levels of constituents under Great Lakes conditions; the cycle of eutrophication and its effects on aquatic life and water quality; and the disposition of pathogenic bacteria and viruses. Part of the continuing studies may be classed as research projects.

#### RECOMMENDATIONS

1. The Commission recommends that the Governments of the United States and Canada, as soon as possible and in association with state and provincial governments, take appropriate action to ensure:

(a) sufficient purification of all municipal and industrial wastes before discharge into these waters and their tributaries to achieve the maximum possible removal of phosphates;

(b) prohibition of the construction of combined sanitary and storm sewers and initiation of a programme of separating existing combined sewers in communities discharging wastes into these waters and their tributaries; and

(c) an effective system of regular sampling of effluents discharged into these waters and their tributaries in accordance with programmes approved by the Commission.

2. The Commission recommends that the two Governments support fully the Commission's programme of investigation and research -- as outlined in this Interim Report and as subsequently developed -- by the provision of the personnel and facilities required from time to time for its effective implementation.

SIGNED this 28th day of December, 1965.

A.D.P. Heeney

Eugene W. Weber

D. M. Stephens

Rene Dupuis

Charles R. Ross



TERMS OF REFERENCE BY THE GOVERNMENTS OF CANADA  
AND THE UNITED STATES TO THE INTERNATIONAL JOINT  
COMMISSION CONCERNING THE POLLUTION OF LAKE ERIE,  
LAKE ONTARIO AND THE INTERNATIONAL SECTION OF THE  
ST. LAWRENCE RIVER.

October 7, 1964

I have the honour to inform you that the Governments of the United States and Canada have been informed that the waters of Lake Erie, Lake Ontario and the international section of the St. Lawrence River are being polluted by sewage and industrial waste discharged into these waters. Having in mind the provision of Article IV of the Boundary Waters Treaty signed January 11, 1909, that boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other side, the two Governments have agreed upon a joint Reference of the matter to the International Joint Commission, pursuant to the provisions of Article IX of said Treaty. The Commission is requested to inquire into and to report to the two Governments upon the following questions:

- (1) Are the waters of Lake Erie, Lake Ontario, and the international section of the St. Lawrence River being polluted on either side of the boundary to an extent which is causing or is likely to cause injury to health or property on the other side of the boundary?
- (2) If the foregoing question is answered in the affirmative, to what extent, by what causes, and in what localities is such pollution taking place?
- (3) If the Commission should find that pollution of the character just referred to is taking place, what remedial measures would, in its judgement, be most practicable from the economic, sanitary and other points of view and what would be the probable cost thereof?

In the conduct of its investigation and otherwise in the performance of its duties under this reference, the Commission may utilize the services of engineers and other specially qualified personnel of the technical agencies of Canada and the United States and will so far as possible make use of information and technical data heretofore acquired or which may become available during the course of the investigation.

The two Governments are also agreed on the desirability of extending this Reference to other boundary waters of the Great Lakes Basin at an appropriate time. The Commission is requested to advise the Governments when, in its opinion, such action is desirable.

The Commission should submit its report and recommendations to the two Governments as soon as practicable.